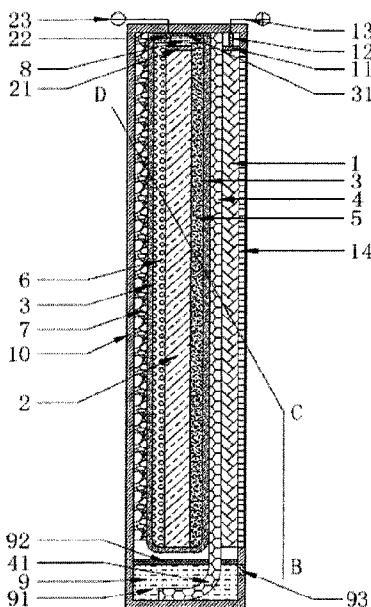




(86) **Date de dépôt PCT/PCT Filing Date:** 2015/12/07
(87) **Date publication PCT/PCT Publication Date:** 2016/06/09
(45) **Date de délivrance/Issue Date:** 2023/03/14
(85) **Entrée phase nationale/National Entry:** 2017/06/05
(86) **N° demande PCT/PCT Application No.:** CN 2015/096576
(87) **N° publication PCT/PCT Publication No.:** 2016/086903
(30) **Priorité/Priority:** 2014/12/05 (CN201410730210.6)

(51) **Cl.Int./Int.Cl.** *H01M 12/06* (2006.01),
H01M 12/08 (2006.01), *H01M 8/16* (2006.01)
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(54) **Titre : PILE A COMBUSTIBLE A AIR METALLIQUE COMPRENANT UN METAL COMME UN MATERIAU ANODIQUE**
(54) **Title: METAL AIR FUEL CELL COMPRISING A METAL AS AN ANODE MATERIAL**



(57) **Abrégé/Abstract:**

This invention relates to a type of metal-air fuel cell. The metal-air fuel cell of this invention mainly consists of an air positive electrode, a metal negative electrode, membranes/membrane bag(s), siphon materials, electrolyte, a core, shockproof buffer layer(s), negative electrolyte fluid, positive electrolyte fluid, a battery shell and a supporting/fixing device. A hydrophobic structure layer exists between the positive and negative electrodes. The cell of this invention has advantages such as high battery energy density, low cost, and is safe and reliable.



ABSTRACT

This invention relates to a type of metal-air fuel cell. The metal-air fuel cell of this invention mainly consists of an air positive electrode, a metal negative electrode, membranes/membrane bag(s), siphon materials, electrolyte, a core, shockproof buffer layer(s), negative electrolyte fluid, positive electrolyte fluid, a battery shell and a supporting/fixing device. A hydrophobic structure layer exists between the positive and negative electrodes. The cell of this invention has advantages such as high battery energy density, low cost, and is safe and reliable.

METAL AIR FUEL CELL COMPRISING A METAL AS AN ANODE MATERIAL

Technical Field

This invention relates to the cell field, specifically to a cell comprising a metal as an anode material.

State of the Art

A metal-air fuel cell featuring high energy density, long life cycle, cell structure diversity, sufficient resources, easy access to materials, green environmental protection (i.e. non-toxic, no harmful gas emission, environmentally friendly); at the same time, capable of storing and generating electric power; as a metal material, capable of being storing and generating electric power, capable of being re-cycled as superior renewable energy resources after its provision of the pyrolysis and reduction of energy in hydro energy, wind energy, solar energy, etc.

In view of those advantages mentioned above, the leading countries in economy and technology have been making heavy investments and conducting an incredible amount of scientific research for decades to develop this cell. However, as it is configured with a protective membrane on the metal surface, causing the electrode potential to be significantly lower than the theoretical value, as well as a significant voltage behavior delay, so far, many challenges worldwide remain unresolved and no ideal solutions have been found for those problems, such as a decline of the metal's corrosion resistance in the activated state, self-discharge, voltage behavior delay, low discharge power, gas-forming, heat-generating, expansion, self-ignition, explosion, etc. In addition, huge costs are incurred as a result of poor research and development, further impeding the commercialization of the cell.

A type of metal fuel cell, as described by the patented documentation CN102244310A, comprises an electrolyzer, as well as a metal positive electrode, an air electrode and electrolyte fluid inside the electrolyzer, achieving a combination and separation of the metal positive electrode, air electrode and

electrolyte fluid by controlling the amount of electrolyte fluid in the electrolyzer; capable of avoiding the metal's corrosion to a certain extent by this method, but failing to apply to a regular cell; and also incapable of being ready at all times.

So far, the metal-air fuel cell technology is still not mature, and issues such as metal corrosion, easy usability and more should be addressed as soon as possible.

Description of the Invention

This invention provides a type of metal-air fuel cell, addressing the issue of deficiencies in current technologies.

This invention is as set forth below:

A metal-air fuel cell, featuring at least one positive unit and at least one negative unit, wherein the positive unit comprises an air positive electrode, positive electrolyte fluid and siphon materials; the said air positive electrode comprises the air electrode carrier with catalysts, capable of catalyzing oxygen to produce anions; the negative unit comprises a metal negative electrode and negative electrolyte fluid and/or electrolyte; the said metal negative electrode comprising metal fuel, providing cations for the discharging of the cell, transporting the positive electrolyte fluid to the air positive carrier via siphon materials for their contact with each other; the said metal negative electrode being put in contact with negative electrolyte fluid and/or electrolyte; between the said air positive electrode and the said metal negative electrode an ion pass is formed; between the air positive electrode/the positive electrolyte and the metal negative electrode/the negative electrolyte fluid and/or electrolyte, a hydrophobic structure layer exists, which lets ion pass through and is configured with hydrophobicity.

The preferred negative unit comprises a metal negative electrode, negative electrolyte fluid and electrolyte.

Further, the said cell also comprises a first storage chamber for positive electrolyte fluid, into which part of the siphon material is inserted, and the other part is put in contact with the air positive carrier.

Furthermore, the said cell also comprises a second storage chamber for positive electrolyte fluid. Both ends of the siphon material are respectively inserted into the first storage chamber and second first storage chamber for positive electrolyte fluid; its middle part is put in contact with the positive carrier.

Moreover, the first storage chamber for positive electrolyte fluid and the second storage chamber for positive electrolyte fluid are linked to each other via a pipe equipped with a positive electrolyte fluid pump driven to facilitate the circulation of the positive electrolyte fluid between the first storage chamber and the second storage chamber for positive electrolyte fluid; a positive electrolyte fluid isolator is installed at the entrances of the first and second storage chambers, respectively, into which the siphon materials are inserted, sealing the junction of the siphon material and the two storage chambers.

The preferred siphon material is capable of resisting both extreme heat and frost.

Furthermore, the said negative unit comprises not only a negative electrolyte fluid, but also a core with absorbability to absorb and store the negative electrolyte fluid; the said core is put in contact with the metal fuel; the preferred metal fuel is placed between the core and the electrolyte fluid, and attached to the core and the electrolyte, respectively.

Moreover, the said cell also comprises a shock-absorbing buffer with elasticity, with the help of which it achieves a tight junction between the components and parts of the cell.

Furthermore, the cell also comprises a supporting/fixing device to secure the components and parts of the cell.

The said air positive electrode also comprises an air electrode positive current collector and an air positive electrode lug; the air electrode positive lug, the air electrode positive current collector and the air electrode carrier are linked one by one.

Furthermore, the said air positive electrode also comprises a positive output circuit linked to the air positive electrode lug.

Furthermore, the air positive electrode current collector, the air positive electrode lug and/or the positive output circuit are integrated as a whole.

Moreover, the said positive unit also comprises an air positive electrode inlet device by which oxygen enters the positive unit and makes contact with the catalyst in the air electrode carrier.

Furthermore, the air positive electrode inlet device is equipped with a layer of breathable material; the layer comprises a waterproof, breathable membrane and /or a carbon dioxide separation membrane; the air positive electrode inlet device can be an inlet hood.

Furthermore, a catalyst is distributed inside or on the surface of the air electrode carrier; the surface of the preferred air electrode carrier is configured with an air electrode catalyst coating, which includes the catalyst.

Furthermore, the said air electrode catalyst coating is made from a catalyst, porous adsorbents, conductive agents and binding agents.

Furthermore, the said catalyst is chosen from one or more of the catalysts, such as silver-based catalyst, perovskite catalyst, platinum catalyst, palladium-based catalyst, manganese-based catalyst, metal composite oxide catalyst, metal oxide catalyst, organic metal catalyst, and metallic chelate catalyst.

Furthermore, the said air electrode carrier is chosen from: 1) the membrane structure, net structure, fabric structure, granule structure, powder structure, and nanomaterial, all of which are made from or mainly from carbon materials; 2) the net structure, foam structure, membrane structure, fabric structure, granule structure and powder structure, which are made from carbon nanomaterials; or, the net structure, foam structure, membrane structure, fabric structure, granule structure and powder structure, which are made from metal and metal nanomaterials. The air electrode carrier includes, but is not limited to, the substances chosen from one or more of the following: 1) carbon cloth, carbon paper, and carbon fiber sheet; 2) carbon nano cloth, and carbon nano cloth; or, 3) copper foam fiber and silver foam granules.

In addition, the positive siphon material is capable of being used as an air electrode carrier; part of the siphon material is inserted into the positive

electrolyte fluid storage chamber; part of the siphon material as an air electrode carrier linked to the air electrode lug.

The metal negative electrode comprises a metal negative current collector, a metal negative lug and the said metal fuel, three of which are linked one by one.

Furthermore, the metal negative lug, the metal negative current collector and /or the metal fuel are capable of being integrated as a whole.

Furthermore, the metal material is chosen from one or more of metals such as Li, Zn, Mg, Al, Fe, Pb, Na, K and Ca, or from the alloy of the said metals, or the alloy made from one or more of the said metals with a non-metal. Al is the preferred metal material.

Besides, the metal fuel can be semi-solid. Meanwhile, the cell also features a metal fuel storage chamber and a metal fuel recovery chamber; the metal fuel enters the metal fuel-recovery chamber from the metal fuel storage chamber after discharging in the negative discharging zone, and the metal fuel can be pumped into the cell negative discharging zone by a metal fuel pump, and then into the fuel-recovery chamber after the discharging is ended.

Furthermore, the said semi-solid metal fuel is selected from the semi-solid mixture with fluidity, made from conductive agents, thickening agents or powders or particles of one or more of the following materials such as lithium, zinc, magnesium, aluminum, iron, lead, sodium, potassium and calcium or chosen from an alloy made of the above metals or an alloy made of one or more of the above metals combined with non-metals.

In addition, the said cell can also include a rotator linked to the metal fuel to drive the metal fuel to rotate; the rotator can include a dynamo and a linking subassembly, whereby the dynamo and the metal fuel are linked. For instance, a spindle is linked to the dynamo over the metal fuel so that a more even discharging of the metal can be achieved by rotating the metal fuel.

Furthermore, the said negative unit also comprises a separation membrane of one or more layers; a hydrophobic coating is applied to at least one of the layers of the separation membrane to form the hydrophobic structure.

Furthermore, the separation membrane material can consist of multiple layers; at least, multiple layers of hydrophobic coating exist between two separation membrane layers of one set.

Moreover, the material of the hydrophobic coating can be selected from polymers: PTEF, polyethylene, etc.; from senior straight-chain alkenes: microcrystalline paraffin, liquid paraffin, polyethylene wax, etc.; from lipids (animal oil and vegetable oil): cream, butter, mutton oil, lard oil, fish oil, poultry oil, soybean oil, sunflower oil, canola oil, castor oil, peanut oil, etc.; and from one or more of synthetic ester-based compounds.

Furthermore, the membrane for the separation membrane can be a polyethylene membrane, a polypropylene membrane, a glass fiber membrane, a PVC membrane, a bioactive membrane, a biological selectivity membrane, a bacteria microbial bio-membrane or an organic spray membrane.

The preferred negative unit includes the electrolyte fitting well with the separation membrane.

Furthermore, the separation membrane can be formed into a membrane bag by itself or with accessory materials. The cell's negative unit, including the metal negative electrode, negative electrolyte fluid, electrolyte, etc., mainly lies inside the membrane bag.

Furthermore, the membrane bag is configured with a membrane bag sealing device which is located at the opening of the bag for sealing the opening of the membrane bag.

Furthermore, the membrane bag consists of a membrane and a septum used to form the bag-like shape.

Furthermore, the material of the septum can be PTEF, polyethylene, polypropylene, PVC, polyvinyl chloride or ABS.

In addition, the added metal elements and/or the added non-metallic elements, both constituting alloys, are applied to the membrane of the septum. The metal elements of the alloy refer to the added elements in the alloy. For example, in a kind of aluminum alloy (an aluminum-based substrate, to which In, Mg, Sn, and Pb are added), these elements, such as In, Mg, Sn, and Pb, are

called the added elements of an alloy, namely, the metal alloy elements. This means that these elements, such as In, Mg, Sn, and Pb, are added to the septum. However, inside the membrane bag, it is still ordinary elemental aluminum, rather than aluminum alloy. As another example, in a kind of aluminum alloy, (an aluminum-based substrate, to which Si, Se, I and S are added), these elements, such as Si, Se, I and S, are considered the added elements in an alloy, namely, non-metal alloy elements. Here, this means that the elements, such as Si, Se, I and S, are added to the septum. However, inside the membrane bag, it is still ordinary elemental aluminum, rather than aluminum alloy.

The metallic elements added to produce an alloy are chosen from at least one of the metal elements in the periodic table; and the non-metal elements added to produce an alloy are chosen from at least one of the non-metal elements in the periodic table.

Furthermore, the said negative unit may also include negative siphon materials and the negative electrolyte fluid can be transported to the metal fuel through the negative siphon material, of which a part is attached to the metal fuel. The negative siphon material, facing one side of the positive unit (the side of the hydrophobic coating), forms the said hydrophobic structure. In this case, the separation membrane or the membrane bag does not need to be put into use.

Furthermore, the said cell also comprises a first storage chamber for negative electrolyte fluid and a second storage chamber for negative electrolyte fluid; both ends of the said siphon material are inserted into the first storage chamber for negative electrolyte fluid and the second storage chamber for negative electrolyte fluid, respectively, and its middle part is put in contact with the metal fuel. The first storage chamber for negative electrolyte fluid and the second storage chamber for negative electrolyte fluid can be linked by a pipe, which is equipped with a negative electrolyte fluid pump; the negative electrolyte fluid circulation between the first storage chamber for negative electrolyte fluid and the second storage chamber for negative electrolyte fluid can be achieved by driving the negative electrolyte fluid pump.

In this invention, the said oxygen comes from 1) air; 2) pure oxygen; or 3) oxygen-producing materials.

The said electrolyte, solid or semisolid, provides ion channels for the positive and negative electrodes, as well as the ionic run electrolyte for the negative electrode.

Furthermore, the said electrolyte may be chosen from: 1) solid electrolyte: β - Al_2O_3 , zirconium dioxide or ceramic materials; 2) polymer electrolyte: polymer electrolytes of polyethylene oxide series, PVDF series, polymethyl methacrylate series, polyacrylic polymer electrolyte series; or 3) semi-solid electrolyte: made via reaction under waterless environment by mixing at least one substance from oligose, polysaccharide, amylum, dextrin, ethyl cellulose and at least one substance from lipid, higher straight-chained alkanes, esters, etc., and at least one substance from carbon material, magnetic material, glass fiber, etc., with at least one of the alkaline organic solutions made from sodium hydroxide, potassium hydroxide, lithium hydroxide, etc. The alkaline organic solutions, such as sodium hydroxide, potassium hydroxide, lithium hydroxide, etc., refer to the alkaline organic solutions made by dissolving at least one of sodium hydroxide, potassium hydroxide, lithium hydroxide and other alkaline substances in the solvents from one or more of ethanol, methanol, acetonitrile, acetone, tetrahydrofuran, isopropyl alcohol, dimethyl sulfoxide and carbonic ester.

The said negative electrolyte fluid provides ion channels for the positive and negative electrodes of the cell and provides the ionic run electrolyte fluid for the cell's negative electrode; the negative electrolyte fluid may be chosen from: 1) alkaline electrolyte fluid: the negative electrolyte fluid made from one or more of sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium bicarbonate, calcium hydroxide, aluminum hydroxide, zinc oxide, hydrogen sodium methoxide, and potassium methoxide combined with the organic solvents from one or more of ethanol, methanol, acetonitrile, dimethyl sulfoxide or carbonic ester; 2) acidic electrolyte fluid: the negative electrolyte fluid made from organic and inorganic weak acids with the organic solvent(s) of one or more from ethanol, methanol, acetonitrile, dimethyl sulfoxide or carbonic ester; 3) neutral electrolyte fluid: a negative electrolyte fluid made from one or more salts such as sodium chloride, sodium fluoride, sodium

iodide, potassium chloride, potassium fluoride and potassium iodide with the organic solvents made from one or more of ethanol, methanol, acetonitrile, dimethyl sulfoxide and carbonic ester. Also, the metal halide and quaternary ammonium salt can be mixed with each other to produce a negative electrolyte of a certain concentration. The metal halide acid ionic liquid as an electrolyte fluid can be produced by mixing metal halide with one of quaternary ammonium salt, or quaternary phosphate salt or quaternary sulphate (halometallic acids, such as aluminum chloride acid, zinc chloride acid, etc.); the solvent includes one or more of ethanol, methanol, acetonitrile, acetone, tetrahydrofuran, isopropyl alcohol, dimethyl sulfoxide and carbonic ester. The metal halide: such as aluminum chloride, ferric chloride, zinc chloride, sodium chloride, sodium fluoride, sodium iodide, potassium chloride, potassium fluoride, potassium iodide, etc.

The said positive electrolyte fluid providing ion channels for the positive and negative electrodes and providing the ionic run electrolyte fluid for the cell's positive electrode, is chosen from: alkaline electrolyte fluid: a mixture of one or more of sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium bicarbonate, calcium hydroxide, aluminum hydroxide, sodium methoxide or potassium methoxide with the organic solvents such as one or more of ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester or water; acidic electrolyte fluid: a positive electrolyte fluid made from organic and inorganic weak acids mixed with the organic solvents such as one or more of ethanol, methanol, acetonitrile, dimethyl sulfoxide or carbonic ester or water; neutral electrolyte fluid: a positive electrolyte fluid made from one or more of sodium chloride, sodium fluoride, sodium iodide, potassium chloride, potassium fluoride, or potassium iodide with the organic solvents such as one or more of ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester or water.

Furthermore, the cell also comprises a positive outlet circuit and a negative outlet circuit, which are connected to the air positive electrode and the metal negative electrode, respectively, and forms a battery pack to provide power supply to the external devices, etc., via the outlet circuit.

The cell as described by the invention also comprises two or more positive units, or two or more negative units. For instance, one negative unit is

positioned between two positive units; or several positive and negative units are alternatively arranged. The positive and negative electrolyte storage chambers then each function as one entity.

In addition, the positive and negative electrodes are capable of separation. The ion channels between the positive and negative electrodes can be formed through the positive electrolyte fluid, siphon materials, etc. For instance, the siphon material can be set up outside the separation membrane or membrane bag in the negative unit, and they are attached. One end of the siphon material is inserted into the negative electrolyte fluid storage chamber, while the siphon material in the positive unit is also inserted into the negative electrolyte fluid storage chamber to form ion channels. The negative electrolyte fluid storage chamber can be the same or a separate one. If the electrolyte storage chambers are different, they can be linked by the same pipe.

The preferred structure for this cell as described by the invention is for the positive unit and the negative unit to form a flat structure; the air electrode carrier, the inlet hood (air positive electrode inlet device), siphon materials, separation membranes, electrolytes, metal fuel, core, septa of the membrane bags, anti-collision buffers, etc., all have a flat structure, and all are tightly connected one by one.

Another preferred structure for the cell as described by the invention is cylindrical. For instance, the negative unit is centered and surrounded by the positive unit; then, the core, metal fuel, electrolyte, membrane/membrane bag, siphon material, air electrode carrier and intake hood are configured one by one from the center to the edge.

Generally, the negative electrolyte fluid fills in the negative unit, and a part or a large part of the fluid can be stored in the core.

The electrolyte fluid storage chamber is usually positioned at the bottom of the cell; if there are two chambers, they can be placed at the top and bottom of a cell, respectively.

The shell and supporting fixtures of the cell as described by the invention ensure that each assembly is fixed and connected tightly. The storage chamber(s), the inlet hood, etc., combined with the fixtures, form the shell of

the cell. Or the shell is formed by the fixtures only; or the shell of individual settings can keep each assembly of the cell hermetic. However, the air inlet port should stay open.

The above cell can form a single cell, a battery pack or a cell stack, etc. According to various purposes, the type of its structure can be adjusted accordingly.

Furthermore, the above single cell, battery packs or cell stacks can be equipped with a shell. Generally speaking, some space exists between the shell and the internal simple cell. The shell may appear in the form of a factory building, a container, a battery case, or a cell bin, etc.

Furthermore, an oxygen supply device is also provided, which is connected to the shell of the cell to supply oxygen to the cell.

Moreover, an oxygen concentration sensor is configured inside the cell's shell. The said oxygen supply device will adjust the oxygen concentration inside the shell according to the data provided by the oxygen concentration sensor.

Furthermore, the cell is equipped with an oxygen-selective pass-through membrane on the shell to selectively allow oxygen to pass through; and is also equipped with a carbon dioxide isolation membrane.

Furthermore, the cell is equipped with an air filter device on the shell, which device can be installed outside the oxygen selective pass-through membrane and/or carbon dioxide isolation membrane to filter out the particles in the air. In addition, the oxygen selective pass-through membrane and/or carbon dioxide isolation membrane can be integrated inside the air filter device.

The cell of this invention maintains the stability of the electrolyte/electrolyte fluid surrounding the metal negative electrode by separating the air positive electrode from the metal negative electrode in the cell's positive electrode and negative electrode without their direct contact, and preventing moisture and other molecular substances in the positive unit from entering into the negative electrode unit and from coming into contact with the metal fuel; meanwhile, the ion can get through freely so that

corrosion of the metal negative electrode, self-ignition and acceleration of self-discharge, and power failure are avoided.

This invention transports the electrolyte fluid through the siphon material to provide a stable electrolyte fluid and, at the same time, to adjust the cell temperature to avoid its temperature from being extremely high or low, and to maintain a stable working condition under normal temperature. When collision occurs to a cell, no direct contact between the positive and negative electrodes will occur, and the electrolyte fluid is mainly stored in the storage chambers, so that no sudden discharge and explosion of the cell due to short-circuit can occur.

This invention stores and absorbs the negative electrolyte fluid for the negative electrode through the core, which enables a tight contact between the negative electrode and electrolyte fluid, provides ion channels for the cell and maintains the stability and durability of current, voltage, etc.

This invention maintains a tight contact of all subassemblies through the shockproof buffer to avoid sudden power failure and current changes while collision happens.

Description of figures

Figure 1, showing the front view of the metal-air fuel cell.

Figure 2, showing the sectional view of the metal-air fuel cell along the direction of Figure 1 E-E.

Figure 3, showing the sectional view of the metal-air fuel cell along the direction of Figure 2 BCD.

Figure 4, showing a typical sectional view of the metal-air fuel cell along the direction of Figure 1 E-E (the enlarged part is marked).

Figure 5, showing a sketch of the positive unit (partially enlarged view of the marked part in Figure 4).

Figure 6, showing another sketch of the positive unit (partially enlarged view of the marked part in Figure 4).

Figure 7, showing another sketch of the positive unit (partially enlarged view of the marked part in Figure 4).

Figure 8, showing another sketch of the positive unit (partially enlarged view of the marked part in Figure 4).

Figure 9, showing a sketch of the structural connection between the air positive electrode current collector and the air electrode carrier.

Figure 10, showing another sketch of the structural connection between the air positive electrode collector and the air electrode carrier.

Figure 11, showing another sketch of the structural connection between the air positive electrode collector and the air electrode carrier.

Figure 12, showing another diagram of the structural connection between the air positive electrode collector and the air electrode carrier.

Figure 13, showing a typical sectional view of the metal-air fuel cell along the direction of Figure 1 A-A.

Figure 14, showing a sketch of the structural connection between the metal negative electrode current collector and the metal fuel.

Figure 15, showing a sketch of the structural connection between the metal negative electrode current collector and the metal fuel, along the section H-H in Figure 14.

Figure 16, showing another sketch of the structural connection between the metal negative electrode current collector and the metal fuel, along the section H-H in Figure 14.

Figure 17, showing another sketch of the structural connection between the metal negative current collector and the metal fuel.

Figure 18, showing another sketch of the structural connection between the metal negative electrode current collector and the metal fuel.

Figure 19, showing another sketch of the structural connection between the metal negative current collector and the metal fuel.

Figure 20, showing a sketch of the structural connection between the metal negative electrode current collector and the metal fuel, along the section I-I in Figure 19.

Figure 21, showing another sketch of the structural connection between the metal negative electrode current collector and the metal fuel, along the section I-I in Figure 19.

Figure 22, showing another sectional view of the metal-air fuel cell along the direction of Figure 1 E-E, including two negative units.

Figure 23, showing another sectional view of the metal-air fuel cell along the direction of Figure 1 A-A, including two negative units.

Figure 24, showing another sectional view of the metal-air fuel cell along the direction of Figure 1 E-E, without electrolyte.

Figure 25, showing another sectional view of the metal-air fuel cell along the direction of Figure 1 A-A, without electrolyte.

Figure 26, showing another sectional view of the metal-air fuel cell along the direction of Figure 1 E-E, without a core.

Figure 27, showing another sectional view of the metal-air fuel cell along the direction of Figure 1A-A, without a core.

Figure 28, showing another sectional view of the metal-air fuel cell along the direction of Figure 1 E-E, without electrolyte and core.

Figure 29, showing another sectional view of the metal-air fuel cell along the direction of Figure 1 A-A, without electrolyte and core.

Figure 30, showing a front view of the membrane bag.

Figure 31, showing a sectional view of the membrane bag along the direction of Figure 30 G-G.

Figure 32, showing a sectional view of the single-layer membrane bag along the direction of Figure 30 F-F.

Figure 33, showing an enlarged view of the membrane bag along Figure 31, Part C.

Figure 34, showing another enlarged view of the membrane bag along Figure 31, Part C.

Figure 35, showing another enlarged view of the membrane bag along Figure 31, Part C.

Figure 36, showing a structural sketch of the double-layer membrane bag.

Figure 37, showing a sectional view of the double-layer membrane bag along the direction of Figure 30 F-F.

Figure 38, showing an enlarged view of the membrane bag along Figure 36, Part D.

Figure 39, showing another enlarged view of the membrane bag along Figure 36, Part D.

Figure 40, showing another enlarged view of the membrane bag along Figure 36, Part D.

Figure 41, showing another enlarged view of the membrane bag along Figure 36, Part D.

Figure 42, showing another enlarged view of the membrane bag along Figure 36, Part D.

Figure 43, showing another enlarged view of the membrane bag along Figure 36, Part D.

Figure 44, showing another enlarged view of the membrane bag along Figure 36, Part D.

Figure 45, showing a sectional view of the double-layer membrane bag along the direction of Figure 30 G-G.

Figure 46, showing a sectional view of the multi-layer membrane bag along the direction of Figure 30 F-F.

Figure 47, showing a sectional view of the membrane bag along the direction of Figure 30 G-G, which is of a single-layer membrane with a single septum structure.

Figure 48, showing a sectional view of the membrane bag along the direction of Figure 30 F-F, which is of a single-layer membrane with a single septum structure.

Figure 49, showing another sectional view of the membrane bag along the direction of Figure 30 G-G, which is of a double-layer membrane with a single septum structure.

Figure 50, showing another sectional view of the membrane bag along the direction of Figure 30 F-F, which is of a double-layer membrane with a single septum structure.

Figure 51, showing another sectional view of the membrane bag along the direction of Figure 30 G-G, which is of a multi-layer membrane with a single septum structure.

Figure 52, showing another sectional view of the membrane bag along the direction of Figure 30 F-F, which is of a multi-layer membrane with a single septum structure.

Figure 53, showing a structural diagram of the siphon material.

Figure 54, showing a sectional view of the metal-air fuel cell along the direction of Figure 1A-A, wherein the siphon material is wavy.

Figure 55, showing a structural sketch of the siphon material shown in Figure 54.

Figure 56, showing another sectional view of the metal-air fuel cell along the direction of Figure 1A-A, wherein the siphon material is semi-wavy.

Figure 57, showing a structural sketch of the siphon material shown in Figure 56.

Figure 58, showing another sectional view of the metal-air fuel cell along the direction of Figure 1A-A, in which the siphon material is semi-wavy.

Figure 59, showing a structural diagram of the siphon material shown in Figure 58.

Figure 60, showing another sectional view of the metal-air fuel cell along the direction of Figure 1E-E, wherein the siphon material functions as the air positive electrode carrier;

Figure 61, showing another sectional view of the metal-air fuel cell along the direction of Figure 1A-A, wherein the siphon material functions as the air positive electrode carrier.

Figure 62, showing a structural sketch of the air positive electrode, wherein the siphon material functions as the air positive electrode carrier.

Figure 63, showing an enlarged view of the air positive electrode along the direction of Figure 62, Part B.

Figure 64, showing another enlarged view of the air positive electrode along the direction of Figure 62, Part B.

Figure 65, showing another enlarged view of the air positive electrode along the direction of Figure 62, Part B.

Figure 66, showing a front view of the triangular metal-air fuel cell.

Figure 67, showing a front view of the circular metal-air fuel cell.

Figure 68, showing a split diagram of each component for the typical metal-air fuel cell.

Figure 69, showing a split diagram of each component for the metal-air fuel cell with the double-positive electrodes.

Figure 70, showing a split diagram of each component for the metal-air fuel cell with no electrolyte.

Figure 71, showing a split diagram of each component for the metal-air fuel cell with no core.

Figure 72, showing a split diagram of each component for the metal-air fuel cell without core and electrolyte.

Figure 73, showing another split diagram of each component for the metal-air fuel cell with catalyst coating.

Figure 74, showing a structural sketch of the membrane bag (indicating Part E enlarged).

Figure 75, showing a locally enlarged view of the separation membrane along the direction of Figure 74.

Figure 76, showing another locally enlarged view of the separation membrane along the direction of Figure 74.

Figure 77, showing another locally enlarged view of the separation membrane along the direction of Figure 74.

Figure 78, showing a structural sketch of the metal-air fuel cell with dynamic negative electrolyte fluid.

Figure 79, showing a structural sketch of the metal-air fuel cell with dynamic positive electrolyte fluid.

Figure 80, showing a structural sketch of the metal-air fuel cell with dynamic positive and negative electrolyte fluid.

Figure 81, showing a structural diagram of the metal-air fuel cell with dynamic metal negative electrode.

Figure 82, showing a structural sketch of the metal-air fuel cell with rotating metal negative electrode.

Figure 83, showing a sketch of series and parallel cells.

Figure 84, showing a front view of the battery pack.

Figure 85, showing a rear view of the battery pack.

Figure 86, showing a sectional view of Figure 89 along the direction of B-B.

Figure 87, showing another front view of the battery pack.

Figure 88, showing another rear view of the battery pack.

Figure 89, showing a sectional view of Figure 84 along the direction of A-A.

Figure 90, showing a sectional view of Figure 87 along the direction of A-A.

Figure 91, showing another structural sketch of the battery pack.

Figure 92, showing a sectional view of Figure 84 along the direction of A-A;

Figure 93, showing another sectional view of Figure 84 along the direction of A-A.

Figure 94, showing a sketch of the metal fuel battery pack with oxygen storage as its oxygen supply mode.

Figure 95, showing a sketch of the metal fuel battery pack that can test the oxygen in the cell pack.

Figure 96, showing a sketch of the metal fuel battery pack with the oxygen-selective filtering membrane.

Figure 97, showing a sketch of the battery that has separate positive and negative electrodes.

Figure 98, showing a curve diagram of a discharge experiment.

Figure 99, showing another curve diagram of a discharge experiment.

In the Figures: 1, Air positive electrode. 11, Air positive electrode current collector. 12, Air positive electrode lug. 13, Air positive electrode outlet circuit. 14, Air positive electrode inlet device. 15, Air electrode carrier. 16, Catalyst. 17, Air electrode catalyst coating. 18, Positive electrode electrolyte fluid pump. 182, Liquid inlet device of positive electrolyte fluid pump. 2, Metal negative electrode. 21, Metal negative current collector. 22, Metal negative lug. 23, Metal negative outlet circuit. 24, Metal fuels. 25, Negative electrolyte fluid pump. 251, Liquid inlet device of negative electrolyte fluid pump. 252, Liquid outlet device of negative electrolyte fluid pump. 26, Semi-solid metal fuels. 261, Metal fuel chamber. 262, Metal fuel recycle chamber. 263, Metal fuel discharge area. 27, Metal fuel pump. 271, Feeding device of metal fuel pump. 272, Discharging device of metal fuel pump. 28, Metal fuel recycle pump. 281, Feeding device of metal fuel recycle pump. 282, A discharging device of metal fuel recycle pump. 29, Negative rotating motor. 291, Negative rotation axis. 292, Rotating seal. 3, Membrane, membrane bag, bioactive membrane bag and bioactive membrane. 31, Membrane bag sealing device. 32, Membrane bag edge bonding part. 33, Separation membrane. 34, Septum. 35, Daub coating.

36, Daub coating B. 37, Metal alloy elements. 38, Non-metal alloy elements. 4, High temperature-resistant, anti-freezing material for the siphon film. 41, Siphon end of siphon film. 42, Ion end of siphon film. 43, High temperature-resistant, anti-freezing material for siphon film of negative electrolyte fluid. 5, Electrolyte. 6, Core. 7, Shockproof buffer layer. 8, Negative electrolyte. 81, Negative electrolyte fluid storage chamber. 82, Negative electrolyte fluid isolation device. 83, Access channels of negative electrolyte fluid storage chamber. 811, Second storage chamber for negative electrolyte. 821, Second isolation device of negative electrolyte. 831, Access channels of second storage chamber for negative electrolyte fluid. 9, Positive electrolyte fluid. 91, Positive electrolyte fluid storage chamber. 92, Positive electrolyte fluid isolation device. 93, Access channels of positive electrolyte fluid storage chamber. 911, Second storage chamber for positive electrolyte fluid. 921, Second isolation device for positive electrolyte fluid. 931, Access channel of second storage chamber for positive electrolyte fluid. 10, Battery shell and supporting/fixing device. 101, Air inlet and outlet device. 102, Monocell. 103, Shell. 105, Plant. 106, Pure oxygen storage tank. 1061, Pure oxygen. 1062, Aerator. 1063, Oxygen supply device. 107, Voltage regulating switch device. 1011, Filter device. 1012, Switching device. 1013, Switch control device. 1014, Carbon dioxide separation membrane. 1016, Pure oxygen supply device. 1017, Pure oxygen inlet device. 1018, Oxygen condition tester. 1019, Oxygen selective filter membrane.

Specific Implementation

Further instructions for this invention are given below with appended figures, which should not be understood as limitations to the invention, but as the protection scope for this invention, given that they do not deviate from the intent and essence of the invention.

The above components may be referred to by synonymous terms in the following descriptions for this invention. Thus, the supporting/fixing device mentioned above is also sometimes referred to as the battery shell and the supporting/fixing device; siphon materials are also sometimes called high temperature-resistant, anti-freezing material for siphon film. The membrane, membrane bag, bioactive membrane bag, and bioactive membrane are mainly referred to as the separation membrane or included in the separation

membrane. The separation membrane mainly refers to the membrane material itself. The shockproof buffer structure is sometimes also called shockproof buffer layers. Hydrophobic coating material is sometimes also referred to as daub coating.

The typical structure of the metal-air fuel cell of this invention consists of the following: air positive electrode 1; metal negative electrode 2; membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; high temperature-resistant, anti-freezing material for siphon film 4; electrolyte 5; core 6; shockproof buffer layer 7; negative electrolyte fluid 8; positive electrolyte fluid 9; battery shell and supporting/fixing device 10; and some other relevant auxiliary materials or other accessory devices. In some cases, some of the components are non-essential. Specific descriptions are given as follows.

Part 1. Respective functions of the components & structures of the metal-air fuel cell

Component 1 – air positive electrode 1: As the cell's positive electrode, this component provides anion for the cell's discharge.

First, it adsorbs oxygen from the air to the air positive electrode 1, and then allows the oxygen to pass over the catalyst to be catalyzed into ions usable to the cell, such as oxygen ions and peroxide ions and hydroxyl ions, etc. and to take part in the process of the cell's discharge.

Second, it adsorbs pure oxygen, liquid oxygen, solid oxygen, gaseous oxygen, compressed gas oxygen, etc. to the air positive electrode 1, and then allows the oxygen to contact with the catalyst to be catalyzed into ions usable to the cell, such as oxygen ions, peroxide ions hydroxyl ions, etc. to take part in the process of the cell's discharge, which can be applied effectively both to the natural conditions and to the conditions of thin air, oxygen deficiency or no oxygen, such as the atmosphere or exo-atmosphere, deep sea or underwater and subspace, etc.

Third, it catalyzes oxygen molecules in oxygen-rich substances and materials which pass over their catalyst into ions usable to the cell, such as oxygen ions, peroxide ions and hydroxyl ions, etc. which take part in the

process of the cell's discharge. For instance, lithium peroxide, sodium lithium peroxide, potassium peroxide, calcium peroxide, hydrogen peroxide, etc.

Fourth, it provides oxygen ions in the oxidant to the cell, and takes part in the process of the cell's discharge.

Fifth, others.

Component 2 – metal negative electrode 2: As the cell's negative electrode, this component provides positive ions for the discharge of the cell, and plays a part in storing electric charges for the cell.

Component 3 – membrane, membrane bag, bioactive membrane bag, bioactive membrane 3: As the separation membrane, this component separates the air positive electrode 1 from the metal negative electrode 2, to avoid direct contact, maintaining the stable electrolyte/electrolyte fluid environment surrounding the metal negative electrode 2., and preventing moisture as well as other molecular materials from entering into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; meanwhile, letting ions pass freely to avoid corrosion, self-ignition and speeding of self-discharge, and power failure for the metal negative electrode 2.

Component 4 – high temperature-resistant, anti-freezing material for siphon film 4: This component provides ion channels for the positive and negative electrodes of the cell and provides ionic run electrolyte fluid for the positive electrode of the cell, and adjusts the cell's temperature to prevent the cell's temperature from being extremely high or low and to maintain a stable working condition under normal temperatures.

Component 5 – electrolyte 5: This component provides ion channels for the positive and negative electrode of the cell, and provides ionic run electrolyte for the negative electrode of the cell.

Component 6 – core 6: This component stores and adsorbs negative electrolyte fluid for the negative electrode; maintaining the tight contact between the negative electrode and electrolyte, and providing the ion channels for the cell, and maintaining the stability and durability of current and voltage, etc.

Component 7 – shockproof buffer layer 7: This component keeps a tight contact among all the components of the cell and prevents sudden power failure and current changes while the cell is exposed to vibrations and collisions.

Component 8 – negative electrolyte 8: This component provides ion channels for the cell's positive and negative electrodes and provides ionic run electrolyte fluid for the negative electrode of the cell.

Component 9 – positive electrolyte 9: This component provides ion channels for the cell's positive and negative electrodes and provides ionic run electrolyte fluid for the positive electrode of the cell.

Component 10 – battery shell and supporting/fixing device 10: This component ensures a tight contact between all the components of the cell and maintains a stable working environment for each component, ensuring the stability and effectiveness of the cell's discharge.

Part 2. Description and illustration of the components and structures of the metal-air fuel cell in this invention and innovation

Component 1 – air positive electrode 1

(A) Structure and features: featuring the air positive electrode current collector 11, air positive electrode lug 12, air positive electrode outlet circuit 13, air positive electrode inlet device 14, air electrode carrier 15, catalyst 16, air electrode catalyst coating 17. See Figures 4-8 for the specific structure of the air positive electrode 1.

In Figure 5, in the structure of the air positive electrode 1, there is no air electrode catalyst coating 17. The air positive electrode 1 consists of the following six components: air positive electrode current collector 11, air positive electrode lug 12, air positive electrode outlet circuit 13, air positive electrode inlet device 14, air electrode carrier 15, and catalyst 16.

In Figure 6, in the structure of the air positive electrode 1, there are air electrode catalyst coatings 17 on the both sides of the air electrode carrier 15; the air positive electrode 1 consists of the following seven components: air positive electrode current collector 11, air positive electrode lug 12, air positive

electrode outlet circuit 13, air positive electrode inlet device 14, air electrode carrier 15, catalyst 16, and air electrode catalyst coating 17.

In Figure 7, in the structure of the air positive electrode 1, the air electrode catalyst coating 17 lies between the air positive electrode inlet device 14 and the air electrode carrier 15. The air positive electrode 1 consists of the following seven components: air positive electrode current collector 11, air positive electrode lug 12, air positive electrode outlet circuit 13, air positive electrode inlet device 14, air electrode carrier 15, catalyst 16, and air electrode catalyst coating 17.

In Figure 8, in the structure of Air positive electrode 1, the air electrode catalyst coating 17 lies between the high temperature-resistant, anti-freezing material for siphon film 4 and the air electrode carrier 15. The air positive electrode 1 consists of the following seven components: air positive electrode current collector 11, air positive electrode lug 12, air positive electrode positive outlet circuit 13, air positive electrode inlet device 14, air electrode carrier 15, catalyst 16, and air electrode catalyst coating 17.

(B) Operating characteristics: The air spreads into the air positive electrode inlet device 14 in order to be filtered, and the filtered air then spreads further and enters into the air electrode carrier 15 and the air electrode catalyst coating 17. Then oxygen in the air is turned into the form of oxygen ions by means of catalysis from the catalyst 16 in the air electrode carrier 15 and the air electrode catalyst coating 17 and participates in the reaction of discharge of the cell.

(C) Technological characteristics of each component:

(C-1) Air positive electrode current collector 11:

A device collecting the current on the air positive electrode 1, one side of which is linked with the air positive electrode lug 12, to export the collected current through the air positive electrode positive lug 12, while the other side is closely linked to the air electrode carrier 15 and the air electrode catalyst coating 17. The optional materials for making the air electrode positive current collector 11 include: metals of high conductivity, such as copper, nickel, silver, lead, etc., or binary and multi-alloys of high conductivity, or carbon products

such as carbon fiber, carbon nanotube, carbon fabric, carbon cloth, carbon paper, carbon rope, graphite felt, graphite plate, etc. The optional shapes can be foil-shaped, flaky, filar, fibrous, mesh-shaped, or coating, plating, etc., such as metal foil, sheet metal, metal wire, metal fiber, metal mesh, metal coating, metal plating, alloy foil, alloy plate, alloy wire, alloy fiber, alloy mesh, alloy coating, alloy plating coating, etc. Its thickness can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or any value within the range of 1 μ m-100 μ m. Its length, width, diameter and limitation can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

Figures 9, 10, 11 and 12 show the linking structure of the air positive electrode current collector 11 and the air electrode carrier 15.

Figure 9 illustrates how the air positive electrode current collector 11 is tightly linked to one side of the air electrode carrier 15 to form a unit. In this linkage, the air positive electrode current collector 11 can be made from foil-shaped or flaky materials such as metals, alloys and carbon products which closely enclose one side of the air electrode carrier 15, or made from the filar, fibrous or mesh-shaped products of metal, alloy and carbon. These products are closely embedded in one side of the air electrode carrier 15 or made from the metal, alloy and carbon products which are attached to one side of the air electrode carrier 15 by coating and plating. Moreover, the air positive electrode current collector 11 can be tightly attached to the air electrode carrier 15 through stamping, embedding, welding, printing, clamping, casting, coating, high temperature/high pressure coating, plating, etc.

Figure 10 illustrates how the air positive electrode current collector 11 contacts tightly to four sides of the air electrode carrier 15 to form a unit. In this linkage, the air electrode positive current collector 11 can be made from foil-shaped or flaky materials such as metals, alloys and carbon products which closely enclose four sides of the air electrode carrier 15, or made from the filar, fibrous or mesh-shaped products of metal, alloy and carbon. These products are closely embedded in four sides of the air electrode carrier 15 or made from the metal, alloy and carbon products which are attached to four sides of the air electrode carrier 15 by coating and plating. Moreover, the air positive electrode current collector 11 can be tightly attached to the air electrode carrier 15

through stamping, embedding, welding, printing, clamping, casting, coating, high temperature/high pressure coating, plating, etc.

Figure 11 illustrates how the air electrode positive collector 11 is tightly attached to one surface of the air electrode carrier 15 to form a unit. In this linkage, the air electrode positive current collector 11 can be made from foil-shaped or flaky materials such as metals, alloys and carbon products which are closely attached to one surface of the air electrode carrier 15. The two surfaces of the air electrode positive current collector 11 and the air electrode carrier 15 are closed linked to each other. In this linkage, the air positive electrode current collector 11 can be made from foil-shaped or flaky materials such as metals, alloys and carbon products which are closely attached and linked to the air electrode carrier 15 so that the two surfaces are tightly linked. Moreover, the air positive electrode current collector 11 can be tightly attached to the air electrode carrier 15 through stamping, embedding, welding, printing, clamping, casting, coating, high temperature/high pressure coating, plating, etc.

Figure 12 illustrates how the air positive electrode current collector 11 is tightly attached to one surface of the air electrode carrier 15 to form a unit. In this linkage, the air electrode positive current collector 11 can be made from mesh-shaped materials such as metals, alloys and carbon products which are closely attached to one surface of the air electrode carrier 15. The two surfaces of the air electrode positive current collector 11 and the air electrode carrier 15 are closed linked to each other. In this linkage, the air positive electrode current collector 11 can be made from mesh-shaped materials such as metals, alloys and carbon products which are closely attached to the air electrode carrier 15 so that the two surfaces are tightly linked. Moreover, the air positive electrode current collector 11 can be tightly attached to the air electrode carrier 15 through stamping, embedding, welding, printing, clamping, casting, coating, high temperature/high pressure coating, plating, etc.

In Figures 9-12, the linkage structures of the air electrode positive collector 11 and the air electrode carrier 15 shown do not indicate that the linkage structures of the air electrode positive current collector 11 and the air electrode carrier 15 in the invented metal-air fuel cell are limited to four types only; that is, if any linkages of certain structures exist between the air electrode

positive collector 11 and the air electrode carrier 15, they are all included in the range of this invented metal-air fuel cell.

The air positive electrode current collector 11, the air electrode positive lug 12, and the air electrode positive output circuit 13 can also be a unit, based on the application of the above technology and special techniques.

(C-2) Air positive electrode lug 12: One end of the lug, which is linked to the air electrode positive current collector 11, exports the current collected by the air positive electrode current collector 11 to the outside from inside the cell, while the other end is linked to the air positive electrode output circuit 13. The link between the air electrode positive lug 12 and the air positive electrode outlet circuit 13 can be achieved through welding, stamping, embedding, printing, coating, high temperature/high pressure coating, plating, etc., in order to conduct out the current from the air electrode carrier 15 and the air electrode catalyst coating 17.

Meanwhile, the link helps the inner substances be blocked inside the battery shell and supporting fixing device 10, to ensure leakproofness. The materials of the air positive electrode lug 12, similar to those of the air electrode positive current collector 11, can also be chosen from high conductive metals, such as copper, nickel, silver and lead, or from high conductive binary alloys and multi-alloys, or from carbon products including carbon fiber, carbon nano-material, carbon fabric, carbon paper, carbon rope, graphite felt, graphite plate, etc. High conductive metals and high conductive alloys are preferred. The shapes can be band-shaped, flaky, columnar, linear, etc. However, band-shaped and columnar are preferred. Its thickness can be any of the values in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or between 1 μ m-100 μ m. Its length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

The air electrode positive current collector 11, air electrode positive lug 12, and air electrode positive output circuit 13 can also be a unit, based on the application of the above technology and special technology.

(C-3) Air electrode positive outlet circuit 13: One end of the circuit is linked to the air electrode positive lug 12, while the other end is linked to the

external load to transport the current to the external load so as to finish the discharge of the cell when discharge occurs. Alternatively, one end of it is linked to the air electrode positive lug 12, while the other end is ready to be linked to the external load, which denotes the following two points: one is that the cell as described by this invention has not been put into use and is still in the state of commodity products and storage after its manufacture; the other point is that the connection is cut off after discharging for a period of time. The air positive electrode outlet circuit 13 can be connected to the air positive electrode lug 12 through welding as well as clipping, clamping, screwing, and other ways such as stamping, printing, coating, high temperature/high pressure coating, and plating, etc.

The optional materials of the air positive electrode outlet circuit 13 may include the following: 1) various types of metallic wires including single strands of copper wire, single strands of aluminum wire, double strands of copper wire and double aluminum wire, multiple strands of copper wire, multiple strands of aluminum wire, etc.; 2) high conductive metals including copper, nickel, silver and lead, as well as high conductive binary alloy and multi-alloy; 3) carbon products including carbon fiber, carbon nanomaterial, carbon fabric, carbon paper, carbon rope, graphite felt, graphite plate, etc. Their shapes can be band-shaped, flaky, columnar, linear, filamentary, etc., although band-shaped and columnar are preferred. Their thickness can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or between 1 μ m-100 μ m. Their length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

The air positive electrode current collector 11, air electrode positive lug 12, and air positive electrode outlet circuit 13 can also be formed as a unit, based on the application of the above technology and special techniques.

(C-4) Air positive electrode inlet device 14: Features a sheet-like structure. Its shapes include rectangle, circle, polygon, etc. The thickness can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or any value in the range of 1 μ m-100 μ m. Its length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

Further descriptions of the spatial positions of the air positive electrode inlet device 14 are provided here. See Figure 1 and Figures 4-8 for the spatial positions of the air positive electrode inlet device 14:

Figure 1 shows the connecting part between the air positive electrode inlet device 14 and the battery shell and supporting/fixing device 10, referred to as the “all around,” “surrounding,” and “four edges.”

Figures 5 & 8 show the connecting part between the air positive electrode inlet device 14 and the air electrode carrier 15, referred to as the “inside.”

Figures 6 & 7 show the connecting part between the air positive electrode inlet device 14 and the air electrode catalyst coating 17, referred to as the “face.”

Figures 4-8 show the connecting part between the air positive electrode inlet device 14 and the outside environment, referred to as the “outside.”

The “all around” of the air positive electrode inlet device 14 is fixed on the battery shell and supporting/fixing device 10. The connection between them is sealed to avoid the inside substances from leaking out or the substances outside from permeating inside.

The “inside” of the air positive electrode inlet device 14 is tightly connected to the air electrode carrier 15 by means of a press roller or other means. Also, the “inside” of the air positive electrode inlet device 14 is tightly attached to the air electrode carrier 15 by the air electrode catalyst coating 17 and then by a press roller or by other means. The connection between the “outside” of the air positive electrode inlet device 14 and the outside can also be achieved in the same ways as the above.

The meanings of the “outside”:

First, referring to the air and the filtered air, i.e., the “outside” is the air and the filtered air.

Second, referring to pure oxygen, liquid oxygen and gaseous oxygen, compressed gaseous oxygen, when the cell is used in the environment of pure oxygen, liquid oxygen, gaseous oxygen, and compressed gaseous oxygen.

Third, referring to oxygen-rich materials such as hydrogen peroxide, when the cell is used in the condition of oxygen-rich materials such as hydrogen peroxide.

Fourth, referring to oxidizing agent, when the cell is used in the condition of oxidizing agents.

The materials of the air positive electrode inlet device 14 can be selected from hydrophobic materials such as teflon, polyethylene and paraffin, etc., and they are made into layers of tiny-pore membrane. Oxygen in the air can enter into the air electrode carrier 15 and the air electrode catalyst coating 17 through the tiny pores so that there is no evaporation, seepage, leakage and outflow of positive electrolyte fluid 9 in the air electrode carrier 15 and the air electrode catalyst coating 17, through the air positive electrode inlet device 14. The alternative material can be a waterproof breathable membrane such as a PTFE waterproof membrane and a waterproof breathable cloth.

The choice of the materials for the air positive electrode inlet device 14 determines the stability of the air with no liquidity “outside” the air positive electrode inlet device 14, which means that there is no evaporation and loss of the electrolyte fluid in the air positive electrode inlet device 14, the air electrode carrier 15 and the air electrode catalyst coating 17. Therefore, the materials for the air positive electrode inlet device 14 include aluminum hydroxide, alumina, perovskite, activated carbon, absorbent cotton, flax, glass fiber, carbon nanomaterial, wheat-germ powder, defatted corn germ powder, corn cob fragments, coarse bran powder, soybean powder, silicon dioxide, vermiculite, calcium silicate, silica, zeolite, clay, etc.

When the positive electrolyte 9 in the air electrode carrier 15 and the air electrode catalyst coating 17 belongs to alkaline electrolyte, carbon dioxide among the outside gases of the air electrode air positive inlet device 14 needs to be separated, and a carbon dioxide isolation membrane needs to be provided to block carbon dioxide entering into the air electrode carrier 15 and the air electrode catalyst coating 17.

Another alternative material of the air electrode air positive inlet device 14 is an oxygen selective membrane, to prevent other gases and substances from entering into the air electrode carrier 15 and the air electrode catalyst

coating 17 except the oxygen outside the air electrode air positive inlet device 14.

Then, an oxygen selective membrane is provided on the air electrode air positive inlet device 14 to prevent other gases except oxygen from entering into the air electrode carrier 15 and the air electrode catalyst coating 17 through the air electrode air positive inlet device 14.

Instructions needed: Due to the limits of technology, equipment and process, these membranes cannot isolate carbon dioxide completely, so a little amount of carbon dioxide and other gases may enter as well. It is the same with the selective membrane.

The air outside the air electrode air positive inlet device 14 can be filtered in advance via a certain accessory device of the metal-air fuel cell. Based on the filtering of carbon dioxide in advance, the carbon dioxide in the air can be filtered and absorbed to meet the need of external conditions, which means that the carbon dioxide membrane on the air electrode air positive inlet device 14 is no longer a necessity.

When the relevant positive electrolyte 9 in the air electrode carrier 15 and the air electrode catalyst coating 17 is neutral and acid, a carbon dioxide membrane is not a necessity. Neither is the filter and absorption of air outside the Air electrode air positive inlet device 14.

When the external condition is pure oxygen, liquid oxygen, gaseous oxygen, pressed gaseous oxygen, hydrogen peroxide and other oxygen-rich materials, and oxidizing agent environment outside the air electrode air positive inlet device 14, no matter whether the positive electrolyte 9 in the air electrode carrier 15 and the air electrode catalyst coating 17 is alkaline, acidic or neutral, a carbon dioxide membrane on the air electrode air positive inlet device 14 is not a necessity. Neither is the filter and absorption of carbon dioxide in advance.

(C-5) Air electrode carrier 15

The structure of the air electrode carrier 15 is porous. The shape can be a rectangle, a circle, a polygon, and other shapes.

The thickness can be any of the values between 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or between 1 μ m-100 μ m. The length, the width, the diameter and the limitation can be any among 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

Further descriptions shown in Figure 10 and Figures 5-8 show the spatial positions of the air electrode carrier 15. Figure 10 shows the connecting part called the “surrounding,” “all around” and “four edges”, between the air electrode carrier 15 and the air electrode positive current collector 11.

Figure 5 shows the connecting part between the air electrode air positive inlet device 14 and the air electrode carrier 15, called the “face” of the air electrode carrier 15, and the other “face” of the air electrode carrier 15 between the high temperature anti-freezing material for the siphon film 4 and the air electrode carrier 15.

Figure 6 shows the connecting part between the air electrode catalyst coating 17 and the air electrode carrier 15, called the “face” of the air electrode carrier 15.

Figure 7 shows the connecting part between the air electrode catalyst coating 17 and the air electrode carrier 15, called the “face” of the air electrode carrier 15, and the other “face” of the air electrode carrier 15 between the air electrode air positive inlet device 14 and the air electrode carrier 15.

The air electrode carrier 15 is connected differently to the air electrode positive current collector 11 to form different structures (more specific information can be found in the instructions for the air electrode positive current collector 11). When the air electrode carrier 15 is connected tightly to the air electrode positive current collector 11, it is connected tightly to the air electrode catalyst coating 17, the air electrode air positive inlet device 14 and the high temperature anti-freezing material for the siphon film 4.

Please note: The connection between the air electrode carrier 15 and the air electrode positive current collector 11 does not affect the connection between the air electrode carrier 15 and the air electrode catalyst coating 17,

the air electrode air positive inlet device 14 and the high temperature anti-freezing material for the siphon film 4.

The “inside” of the air electrode carrier 15 is tightly connected to the air electrode air positive inlet device 14 via a roller press or other means.

The “inside” of the air electrode air positive inlet device 14 is tightly connected to the air electrode carrier 15 via the air electrode catalyst coating 17, and then via a roller press or other means.

The air electrode carrier 15, being an electronic conductor and a multi-hole material larger than the surface area, is the carrier of the catalyst 16. The catalyst 16 is evenly applied to the multi-hole surface of the air electrode carrier 15 by means of various techniques and methods such as gas phase deposition method, ion plating method, electrolytic plating method, spraying method, hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black reducing potassium permanganate method, manganese nitrate and cobalt nitrate decomposition method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion coating method, high temperature and high pressure spraying ion plating method, biological bacteria, biological fermentation, biological bonding method, etc. Thus, electronics can be obtained in the most effective and shortest distance, while turning oxygen molecules into cations in the presence of the catalyst 16.

The optional forms of the air electrode carrier 15 include, but are not limited to, the following: 1) membrane structure, net structure, fabric structure, particle structure, powder structure, nanostructure and other structures made from carbon materials or carbon-based materials; 2) mesh structure, foam structure, membrane structure, fabric structure, particle structure, powder structure and other structures made from carbon nanomaterials; 3) mesh structure, membrane structure, fabric structure, particle structure, powder structure and other structures made from metal foam fibers, such as copper foam fiber, silver foam particles, etc.; and 4) mesh structure, foam structure, membrane structure, fabric structure, particle structure, powder structure and other structures made from metal nanomaterials, such as copper fiber, copper fiber cloth, silver fiber cloth, silver particles, etc.

(C-6) Catalyst 16

The catalyst 16 is evenly applied to the multi-hole surface of the air electrode carrier 15 by means of various techniques and methods, including the chemical deposition method, vapor deposition method, ion plating method, electrolytic plating method, spraying, hydrothermal method, normalization method, microwave method, normalization-microwave method, acetylene black reducing potassium permanganate method, manganese nitrate and cobalt nitrate decomposition method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria, biological fermentation, biological art bonding, etc. The catalyst 16 made by means of the above techniques and methods is turned into at least nanoscale particles, but in the actual production process, micron-scale particles with diameters chosen from the range between 0.001-1000 m and 1 μm -1000 μm might appear, although nanoscale particles are preferred.

The optional materials of the catalyst 16 can be chosen from silver catalysts, perovskite catalysts, platinum catalysts, and palladium catalysts, manganese catalysts, metal composite oxide catalysts, metal oxide catalysts, metal organic catalysts, metal chelate catalysts, etc.

The catalyst 16 is an important component of the air electrode catalyst coating 17 and is made by means of various techniques and methods such as the following: chemical deposition method, gas phase deposition method, ion plating method, electrolytic plating method, spraying method, hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black restoring potassium permanganate method, manganese nitrate and cobalt nitrate method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria method, biological fermentation, biological bacteria binding method, etc. After being crushed, the catalyst 16 is mixed with a conductive agent porous adsorbent to form the air electrode catalyst coating 17.

Various techniques and methods of applying the catalyst 16 to the multi-hole surface of the air electrode carrier 15:

1. Pretreatment of the air electrode carrier 15

(1-1) Alcohol washing

Put the air electrode carrier 15 of a certain size into the right amount of 95% ethanol, stir it thoroughly for two hours, then pour out the liquid after a thorough stirring; then clean it three times with a large amount of deionized water, and finally, put the clean air electrode carrier 15 into the oven at 40°C to dry for twelve hours, as a backup.

(1-2) Acid pickling

Put the air electrode carrier 15 of a certain size into 10% HCl solution, stir it thoroughly for three hours, then dump the liquid after a thorough stirring; then clean it with a large amount of deionized water until it is nearly neutral; finally, pour out the deionized water and put the clean air electrode carrier 15 into the oven at 40°C to dry for twelve hours, as a backup.

(1-3) Alkaline washing

Put the air electrode carrier 15 of a certain size into 10% NaOH solution, stir it thoroughly for three hours, then pour out the liquid; then clean it with a large amount of deionized water until it is nearly neutral; finally, pour out the deionized water and put the clean air electrode carrier 15 into the oven at 40°C to dry for twelve hours, as a backup.

(1-4) Undertaking the following treatment directly without the above pretreatment

2. Taking manganese-based catalyst (for example) to apply manganese-based catalyst to the air electrode carrier 15 by various means.

(2-1) Applying a manganese-based catalyst to the air electrode carrier 15 using the precipitation method.

After pretreatment, at a constant temperature of 60°C with electromagnetic stirring and oscillation, put the air electrode carrier 15 of a certain size into 100 ml 0.22 mol/L KMnO_4 solution, then slowly drop 100 ml 0.3 mol/L $\text{Mn}(\text{NO}_3)_2$

solution into 100 ml 0.22 mol/L KMnO_4 solution with the air electrode carrier 15; during the adding process, blend it with 0.8 mol/L KOH solution until the pH value reaches about 8. After the adding process, stop all stirring and oscillation, then let the treated carrier sit for two hours in a water bath at 60°C , and wash it with distilled water of the same temperature until neutral. Finally, place it at a temperature of 110°C for drying and at a temperature of 400°C for four hours for baking.

(2-2) Applying manganese-based catalyst to the air electrode carrier 15 using the electrolysis method.

The temperature of the electrolyte fluid is $95\pm 2^\circ\text{C}$, and the electrolyte fluid is a mixed solution of 130g/L H_2SO_4 and 130 g/L MnSO_4 . Put the air electrode carrier 15 of a certain size into the solution, stir the solution constantly and perform electrolysis; wash the air electrode carrier 15 at the bottom of the electrolyzer with deionized water until the solution becomes neutral, blast and dry it at a temperature of 80°C for 24 hours.

(2-3) Applying manganese-based catalyst to the air electrode carrier 15 using the hydrothermal method.

Dissolve 33.8g $\text{MnSO}_4\cdot\text{H}_2\text{O}$ and 0.25mol/L $(\text{NH}_4)_2\text{SO}_4$ in 500ml water; put in the air electrode carrier 15 of a certain size and stir the solution for 30 minutes, with ultrasonic vibration for 15 minutes; then the water bath temperature is raised to 90°C ; heat another 500 ml water to 90°C , add 45.66g $(\text{NH}_4)_2\text{S}_2\text{O}_8$, stir it until it is thoroughly dissolved, and then mix the two quickly for twelve hours of reaction. After twelve hours of reaction, let it cool down naturally to a normal temperature, and wash the air electrode carrier 15 with deionized water until the pH=5-6, blast and dry it at a temperature of 80°C for 24 hours.

(2-4) Applying manganese-based catalyst to the air electrode carrier 15 using the normalization method.

Dissolve 21.4 g solution of KMnO_4 in 700 ml deionized water, and put in the air electrode carrier 15 of a certain size; in addition, dissolve 33.8 g solution of $\text{MnSO}_4\cdot\text{H}_2\text{O}$ in 300 ml deionized water until it is completely melted; then, after stirring vigorously for 30 minutes, the mixed solution of MnSO_4 is dropped into the solution of KMnO_4 ; after completing 60 minutes of dropping, the reaction is

continued for 120 minutes; wash the air electrode carrier 15 with deionized water until it reaches pH=6-7; then blast and dry it at a temperature of 80°C for 24 hours.

(2-5) Applying manganese-based catalyst to the air electrode carrier 15 using the microwave method. Dissolve 33.8 g $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ and 0.25 mol/L $(\text{NH}_4)_2\text{SO}_4$ in 500 ml water and put in the air electrode carrier 15 of a certain size; stir for 30 minutes, with ultrasonic vibration for 15 minutes; then the temperature of the water bath is raised to 90°C; heat another 500 ml water to 90°C, and add 45.66 g $(\text{NH}_4)_2\text{S}_2\text{O}_8$; stir until it is thoroughly dissolved, then mix the two solutions quickly, vigorously stir for one minute and put it into a micro-oven (1500 w); take it out after 15 minutes, then let it cool naturally to a normal temperature; wash the air electrode carrier 15 with deionized water until it reaches pH=5-6; then blast and dry it at a temperature of 80°C for 24 hours.

(2-6) Applying manganese-based catalyst to the air electrode carrier 15 using the normalization microwave method.

Dissolve 21.4 g KMnO_4 in deionized water and put in the air electrode carrier 15 of a certain size; in addition, dissolve 33.8 g $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ in 300 ml deionized water; when it is completely dissolved, stir vigorously for 30 minutes, then drop MnO_4 mixture liquor into the KMnO_4 solution; after completing 60 minutes of dropping, put it into a micro-oven (microwave power 1500 w), take it out after 15 minutes and let it cool naturally to a normal temperature, filter and wash the air electrode carrier 15 with deionized water until it reaches pH=6-7; then blast and dry it at a temperature of 80°C for 24 hours.

(2-7) Applying manganese-based catalyst to the air electrode carrier 15 using the acetylene black restoring potassium permanganate method.

Dissolve 0.354 g acetylene black in 200 ml 0.1mol/L KMnO_4 solution and stir for 20 minutes; then put the air electrode carrier 15 of a certain size in a water bath with a constant temperature of 90°C for 24 hours until its reaction is completed; wash it three times with deionized water, blast and dry it at a temperature of 80°C for 24 hours.

(2-8) Applying manganese-based catalyst to the air electrode carrier 15 using the manganese nitrate decomposition method.

Put the air electrode carrier 15 of a certain size, such as carbon paper, carbon cloth, carbon felt, carbon fiber membrane, or glass fiber membrane, etc. into 500 ml 50% $\text{Mn}(\text{NO}_3)_2$ solution and soak it for 10 minutes; then heat the $\text{Mn}(\text{NO}_3)_2$ solution with the air electrode carrier 15; heat the air electrode carrier 15, such as carbon paper, carbon cloth, carbon felt, carbon fiber, or glass fiber membrane, etc., to 280°C-700°C (the rate of temperature rise does not exceed 2°C per minute); during the heating process to reach a temperature of 280°C-700°C, at the same time, rotate the air electrode carrier 15 until it is dry; then let it naturally cool to room temperature after keeping it at a constant temperature of 280°C-700°C for one hour.

Most proper temperature: for example, heat $\text{Mn}(\text{NO}_3)_2$ with the air electrode carrier 15, such as carbon paper, carbon cloth, carbon felt, carbon fiber membrane, or glass fiber membrane to 300°C-350°C (the rate of temperature rise does not exceed 2°C per minute); during the heating process to reach a temperature of 300°C-350°C, at the same time, rotate the air electrode carrier 15 until it is dry; then keep it at a constant temperature of 280°C-700°C for one hour.

3. Applying silver-based catalyst (as an example) to the air electrode carrier 15.

(3-1) Applying silver-based catalyst to the air electrode carrier 15 using the deposition method.

Weigh 34 g PVP and 17 g silver nitrate at a mass ratio of 2:1 and mix them to produce 10 L transparent aqueous solution (silver nitrate concentration is 0.01 mol/L). Put in the air electrode carrier 15 of a certain size and vigorously stir for 30 minutes; then gradually drop in 10 L 0.1 mol NaBH_4 solution and keep stirring and agitating for two hours until the reaction is completed; then wash and dry it in a vacuum of 2°C for twelve hours.

4. Applying the composite catalyst of silver-based catalyst and manganese-based catalyst (as an example) to the air electrode carrier 15.

(4-1) First, apply a manganese-based catalyst to the air electrode carrier 15 using the methods mentioned in Parts (2-1) (2-2) (2-3) (2-4) (2-5) (2-6) (2-7) and (2-8). Next, apply a manganese-based catalyst to the air electrode carrier 15 using the methods mentioned in Part (3-1).

(4-2) First, apply a silver-based catalyst to the air electrode carrier 15 using the methods mentioned in Part (3-1). Next, apply a silver-based catalyst to the air electrode carrier 15 using the methods mentioned in Parts (2-1) (2-2) (2-3) (2-4) (2-5) (2-6) (2-7) and (2-8).

5. Applying a cobalt-based catalyst (as an example) to the air electrode carrier 15.

(5-1) Applying cobalt-based catalyst to the air electrode carrier 15 using the cobalt nitrate decomposition method.

Put the air electrode carrier 15 of a certain size (such as carbon paper, carbon cloth, carbon felt, carbon fiber membrane, or glass fiber membrane, etc.) in 500 ml 20% $\text{Co}(\text{NO}_3)_2$ solution; agitate it for 10 minutes, and heat the $\text{Co}(\text{NO}_3)_2$ solution with the air electrode carrier 15, heat a certain spot on the air electrode carrier 15 (such as carbon paper, carbon cloth, carbon felt, carbon fiber membrane, or glass fiber membrane, etc.) to 500°C-800°C (the rate of temperature rise does not exceed is 2°C per minute); during the process of heating the certain spot on the air electrode carrier 15 (such as carbon paper, carbon cloth, carbon felt, carbon fiber membrane, or glass fiber membrane, etc.) to reach a temperature of 500°C-800°C, at the same time, rotate the air electrode carrier 15 until it is dry; then let it naturally cool to room temperature after keeping it at a constant temperature of 500°C-800°C for one hour.

6. Applying the composite catalyst of cobalt-based catalyst and manganese-based catalyst (as an example) to the air electrode carrier 15.

(6-1) First, apply a cobalt-based catalyst to the air electrode carrier 15 using the methods mentioned in Part (3-1). Next, apply a manganese-based catalyst

to the air electrode carrier 15 using the methods mentioned in Part (2-1) (2-2) (2-3) (2-4) (2-5) (2-6) (2-7) (2-8).

Other methods to apply the different catalysts to the air electrode carrier 15 besides the methods mentioned in Parts 1-6 include: ion plating method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, high temperature and high pressure spraying ion plating method, and manual spraying.

During the process of catalyst production, it is necessary to recycle harmful substances and other products such as nitric oxide, nitrogen dioxide, sulfur dioxide, etc. For instance, nitric oxide and nitrogen dioxide can be made into nitric acid and sulfate, and sulfur dioxide into sulfuric acid and sulfate.

The techniques and methods mentioned above integrate the catalyst 16 and the air electrode carrier 15 into an inseparable and unified oxygen auxiliary structure and auxiliary material on the air positive electrode 1.

The catalyst 16 includes, but is not limited to, the following: silver catalyst, perovskite catalyst, platinum catalyst, palladium catalyst, manganese catalyst, metal composite oxide catalyst, metal oxide catalyst, organic metal oxide catalyst, cobalt catalyst, metal chelate catalyst, silver catalyst, etc.

The air electrode carrier 15 includes, but is not limited to, the following: 1) substances made from carbon materials and carbon-based materials such as membrane structure, net structure, fabric structure, particle structure, powder structure, nanometer materials, etc; 2) substances made from carbon nanomaterials such as mesh structure, foam structure, membrane structure, fabric structure, particle structure, powder structure, etc.; 3) substances made from metal foam materials such as mesh structure, membrane structure, fabric structure, particle structure, powder structure, etc. as well as copper foam fiber, silver particles, etc.; 4) substances made from metal nanomaterials such as mesh structure, foam structure, membrane structure, fabric structure, grain structure, particle structure, powder structure, etc., as well as copper fiber, copper fiber cloth, silver fiber cloth, silver particles, etc.

What matters most is that the techniques and methods mentioned above integrate the catalyst 16 and the air electrode carrier 15 into an inseparable and unified oxygen auxiliary structure and auxiliary material on the air positive electrode 1.

(C-7) Air electrode catalyst coating 17

The air electrode catalyst coating 17, in the form of paste and mud, is applied to the locations between the air electrode carrier 15 and the air positive electrode inlet device 14, between the air electrode carrier 15 and the high temperature anti-freezing material for the siphon film 4. Meanwhile, it is applied to the locations between the air electrode carrier 15 and the air positive electrode inlet device 14, and between the air electrode carrier 15 and the high temperature anti-freezing material for the siphon film 4.

The thickness of the air electrode catalyst coating 17, which is applied to the locations between the air electrode carrier 15 and the air positive electrode inlet device 14 and between the air electrode carrier 15 and the high temperature anti-freezing material for the siphon film 4, can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or in the range of 1 μ m-100 μ m.

The air electrode catalyst coating 17 promotes the catalytic activity of the air positive electrode 1, the tightness between the air electrode carrier 15 and the air positive electrode inlet device 14, and the tightness between the air electrode carrier 15 and the high temperature anti-freezing material for the siphon film 4.

The air electrode catalyst coating 17 in the form of paste and mud can be made in the following ways: 1) mixing up crushed catalyst 16 with conductive agent and porous sorbent by adding water; 2) mixing up crushed catalyst 16 with conductive agent and porous sorbent by positive electrolyte 9; and 3) mixing up crushed catalyst 16 with conductive agent and porous sorbent by the solvent of positive electrolyte 9.

The optional materials of the conductive agent for the air electrode catalyst coating 17 include graphite (ks-6), carbon black (KB), acetylene black (AB),

metal fiber, metal powder, vapor grown carbon fiber (VGCF), carbon nanotubes CNTs, etc.

The optional materials of the porous sorbent for the air electrode catalyst coating 17 include alumina, perovskite, activated carbon, absorbent cotton, absorbent flax, glass fiber, carbon nanomaterials, etc.

The mass ratio between the catalyst 16, the conductive agent and the porous adsorbent is X: Y: Z (each greater than zero positive).

Such as the following table:

X Catalyst 16	Y Conductive agent	Z Porous adsorbent
1	2	5
1	4	7
1	2	6
1	1	15
1	2	8
1	1	8

Air electrode catalyst coating 17 in the form of paste and mud can be made in the following ways: 1) mixing up crushed catalyst 16 with conductive agent, porous sorbent and binder by adding water; 2) mixing up crushed catalyst 16 with conductive agent and porous sorbent by positive electrolyte 9; and 3) mixing up crushed catalyst 16 with conductive agent and porous sorbent by the solvent of positive electrolyte fluid 9.

The optional materials of the conductive agent for the air electrode catalyst coating 17 are chosen from: graphite (ks-6), carbon black (KB), acetylene black (AB), metal fiber, metal powder, vapor grown carbon fiber (VGCF), carbon nanotubes CNTs, etc.

The optional materials of the porous sorbent for the air electrode catalyst coating 17 are chosen from: aluminum hydroxide, alumina, perovskite,

activated carbon, absorbent cotton, absorbent flax, glass fiber, carbon nanomaterials, wheat germ powder, defatted corn germ meal, corn cob fragments, coarse bran, soybean powder, silica, vermiculite, calcium silicate, silica gel, zeolite, clay, etc.

The optional materials of the binder for the air electrode catalyst coating 17 are chosen from: PVA, PTFE, hydroxymethyl cellulose sodium (CMC), polyolefins (PP, PE and other copolymer), PVDF/NMP, good bonding modified SBR rubber, fluorine rubber, polyurethane, etc.

The mass ratio of the catalyst 16, the conductive agent, the porous adsorbent and the binder: X: Y: Z: W (each greater than zero positive).

Such as the following table:

X Catalyst 16	Y Conductive agent	Z Porous adsorbent	W Binder
1	2	5	1
1	4	7	4
1	2	5	7
1	4	9	2
1	1	15	2
2	2	16	1
1	1	8	3

Other optional methods of producing the air electrode catalyst coating 17 are listed as follows: 1) apply the catalyst 16 to the porous adsorbent by various methods, then mix it with conductive agent and binder into the form of paste and mud; 2) apply the catalyst 16 to the porous adsorbent by the various methods and techniques used to apply the catalyst 16 to the air electrode carrier 15, such as chemical deposition method, gas phase deposition, ion plating method, electrolytic plating, spraying method, hydrothermal method,

normalization method, microwave method, normalization microwave method, acetylene black reducing potassium permanganate method, manganese nitrate, cobalt nitrate decomposition method, and other decomposition method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature/high pressure spraying ion plating method, etc.

Production process of air electrode:

A. Distribution of catalyst on air electrode carrier

1. Select an air electrode carrier of a certain size.
2. Apply catalyst to air electrode carrier

B. Making air positive electrode current collector and lug on air electrode carrier

C. Produce catalyst coating

D. Make catalyst coating on air electrode carrier

E. Install air positive electrode inlet device on air electrode

A. Distribute catalyst to air electrode carrier

1. Select a kind of material and producing an air electrode carrier of a certain size; soak the tailored air electrode carrier in strong acid or strong alkali, or soak it consecutively in the strong acid and the strong alkali of a certain concentration. Next, seal and soak it for 1-100h; 12-24h is preferred.

2. Unseal it when the soak is over; remove it from the strong acid and strong alkali and wash it with distilled water or water until it reaches pH=6.5-7.5; then dry out the distilled water with a spin-dryer and put it into a vacuum drying oven.

3. Soak the dried air electrode carrier in a catalyst precursor solution or suspension; seal and soak it for 1-100h; 12-24h is preferred. Then add some chemicals to increase the catalyst coating's porous structures and catalytic activity. The optional chemicals include at least one of the following: sodium chloride and sucrose, fructose, ammonium oxalate, sodium thiosulfate, etc.

4. Unseal it when the soak is over; remove the air electrode carrier from the catalyst precursor solution or suspension and evenly spread it in a flat-bottomed enamel dish or glass plate.

5. Keep the air electrode carrier adsorbing enough amount of catalyst precursor solution or suspension.

6. Carry out sectional heating or reaction.

7. Heat it to the first temperature point and keep the first temperature point constant for a certain period of time; then heat it to the second and keep the second temperature point constant for a certain period of time; and then repeat the same steps up until the fifth point. After that, heat it slowly up to the sixth point and keep the same pace, which means increasing a certain degree of temperature within a certain period of time, and then heat it up to the seventh point and keep the seventh point constant for a certain period of time. Then stop heating and let the high temperature stove naturally cool down to room temperature, or stop the reaction.

The process of distributing catalyst to the air electrode carrier is completed, and the air electrode carrier is ready for use.

B. Installing an air positive electrode current collector and an air positive electrode lug to an air electrode carrier

1. Take the air electrode carrier prepared above, covered with catalysts, and trim its four edges with scissors or a trimmer to make them smooth; then put the trimmed air electrode carrier into an electroplating apparatus for electroplating; surrounding the air electrode carrier with a circle of copper plating or nickel plating or other metal plating with a width of 5-10 mm and a thickness of 0.03 mm-0.05 mm; then the copper or nickel with a width of 5-10 mm surrounding the air electrode carrier is the air positive electrode current collector.

2. Weld one or more bars of copper or nickel with a width of 5-10 mm and a thickness of 0.05-0.1 mm to a circle of the copper or nickel circle with a width of 5-10 mm surrounding the air electrode carrier. These copper or nickel bars, welded to the air electrode positive current collector, are the air positive

electrode lugs. Optional methods of welding include resistance welding, ultrasonic welding, laser welding, etc.

C. Producing the catalyst coating

Select active carbon as an adsorbent, and select grapheme and acetylene black as a conductive agent.

Catalyst coating consists of catalyst, porous adsorbent, conductive agent, dispersant and binder.

Optional methods of producing catalyst coating include the following:

The catalyst is selected from one or more of silver catalyst, perovskite catalyst, platinum, palladium catalyst, manganese catalyst agent, metal composite oxide catalyst, metal oxide catalyst, metal organic catalyst, and metal chelate catalyst.

The adsorbent is selected from one or more of activated carbon, activated alumina, molecular sieve and silica gel.

The conductive agent is selected from one or more of acetylene black, graphene, graphite powder, carbon black and super carbon black, polyaniline, acetylene, polypyrrole, polythiophene, and metal powder.

The binder is selected from one or more from PTFE emulsion, fatty acid metal salt (fatty acid sodium, fatty acid potassium, etc.), vinyl acetate, polyvinyl alcohol, polyoxyethylene, polyvinylpyrrolidone, polyvinylether, methyl methacrylate, polyvinylidene fluoride, polyvinyl chloride, polyacrylonitrile, polyvinyl pyridine, polystyrene, or one or more from their derivatives and copolymers.

Dispersant is selected from one or more of ethanol, methanol, ethyl cellulose, water, and fatty acid.

The production steps:

1. First, make the catalyst itself, then mix the prepared catalyst with porous adsorbent, conductive agent, dispersant and binder directly.

2. Mix the catalyst precursor with porous adsorbent, conductive agent, and dispersant and spread them to produce a solution or suspension. Then distribute the catalyst onto the adsorbent and conductive agent in the same way whereby the catalyst is produced; in order to integrate these three items, the catalyst of the size of the nanoscale is distributed to the adsorbent and conductive agent (wherein the dispersant is released in the form of a gas or vapor, or decomposed gas). Then mix the adsorbent and conductive agent with the catalyst, which has been distributed to the adsorbent and conductive agent, by means of a binder and dispersant to produce catalyst coating.

3. First, mix the catalyst precursor with a porous adsorbent and a dispersant and spread them to produce a solution or suspension. Then distribute the catalyst onto the adsorbent in the same way whereby the catalyst is produced; in order to integrate these two items, the catalyst of the size of the nanoscale is distributed to the adsorbent; then mix and spread the catalyst precursor with a porous adsorbent and a conductive agent to produce a solution or suspension; then directly distribute the catalyst to the adsorbent in the same way whereby the catalyst is produced; in order to integrate these two items, the catalyst of the size of the nanoscale is distributed to the conductive agent (wherein the conductive agent is released in the form of a gas or vapor, or decomposed gas). After that, mix the above two adsorbents, each of which is distributed with catalyst, by using binder and dispersant to produce the catalyst coating.

4. Based on steps 2 and 3, add some chemicals to increase the porous structures and catalytic activity. The optional chemicals include one or more of the following: sodium chloride and sucrose, fructose, ammonium oxalate, sodium thiosulfate, etc.

(4-1) Mix and spread the catalyst precursor with the porous adsorbent, conductive agent, dispersant, and one or more of the above chemicals to produce a solution or suspension; then directly distribute the catalyst to the adsorbent and conductive agent in the same way whereby the catalyst is produced. Finally, mix the adsorbent and conductive agent with the catalyst, which has been distributed to the adsorbent and conductive agent, by means of a binder and dispersant to produce the catalyst coating.

D. Applying the catalyst coating to the air electrode carrier

Methods of application are listed as follows:

1. Apply the catalyst coating directly to one or two sides of the air electrode carrier with a coating machine. The thickness of the coating is 0.05-0.1 mm.

2. Apply the catalyst coating to one or two sides of the air electrode carrier with a coating machine, and then compress it within an axial compressor. The thickness of the coating is 0.05-0.1 mm, and 0.03-0.05 mm after compression.

3. Spray with a spraying machine.

4. Baking

(4-1) Selecting a kind of material and producing an air electrode carrier of a certain size: soak the tailored air electrode carrier in strong acid or strong alkali, or soak it consecutively in the strong acid and the strong alkali of a certain concentration. Next, seal and soak it for 1-100h; 12-24h is preferred. (4-2) Unsealing it when the soak is over; remove it from the strong acid or strong alkali and wash it with distilled water or water until it reaches pH=6.5-7.5; then, dry out the distilled water with a spin-dryer and put it into a vacuum drying oven.

(4-3) Soaking the dried air electrode carrier in the catalyst precursor solution or suspension, seal and soak it for 1-100h; 12-24h is preferred.

(4-4) Unsealing when the soak is over; remove the air electrode carrier from the catalyst precursor solution or suspension, and evenly spread it in a flat-bottomed enamel dish or glass plate.

(4-5) Producing the catalyst coating.

(4-5-1) Mixing and spreading the catalyst precursor with the porous adsorbent, conductive agent, and dispersant to produce a solution or suspension.

(4-5-2) Mixing and spreading the catalyst precursor with the porous adsorbent and dispersant to produce a solution or suspension.

(4-5-3) Mixing and spreading the catalyst precursor with conductive agent and dispersant to produce a solution or suspension

(4-6) Applying at least one of the catalyst coatings made in step (4-5) to the air electrode carrier prepared in step (4-4).

(4-7) Heat it to the first temperature point and keep the first temperature point constant for a certain period of time; then heat it to the second temperature point and keep the second point constant for a certain period of time; then repeat the same steps up until the fifth point. After that, heat it slowly up to the sixth point and keep the same pace which means increasing a certain degree of temperature within a certain period of time, and then heat it up to the seventh point and keep the seventh point constant for a certain period of time. Then stop heating and let the high temperature stove naturally cool down to room temperature.

The process of baking is completed, and the catalyst coating has been applied to the air electrode carrier by baking.

5. Repeat baking.

Re-soak the baked air electrode carrier, to which the catalyst coating has been applied by baking, in catalyst precursor solution or suspension and seal it; soak it for 1-100h; 12-24h is preferred. Then repeat the process from step (4-4) to step (4-8) so that the second baking is completed when the catalyst coating is applied to the air electrode carrier by baking. Alternatively, more repetitions can be performed in the same way.

Example of distributing catalyst onto the air electrode carrier

Select 3K carbon cloth material as an air electrode carrier, select manganese dioxide as the catalyst, and select manganese nitrate solution (50%) as a catalyst precursor; then distribute manganese dioxide as the catalyst to the air electrode carrier.

1. Cut a 3K carbon cloth into a required size of 12 cm x 12 cm and soak the tailored carbon cloth in concentrated sulfuric acid (98.3%); seal and soak it for 12h.

2. Unseal when the soak is over; remove it from the concentrated sulfuric

acid and wash it with distilled water or water until it reaches a neutral value (pH=6.5-7.5); spin-dry the distilled water with a dryer and then put it into a vacuum drying oven until it is dry.

3. Soak the dried carbon cloth in manganese nitrate solution (50%), sealed and soaked for 24h.

4. Unseal when the soak is over; remove the carbon cloth from the manganese nitrate solution (50%) and evenly spread it in a flat-bottomed enamel dish or glass plate.

5. Absorb 10 ml of manganese nitrate solution (50%) through an infusion apparatus and drop the solution onto the flat carbon cloth for absorption.

6. Put the carbon cloth, fully soaked with manganese nitrate solution, into a high temperature stove together with the enamel dish or glass plate; shut the enclosure door, and apply sectional heating.

7. Heat to 100°C and keep the temperature constant for 15 minutes; then heat to 150°C and keep the temperature constant for 60 minutes; then repeat the same step to 180°C and keep it constant for 90 minutes. Further heat to 200°C and keep it for 30 minutes, then slowly to 300°C at a rate of 2°C every 3-4 mins, and keep that temperature constant for 60 minutes. Finally, stop heating and let the high temperature stove naturally cool down to room temperature.

8. Open the enclosure door of the high temperature stove after its temperature has naturally cooled down to room temperature; remove the carbon cloth from the high temperature stove. The process of distributing the catalyst to the air electrode carrier is complete, and the air electrode carrier is ready for use.

Example:

Select manganese nitrate solution (50%) as a catalyst precursor to produce manganese dioxide catalyst.

Steps:

1. Weigh 600 g manganese nitrate solution (50%), evenly divide it into four portions of 150 g each, and add each portion into a 500 ml beaker.

2. Put the four beakers into a high temperature stove, shut the enclosure door and apply sectional heating.

3. Heat to 100°C and keep that temperature constant for 15 minutes; then heat to 150°C and keep that temperature constant for 60 minutes; then repeat the same step to 180°C and keep it constant for 90 minutes. Further heat to 200°C and keep it for 30 minutes and then slowly to 300°C at a rate of 2°C every 3-4 mins, and keep that temperature constant for 60 minutes. Finally, stop heating and let the high temperature stove naturally cool down to room temperature.

4. Open the enclosure door of the high temperature stove after the temperature has cooled to room temperature, and remove the beakers from the high temperature stove. Remove the prepared manganese nitrate catalysts from the beakers, then put them into a ball mill to grind them into powder.

The process of producing manganese nitrate catalyst is complete.

Example:

How to select manganese nitrate solution (50%), lithium carbonate and cobalt nitrate as a catalyst precursor to produce a manganese-cobalt-lithium catalyst.

Steps:

1. Weigh 2000 g manganese nitrate solution (50%), 104 g lithium carbonate and 43 g cobalt nitrate; add the cobalt nitrate to the 2000 g manganese nitrate solution with mixing and blending. Then add the lithium carbonate with mixing and blending as well. Later, add a certain amount of sulfuric acid to facilitate the dissolution of the added lithium carbonate.

2. Equally divide the above mixed solution into eight portions, and add each to a 1000 ml beaker.

3. Put the eight beakers with the above mixed solution into a high temperature stove, shut the enclosure door and apply sectional heating.

4. Heat to 100°C and keep that temperature constant for 15 minutes; then heat to 150°C and keep that temperature constant for 60 minutes; then repeat the same step to 180°C and keep it constant for 90 minutes. Further heat to 200°C and keep it for 30 minutes and then slowly to 300°C at a rate of 2°C every 3-4 mins, and keep that temperature constant for 60 minutes. Finally, stop heating and let the high temperature stove naturally

cool down to room temperature.

5. Open the enclosure door of the high temperature stove after the temperature has cooled down to room temperature and remove the beakers from the high temperature stove. Remove the products from the beakers, and then put them into a ball mill to grind them into powder.

6. Divide the powder evenly into four parts, and pour each into a 100 ml crucible.

7. Put the four crucibles with catalyst powder into a muffle furnace for further heating.

8. Heat to 800°C and keep that for 12h; then let it naturally cool down.

9. Take the product out of the muffle furnace, and put it into a ball mill to grind it into powder. Then repeat steps 6-9, and when heating to 800°C, keep it for 12h.

Finally, put it into a ball mill and grind it into powder for a second time.

The process of producing manganese-cobalt-lithium catalyst is complete.

Component 2 – metal negative electrode 2

(A) Structures: consisting of a metal negative collector 21, a metal negative lug 22, a metal negative outlet circuit 23 and a metal fuel 24, etc.

(B) Running features: Cations, produced in the air positive electrode 1, pass through the siphon membrane with the positive electrolyte fluid 4, then go through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and electrolyte 5 and reach the metal fuel 24. Meanwhile, the atoms of the metal fuel 24 lose an electron to form metal ions. Then the electron passes through the metal negative current collector 21, the metal negative lug 22, the metal negative outlet circuit 23 and the external circuit of the cell to enter into the air positive electrode 1. At this time, oxygen atoms are combined with metal ions to produce metallic oxide, and a discharge reaction begins.

(C) Technical features of each component:

(C-1) Metal negative current collector 21

A device for collecting the current of the metal negative electrode 2, one side of which is connected to the metal negative lug 22, conducts the collected

current through the metal negative lug 22; its other side is connected to the metal fuels 24; the metal negative current collector 21 can be closely linked to the metal fuels 24 via the methods of stamping, embedding, welding, printing, clamping, casting, spraying, high temperature/high pressure spraying, coating, etc. The metal negative current collector 21 can be linked to the metal negative lug 22 via the methods of welding, stamping, printing, spraying, high temperature/high pressure spraying, coating, etc.

The metal negative current collector 21 is made from the following materials: 1) high conductive metals: copper, nickel, silver, lead, etc.; or 2) high conductive binary alloys and multi-alloy materials; or 3) carbon products: carbon fiber, carbon nano-materials, carbon fabric and felt, carbon rope, graphite felt, graphite plate, etc.

The optional shapes of the metal negative current collector 21 include: foil, sheet, filiform, fibrous, mesh, coating, plating, etc., such as metal foil, sheet metal, metal wire, metal fiber, metal mesh, metal coating, metal plating, alloy foil, alloy plate, alloy wire, alloy fiber, alloy net, alloy coating, alloy plating, etc.

The thickness of the metal negative current collector 21 includes any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or any value in the range of 1 μ m-100 μ m. The length, the width, the diameter and the limitation of the metal negative current collector 21 include any of the value among 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

See Figures 14-21 for the connection structure between the metal negative current collector 21 and the metal fuel 24.

In Figure 14, the metal negative current collector 21 is tightly connected to one side of the metal fuel 24.

The methods of the tight connection include the following:

1) The metal negative current collector 21 in the form of foil or sheet metal, alloy, carbon products, etc., covers one side of the metal fuel 24.

2) The metal negative current collector 21 in the form of filaments, fibrous, mesh metal, alloy, carbon products, etc., is embedded in one side of the metal fuel 24.

3) The metal negative current collector 21 in the form of metal, alloy and carbon products is sprayed on one side of the metal fuel 24 by means of coating and plating.

4) The metal negative current collector 21 can be attached to the metal fuel 24 by means of stamping, embedding, welding, printing, clamping, casting, coating, high temperature high/pressure spraying, and coating, etc.

Figures 15 & 16 show a sectional view along the direction of Fig. 14 H-H.

In Figure 15, the metal negative current collector 21 is tightly connected to one side of the metal fuel 24, in the same ways as shown in Figure 14.

In Figure 16, the metal negative current collector 21 is embedded in the metal fuel 24; this connection structure can be applied to the cell in Figures 22 & 23. In the example cell, there is a metal negative electrode 2 in its center, and an air positive electrode 1 each on its two sides. In this case, the two air positive electrodes 1 share one metal negative electrode 2. More details are shown below.

In Figure 17, the metal negative collector 21 is tightly connected to four sides of the metal fuel 24.

The methods of the tight connection include the following:

1) The metal negative current collector 21, in the form of foil-shaped or sheet-shaped metal, alloy, carbon products, etc., tightly covers four sides of the metal fuel 24; or

2) The metal negative current collector 21, in the form of filiform, fibrous, mesh-shaped metal, alloy, carbon products, etc., is embedded in four sides of the metal fuel 24; or

3) The metal negative collector 21, in the form of metal, alloy and carbon products, is sprayed and plated to four sides of the metal fuel 24 by means of coating and plating; or

4) The metal negative current collector 21 is closely attached to the metal fuel 24 by means of stamping, embedding, welding, printing, clamping, casting, coating, high temperature/high pressure spraying, and coating, etc.

In Figure 18, the metal negative collector 21 is tightly connected to one side of the metal fuel 24.

The methods of the tight connection include the following:

1) The metal negative current collector 21, in the form of foil-shaped or sheet-shaped metal, alloy, carbon products, etc., is closely attached to one face of the metal fuel 24; or

2) The metal negative current collector 21, in the form of foil-shaped or sheet-shaped metal, alloy, carbon products, etc., is closely attached to two sides of the metal fuel 24, if the metal negative current collector 21 is closely connected to two faces of the metal fuel 24 ; or

3) The metal negative current collector 21 is closely attached to the metal fuel 24 by means of stamping, embedding, welding, printing, clamping, casting, coating, high temperature/high pressure spraying, coating, etc.

In Figure 19, the metal negative current collector 21 is tightly connected to one face of the metal fuel 24. The methods of the tight connection include the following:

1) The metal negative current collector 21, in the form of mesh-shaped metal, alloy and carbon products, is closely attached to one face of the metal fuel 24; or

2) The metal negative current collector 21, in the form of mesh-shaped metal, alloy and carbon products, is closely attached to two faces of the metal fuel 24, if the metal negative current collector 21 is closely connected to two faces of the metal fuel 24; or

3) The metal negative current collector 21 is closely attached to the metal fuel 24 by means of stamping, embedding, welding, printing, clamping, casting, coating, high temperature/high pressure spraying, coating, etc.

Figures 20 & 21 show a sectional view along the direction of Figure 19 I-I.

In Figure 20, the metal negative current collector 21 is tightly connected to one face of the metal fuel 24 as a unit, in the same ways as shown in Figure 19.

In Figure 21, the metal negative current collector 21 is embedded in the metal fuel 24; this connection structure can be applied to the cell shown in Figures 22 & 23. In the example cell, there is a metal negative electrode 2 in its center, and an air positive electrode 1 on each of its two sides. In this case, the two air positive electrodes 1 share one metal negative electrode 2. More details are shown as follows.

The mutual structure relationships between the air positive electrodes 1 and the metal fuel 24 shown in Figures 14-21 do not mean their relationships are limited just to these ones in the invented cell. On the contrary, all the mutual structure relationships between the two are within the scope of this invention.

The air electrode positive collector 11, the air electrode positive lug 12 and the air electrode positive outlet circuit 13 can form a unit via the above methods and special technology.

(C-2) Metal negative lug 22

One end of the metal negative lug 22, connected to the metal negative current collector 21, conducts the collected electrical current from the cell to the outside; the other end, connected to the metal negative outlet circuit 23, conducts the electrical current effectively from the metal fuel 24 to the outside when the metal negative lug 22 is connected to the metal negative current collector 21 and the metal negative outlet circuit 23 by means of welding, stamping, printing, spraying, high temperature/high pressure spraying, coating, etc. Meanwhile, this connection effectively blocks the inner substances of the cell inside the battery shell and supporting/fixing device 10 to ensure the good leakproofness of the cell.

The materials chosen for the metal negative lug 22 can be the same as the ones of the metal negative current collector 21, including the following: 1) copper, nickel, silver, lead and other high-conductive metals; 2) binary alloy and multi-alloy materials of high conductivity; or 3) carbon fiber, carbon nano-materials, carbon cloth, carbon paper, carbon rope, graphite felt, carbon

graphite plate and other carbon products. Metals and alloy materials with a high conductivity are preferred.

The optional shapes can be the following: strip, sheet, column, line, and other shapes; strip and column are preferred. The thickness of the metal negative lug 22 can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or any value in the range of 1 μ m-100 μ m. The length, the width, the diameter and the limitation of the metal negative lug 22 can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

The air positive electrode collector 11, the air positive electrode lug 12 and the air electrode positive outlet circuit 13 can form a unit by means of the above methods and special technology.

(C-3) Metal negative electrode outlet circuit 23

One end of the metal electrode negative outlet circuit 23 is connected to the metal negative lug 22, while the other end is connected to the load outside. When the cell discharges, the metal negative output circuit 23 carries electrical current to the outside load, to finish the discharge reaction. Or one end is connected to the metal negative lug 22, while the other end is ready to be connected to the load outside, which means that the invented cell is on sale or in storage after its manufacture and before being put into use, or means that its connection is cut off after discharging for a period.

The methods of connection between the metal negative outlet circuit 23 and the metal negative lug 22 include welding, clamping, clipping, screwing, etc.

The metal negative outlet circuit 23 can be connected to the metal negative current collector 21 and the metal negative lug 22 by means of welding, stamping, printing, spraying, high temperature/high pressure spraying, coating, etc. to conduct the electrical current from the metal fuel effectively to the outside.

The metal negative electrode outlet circuit 23 can be made from the following: 1) various common metallic conductors seen in daily life, such as copper wire of single strands, aluminum conductors of single strands, copper conductors of double strands, aluminum conductors of double strands, copper

wires of multiple strands, and aluminum conductors of multiple strands; or 2) metal materials of high conductivity, such as copper, nickel, silver, lead, etc.; or 3) binary alloys and multi-alloys of high conductivity; or 4) conductive carbon products such as carbon fiber, carbon nano-materials, carbon cloth, carbon paper, carbon rope, graphite felt, graphite plate, etc.

Its shapes can be the following: strip, sheet, column, line, filiform and other shapes; strip and column are preferred.

Its thickness can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μm -1000 μm , 1 mm-1000 mm, and more than 1 m, or any value in the range of 1 μm -100 μm . Its length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μm -1000 μm , 1 mm-1000 mm, and more than 1 m.

The air positive electrode collector 11, the air positive electrode lug 12 and the air positive electrode outlet circuit 13 can form a unit via the above methods and special technology.

(C-4) Metal fuel 24

This can be a sheet structure, powder structure, column structure or paste structure.

Its optional shapes include rectangle, circle, polygon and other shapes.

Its thickness can be any value larger than 0.01 nm. Based on the differences in usage and capacitance of the cell, its thickness can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μm -1000 μm , 1 mm-1000 mm, and more than 1 m, or any value in the range of 1 μm -100 μm . Its length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μm -1000 μm , 1 mm-1000 mm, and more than 1 m.

It is to be noted that descriptions for the spatial position of the metal fuel 24 are given in Figures 2 & 3, and Figures 22-29.

In Figures 2 & 3, the metal fuel 24 is located in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The left and right sides of the metal fuel 24 are adjacent to the membrane bag edge bonding part 32 of the membrane, membrane bag, bioactive membrane bag, bioactive

membrane 3, which means the two sides of the metal fuel 24 are either connected or unconnected to the membrane bag edge bonding part 3. There is some space, which is filled with electrolyte 5 and negative electrolyte 8. Here the above two sides are referred to as the “left side” and “right side” of the metal fuel 24.

The lower edge of the metal fuel 24 is adjacent to the bottom of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which means its lower edge is either connected or unconnected to the membrane bag edge bonding part 3. If unconnected, there is some space, which is filled with electrolyte 5 and negative electrolyte 8. Here the lower edge of the metal fuel 24 is referred to as the “lower side”.

The upper edge of the metal fuel 24 is adjacent to the membrane bag sealing device 31 of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which means the upper edge is either connected or unconnected to the membrane bag sealing device 31. If unconnected, there is some space, which is filled with electrolyte 5 and negative electrolyte 8. Here the upper edge of the metal fuel 24 is referred to as the “upper side”.

In Figures 2 & 3, the connection part between the metal fuel 24 and the electrolyte 5 is referred to as the “face” of the metal fuel 24, and the connection part between the metal fuel 24 and the core 6 is also referred to as the “face” of the metal fuel 24.

In Figures 22 & 23, the connection part between the metal fuel 24 and the electrolyte 5 is referred to as the “face” of the metal fuel 24. In this structure, both “faces” of the metal fuel 24 are connected to the electrolyte 5. In the example cell, there is a metal negative electrode 2 in its center, and an air positive electrode 1 on each of its two sides. In this case, the two air positive electrodes 1 share one metal negative electrode 2.

In Figures 24 & 25, the metal fuel 24 is adjacent to an inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The connection part between the metal fuel 24 and the inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, is referred to as the “face” of the metal fuel 24. And the connection part

between the metal fuel 24 and the core 6 is also referred to as the “face” of the metal fuel 24.

Being adjacent means the upper edge is either connected or unconnected to an inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. If unconnected, there is some space, which is filled with negative electrolyte fluid 8.

In Figures 26 & 27, the connection part between the metal fuel 24 and the electrolyte 5 is referred to as the “face” of the metal fuel 24. And the metal fuel 24 is adjacent to an inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The connection part between the metal fuel 24 and the inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is referred to as the “face” of the metal fuel 24.

Being adjacent means the upper edge is either connected or unconnected to an inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. If unconnected, there is some space, which is filled with negative electrolyte fluid 8.

In Figures 28 & 29, the metal fuel 24 is adjacent to an inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The connection part between the metal fuel 24 and the inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, is referred to as the “face” of the metal fuel 24. And the metal fuel 24 is adjacent to another inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The connection part between the metal fuel 24 and the inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is also referred to as the “face” of the metal fuel 24.

Being adjacent means the upper edge of the metal fuel 24 is either connected or unconnected to an inner face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. If unconnected, there is some space, which is filled with negative electrolyte fluid 8.

The metal fuel 24 can be connected to the metal negative current collector 21 in different ways, which is shown in the instructions for the metal negative current collector 21. Meanwhile, the metal fuel 24 is also tightly connected to the electrolyte 5, the core 6, the negative electrolyte 8 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. What should be noted here is that the connection between the metal fuel 24 and the metal negative current collector 21 does not affect the close connections of the metal fuel 24 with the electrolyte 5, the core 6, the electrolyte fluid 8 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The close connection between the metal fuel 24 and the electrolyte 5 can be achieved by first spraying electrode on the “face” of the metal fuel 24, then stove-drying, and finally pressing it using a press roller or other means. The interspaces are filled by the negative electrolyte fluid 8 after the metal fuel 24 has been tightly connected to the electrolyte 5, the core 6, the electrolyte 8 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The metal fuel 24 is the capacitance storage of the whole cell, and its effective weight and volume are the keys that determine the energy density of the cell.

The optional materials for the metal fuel 24 include the following: metallic elements in the periodic table such as Zn, Mg, Al, Fe, Pb, Na, K, Ga, etc, or alloys made from one or more of these metallic elements, such as magnesium alloy, lead calcium alloy, magnesium aluminum iron germanium manganese alloy, etc.; or alloys made from the combination of one or more of the metallic elements with a non-metallic element, such as carbon zinc alloy, carbon iron tin alloy, calcium magnesium silicon aluminum alloy, etc. Its materials can also be chosen from the shapes of the above metals, such as sheet, rod, particles, powder, foam, multi-hole, fiber, silk or from nano-metallic materials, nano-alloy materials and other materials made from the above metallic materials and nano-crystallized alloy materials, etc.

Based on the differences in materials and changes of actual needs and conditions for the metal fuel 24, a cell can be made in the shape of a block,

such as cuboids, cubes, round cakes, ellipsoid, cylinder and other shapes. Also, it can be made into a soft semi-solid cell or fluid dynamic cell.

Component 3 – membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

(A) Structure features: consisting of the membrane bag sealing device 31, membrane bag edge bonding part 32, separation membrane 33, septum 34, daub coating 35, and daub coating B 36, etc. In Figure 30, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is in the shape of a bag, one of whose edges is open. The opening edge is referred to as the “mouth” or “opening”; the sealed edge, opposite to the “mouth,” is referred to as the “bottom” of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The two other sealed edges are referred to as the “left part” and “right part” of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The inside of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, is equipped with all parts of the metal negative electrode 2, including the metal negative collector 21, metal negative lug 22, metal negative outlet circuit 23, electrolyte 5, core 6 and negative electrolyte fluid 8, which means the negative materials of the cell are installed inside the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. One outer face of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is connected to the high temperature-resistant, anti-freezing material for the siphon film 4, while the other face is connected to the shock-proof buffer layer 7. Both two outside faces can be connected to the high temperature-resistant anti-freezing material for the siphon film 4 at the same time, which is shown in Figures 22 and 23.

The membrane 33 and the septum 34 are produced into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in different sizes, thicknesses, and shapes with different materials, based on the changes of practical requirements and conditions. The membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 can be a single-layer membrane bag, a double-layer membrane bag or a multi-layer membrane bag,

or can consist of a single-layer membrane, double-layer membrane or multi-layer membrane.

The thicknesses of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 vary, based on various practical requirements and conditions. For example: mini-cells, such as pearl cells and button cells, or medium cells, such as mobile phone batteries and motorcycle batteries, large cells, such as vehicles batteries and batteries for transportation tools, and super-large cells, such as batteries used in power stations.

The materials, properties and structures of membranes for the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 differ, based on various practical requirements and conditions. For example, the optional membranes include some membranes of different materials, such as polyethylene membrane, polypropylene membrane, glass fiber separation membrane, PVC separation membrane, etc., or some membranes of different properties, such as organic membranes, inorganic membranes, fiber membrane, etc., or some biofilms, such as bioactive membranes, biological selective membranes, bacteria microbial biofilms, etc.

(B) Running features:

Separating the air positive electrode 1 from the metal negative electrode 2 to avoid direct connection, and to maintain the stable environment around the metal negative electrode 2.

Preventing water and other molecular substances on the side of the positive electrode from entering into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and preventing the molecular substances from overflowing and leaking from the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; however, ions can pass through freely; and avoiding the corrosion of the metal negative electrode 2 and the speeding-up of the cell's self-discharge.

(C) Technical features of each component:

(C-1) Membrane bag sealing device 31

The membrane bag sealing device 31, made in the shape of a clip, clamp, colloid or double-sided colloid, is an accessory device of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; after all the parts of the metal negative electrode 2, such as the metal negative current collector 21, the metal negative electrode lug 22, the metal negative electrode outlet circuit 23, the electrolyte 5, the core 6 and the negative electrolyte fluid 8, have been installed inside of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, the membrane bag sealing device 31 is used to seal the mouth of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, with the metal negative lug 22 exposed to the outside to conduct electricity. The space between the metal negative lug 22 and the membrane bag sealing device 31 is sealed as well. After the membrane bag sealing device 31 has sealed the mouth of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, the inner substances of the membrane bag are prevented from passing through the mouth of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, except electrical current.

When the cell is disposable, the optional materials of the membrane bag sealing device 31, used to directly seal the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, are the sealants, including epoxy, unsaturated polyester resin, phenolic resin, acrylic resin, polyvinyl chloride (PVC) resin, etc. Alternatively, the method of hot melting can be used for sealing.

When the cell is reusable, the membrane bag sealing device 31 can be in the form of a clip, clamp, or double-sided adhesive. After the inner negative materials inside the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 finish discharging, the membrane bag sealing device 31 can be opened to remove the old negative electrode and replace it with a new one for later use.

(C-2) Membrane bag edge bonding parts 32

The membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 seals the “bottom,” “left part” and “right part” of two or more pieces of the separation membrane 33, turning them into a bag. The membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 can also seal the “bottom,” “left part” and “right part” of at least one piece of the separation membrane 33 and at least one piece of the septum 34, turning them into a bag. The parts where the “bottom,” “left part” and “right part” of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 are sealed are referred to as the membrane bag edge bonding parts 32.

The “bottom,” “left part” and “right part” of the separation membrane 33 can be sealed by using sealant, glue and other means, or by means of hot melting, hot pressing and cold pressing; or the separation membrane 33 is directly turned into the shape of bag during the manufacturing process. Thus, the parts of the “bottom,” “left part” and “right part” of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 are referred to as the membrane bag edge bonding parts 32.

The methods of sealing the part of the “bottom,” “left part” and “right part” of the membrane 33 and the septum 34 are the same, including: using sealant, glue and other means, or using hot melting, hot pressing and cold pressing, or directly turning the membrane 33 and septum 34 into bags during the manufacturing process. The parts of the “bottom,” “left part” and “right part” of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 are referred to as the membrane bag edge bonding parts 32.

(C-3) Separation membrane 33

Its shape can be in the form of a flake, bag, rectangle, circle, polygon, triangle, etc.

Its thickness can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or any value in the range of 1 μ m-100 μ m. Its length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

The separation membrane 33 has a porous structure to let the ions of the negative electrolyte fluid 8 and the positive electrolyte fluid 9 pass through the separation membrane 33 freely. The separation membrane 33 is the main material to form the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Sealing the “bottom,” “left part” and “right part” of two or more pieces of the separation membrane 33:

The basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is made by sealing at least one piece of the separation membrane 33 and at least one piece of the septum 34 at the “bottom,” “left part” and “right part” of the separation membrane 33 and the septum 34.

The sizes, thicknesses, materials and shapes of the separation membrane 33 vary, based on practical requirements and conditions of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The materials, properties and structures of the membranes differ, based on various practical requirements and conditions of the separation membrane 33. For example, the optional membranes of different materials include polyethylene membranes, polypropylene membranes, glass fiber separation membranes, PVC separation membranes, etc., or some membranes of different properties, such as organic membranes, inorganic membranes, and fiber membranes, etc., or some biofilms, such as bioactive membranes, biological selective membranes, bacteria microbial biofilms, etc.

Choices for the separation membrane 33 include: polyethylene membrane, polypropylene membrane, glass fiber separation membrane, PVC separation membrane, etc.

Figures 31 and 32 show how the basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is formed by sealing the “bottom,” “left part” and “right part” of two pieces of the separation membrane 33. This type of membrane bag is referred to as a monolayer membrane bag.

Figures 36 and 37 show how the basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is formed by sealing the “bottom,” “left part” and “right part” of four pieces of the separation membrane 33. This type of membrane bag is referred to as a double-layer membrane bag.

Figures 45 and 46 show how the basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is formed by sealing the “bottom,” “left part” and “right part” of six pieces of the separation membrane 33. This type of membrane bag is referred to as a triple-layer membrane bag or a multilayer membrane bag.

(C-4) Septum 34

It can be flake-shaped, bag-shaped, rectangle-shaped, circle-shaped, polygon-shaped, triangle-shaped, etc.

Its thickness can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or between 1 μ m-100 μ m. Its length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

The septum 34 can prevent the substances both inside and outside the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 from passing through.

The septum 34 is the material to form the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is created by sealing the “bottom,” “left part” and “right part” of at least one piece of the separation membrane 33 and at least one piece of the septum 34.

The sizes, thicknesses, materials and shapes of the septum 34 vary, based on practical requirements and conditions of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The materials chosen for the septum 34 include four fluorine polyethylene, polyethylene, polypropylene, PVC, polyvinyl chloride, ABS, etc.

Figures 47 and 48 show the basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which is formed by sealing the “bottom,” “left part” and “right part” of one piece of the separation membrane 33 and one piece of the septum 34. This type of membrane bag is referred to as a single-layer and single-face membrane bag.

Figures 36 and 37 show the basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which is formed by sealing the “bottom,” “left part” and “right part” of two pieces of the separation membrane 33 and one piece of the septum 34. This type of membrane bag is referred to as a double-layer and single-face membrane bag.

Figures 45 and 46 show the basic structure of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which is formed by sealing the “bottom,” “left part” and “right part” of three pieces of the separation membrane 33 and one piece of the septum 34. This type of membrane bag is referred to as a triple-layer and single-face membrane bag or multi-layer and single-face membrane bag.

(C-5) Daub coating 35

This consists of some hydrophobic materials such as teflon, polyethylene, paraffin, lipid esters, vegetable oil, animal oil, oils, kerosene, diesel oil, petrol, vegetable oil, animal oil, cream, butter, cooking oils, etc.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then spray it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then fumigate it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then ion-coat it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then adopt the method of vac-ion coating to selectively spray it on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then adopt the method of high voltage ion spraying coating to selectively spray it on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then adopt the method of high-temperature/high-voltage ion spraying coating to selectively spray it on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then mechanically brush it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then artificially brush it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then soak it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then adopt the synthesis method to compound it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Other methods such as deposition and more can be adopted to melt one or two or more daub coatings 35 at a certain temperature (there is no need to melt if liquid), and then adopt other methods to apply it selectively on the corresponding parts of the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The most important point is that one or more of all the above methods can be used to achieve a tight, inseparable and seamless connection between the daub coatings 35 and the separation membrane 33, in order to form the globally unique and original (mixed) new structure and material of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The (mixed) new structure and material of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is a unique and effective solution to many universal problems in the present research and development of metal fuel cell.

The substances that are treated with all the above methods to be painted, coated, fumigated, brushed, and compounded on the separation membrane 33 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 are referred to as daub coatings 35.

Daub coatings 35 can also be some substances that possess an easy affinity with, and can be easily soaked with, the separation membrane 33.

Daub coatings 35 can be selectively applied to the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 by the various methods mentioned above.

The most important point is that the daub coatings 35, treated by the above methods, are connected to the separation membrane 33 to form an inseparable and seamless accessory structure and materials for the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

In Figure 33, the application of a daub coating 35 to the external surface of the monolayer membrane bag is referred to as external coating.

In Figure 34, the application of a daub coating 35 to the internal surface of the monolayer membrane bag is referred to as internal coating.

In Figure 35, the application of daub coating 35 to both external and internal surfaces of the monolayer membrane bag is referred to as external coating.

In Figures 33-35, it appears as if the daub coating 35 is attached to the separation membrane 33, but in fact it is immersed in the separation membrane 33 through the film holes.

In Figure 38, daub coating 35 is applied to the inter-part between the two layers of the separation membrane 33 of a double-layer membrane bag.

In Figure 41, daub coating 35 is applied to the inter-part of the two layers of a double-layer membrane bag, and to the internal and external parts of a double-layer membrane bag.

In Figure 42, daub coating 35 is applied to the inter-part of the two layers of a double-layer membrane bag and to the internal part of the double-layer membrane bag.

In Figure 43, daub coating 35 is applied to the inter-part of the two layers of a double-layer membrane bag, and to the external part of the double-layer membrane bag.

(C-6) Daub coating B 36

The structure of daub coating B 36 is the same as with daub coating 35. Their different assigned numbers indicate there can be one or more separation membrane layers on the membrane 33 of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and that the materials of these membrane layers can be identical or different, and that separation membrane coatings of different materials can be applied to different faces of the separation membrane 33 of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

In Figure 39, daub coating B 36 is applied to the inter-part between two layers of the separation membrane 33 of a double-layer membrane bag after daub coating 35 has already been applied to the same part.

In Figure 40, daub coating 35 is applied to the inter-part between the two layers of the separation membrane 33 of a double-layer membrane bag close to the inner part of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and daub coating B 36 is applied to the inter-part between the two layers of the separation membrane 33 of a double-layer membrane bag close to the outer part of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

In Figure 44, daub coating 35 is applied to the inter-part between the two layers of the separation membrane 33 of a double-layer membrane bag and daub coating B 36 is applied over the same part; and daub coating 35 is applied to the internal part and external part of the double-layer membrane.

Component 4 – High temperature-resistant anti-freezing material for siphon film 4

(A) Structure features:

Consisting of the siphon end of the siphon film 41 and the ion terminal of the siphon film 42.

Its shapes include sheet, strip, rectangle, bar, polygon, circle, oval, triangle, polygon, etc.

Its thickness can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m, or any value in the range of 1 μ m-100 μ m. Its length, width, diameter and limitation can be any value in the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, and more than 1 m.

Its cross-section shape can be a regular rectangle, as shown in Figures 13 and 53.

Its cross-section shape can also be waves, like the shapes of asbestos shingle and color steel shingle, as shown in Figures 54 and 55. This shape of the high temperature-resistant anti-freezing material for the siphon film 4 can increase

the indirect contact area between the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the air positive electrode 1.

In Figures 54 and 55, the high temperature-resistant anti-freezing material for the siphon film 4 appears in the shape of asbestos shingle, so the air positive electrode inlet device 14, the air electrode carrier 15, and the air electrode catalyst coating 17 on the air positive electrode 1, which is in contact with the high temperature-resistant anti-freezing material for the siphon film 4, all change their shapes into waves. In this case, the surface area of the air positive electrode 1 is increased. The membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the electrolyte 7 also turn their shapes into waves so that their surface area is increased.

Put the siphon end of the siphon film 41, part of the high temperature-resistant anti-freezing material for the siphon film 4, into the positive electrolyte storage chamber 91 which is filled with positive electrolyte fluid 9, and seal the joint of the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte storage chamber 91 with the positive electrolyte isolation device 92.

The thicknesses, sizes and shapes of the high temperature-resistant anti-freezing material for the siphon film 4 vary, based on practical requirements and conditions. The advantages of this structure include the following: maintaining the properties of the positive electrolyte 9 and existing in solid and semi-solid form; well connected to the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, as well as keeping the essential boundaries between the two, which greatly reduces and saves the usage amount of the positive electrolyte 9. As a result, the cost is decreased, the stable operation of the positive electrolyte fluid 9 is ensured, and the volume and weight of the cell are reduced.

The thicknesses, sizes and shapes of the high temperature-resistant anti-freezing material for the siphon film 4 vary, based on practical requirements and conditions, so as to adjust the supply quantity and supply temperature of the positive electrolyte fluid 9, and to ensure the stable magnitude of current so as to completely solve the problems of too-high temperature, inflation, and spontaneous combustion of the cell, and to ensure

its operating condition is as perfect with high or low temperatures as it is with normal temperatures.

The shape of the cross-section can be half-wavy, which means one side is wavy while the other is straight, as shown in Figures 56-59. This shape of the high temperature-resistant anti-freezing material for the siphon film 4 can increase the indirect contact area between the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the air positive electrode 1 as well.

In Figures 56 and 57, the shape of the high temperature-resistant anti-freezing material for the siphon film 4 is half-wavy, so the shapes of the air positive electrode air inlet device 14, the air electrode carrier 15, and the air electrode catalyst coating 17 on the air positive electrode 1, which are in contact with the wavy side of the high temperature-resistant anti-freezing material for the siphon film 4, all are changed into waves. In this case, the surface area of the air positive electrode 1 is increased.

In Figures 58 and 59, the shape of the high temperature-resistant anti-freezing material for the siphon film 4 is half-wavy, so the shapes of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the electrolyte 7, which are in contact with the wavy side of the high temperature-resistant anti-freezing material for the siphon film 4, all are turned into waves, in which case the surface area of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the electrolyte 7 is increased as well.

(B) Running features: The high temperature-resistant anti-freezing material for the siphon film 4 adsorbs the positive electrolyte fluid 9 from the positive electrolyte storage chamber 91 to the inter-space between the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the air positive electrode 1 by means of its capillary action, to provide ion channels as well as ion moving electrolyte to the positive and negative electrodes of the cell, in order to reduce the liquid pressure caused by the direct soaking of membrane bags in the positive electrolyte fluid 9.

The thicknesses, sizes and shapes of the high temperature-resistant anti-freezing material for the siphon film 4 vary, based on practical

requirements and conditions, so as to adjust the supply quantity and temperature of the positive electrolyte 9, and to ensure the stable magnitude of current, and to completely solve the problems of too-high temperature, inflation, and spontaneous combustion of the cell, and to ensure its operating condition is as perfect with high or low temperatures as it is with normal temperatures.

(C) Technical features of each component:

Siphon end of siphon film 41 and ion terminal of siphon film 42

Part of the high temperature-resistant anti-freezing material for the siphon film 4, soaked in positive electrolyte fluid 9 inside the positive electrolyte fluid storage chamber 91, is referred to as the siphon end of the siphon film 41. Another part, clipped between the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the air positive electrode 1 is referred to as the ion terminal of the siphon film 42.

The optional materials of the high temperature-resistant anti-freezing material for the siphon film 4 can be materials with adsorption capacity, capillary structure, such as polyethylene membrane, polypropylene membrane, glass fiber separation membrane, PVC separation membrane, as well as foam nanocarbon, absorbent cotton, linen, etc.

Moreover, the high temperature-resistant anti-freezing material for the siphon film 4 can replace the air electrode carrier 15 on the air positive electrode 1; see Figures 60-65. Thus, the catalyst 16 is required to be applied to the high temperature-resistant anti-freezing material for the siphon film 4 through various methods and techniques, including the chemical deposition method, vapor deposition method, ion plating method, electrolytic plating method, spraying method and more, as well as the precipitation method, electrolytic method, hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black restoring potassium permanganate method, manganese nitrate decomposition method, ion plating method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature/high pressure spraying ion plating method, high

temperature and high pressure spraying method, manual spraying method, etc.

The high temperature-resistant anti-freezing material for the siphon film 4 is also a type of porous absorptive material. Conductive agents also need to be applied to the high temperature-resistant anti-freezing material for the siphon film 4 to replace the air electrode carrier 15 on the air positive electrode 1, through the methods of spray and ion plating. Also, after conductive agents, catalyst 16 and binders are mixed together, their mixture can be applied to the high temperature-resistant anti-freezing material for the siphon film 4 by other methods to reduce the cost of the cell as well as simplify the structure of the cell. This kind of substitute structure to replace the air electrode carrier 15 is referred to as air electrode siphon catalytic conductive integration.

In Figure 63, the high temperature-resistant anti-freezing material for the siphon film 4, the conductive agent, the catalyst 16, and the air positive electrode inlet device 14 form the air positive electrode 1.

In Figure 64, the high temperature-resistant anti-freezing material for the siphon film 4, the conductive agent, the catalyst 16, the air electrode catalyst coating 17 and the air positive electrode inlet device 14 form the air positive electrode 1. The air electrode catalyst coating 17 is located between the high temperature-resistant anti-freezing material for the siphon film 4 and the air positive electrode inlet device 14, and the three are tightly connected to each other.

In Figure 65, the air electrode catalyst coating 17, the high temperature-resistant anti freezing material for the siphon film 4, the conductive, the catalyst 16, the air electrode catalyst coating 17 and the air positive electrode inlet device 14 constitute the air positive electrode 1; the air electrode catalyst coating 17 lies on the two sides of the high temperature-resistant anti freezing material for the siphon film 4; the air electrode catalyst coating 17 is between the high temperature-resistant anti freezing material for the siphon film 4 and the air positive electrode inlet device 14, and these three are closely linked with each other.

Net structure and fibrillar materials are preferred for the air electrode positive collector 11 to export the current integrated by the air electrode

siphon catalytic and conductive collector constituted by the high temperature-resistant anti freezing material for the siphon film 4, conductive agents, and catalyst 16.

It should be noted that: The conductive agents and catalyst 16 are usually applied to the ion terminal of the siphon film 42, instead of the entire high temperature-resistant anti freezing material for the siphon film 4. Its application to the entire high temperature-resistant anti freezing material for the siphon film 4 is passable and its application to the ion terminal of the siphon film 42 is preferred.

Component 5 – Electrolyte 5

(A) Structural characteristics: It can be a solid electrolyte, polymer electrolyte or semi-solid electrolyte.

1) Solid electrolyte: Materials are chosen from β -A1203, zircon alba, ceramics, etc.;

2) Polymer electrolyte: Materials are chosen from PEO, PVDF, PMMA or PAN.

3) Semi-solid electrolyte: Materials are chosen from oligosaccharides, polysaccharides, lipids, oils or esters produced in an organic solvent under the alkalinity environment by reaction with carbon materials and magnetic materials; or chosen from oligosaccharides, polysaccharides, lipids, oils or esters produced in an organic solvent under the alkalinity environment by reaction with magnetic materials; or chosen from oligosaccharides, polysaccharides, lipids, oils or esters produced in an organic solvent under the alkalinity environment by reaction with conductive agent and magnetic materials.

Oligosaccharides such as isomaltooligosaccharide, oligosaccharide, dextrin, gentiobiose glucose, etc.

Polysaccharides such as starch, glycogen, cellulose, agar, chitin, etc.

Lipids such as triglyceride, phospholipid, wax, terpene, etc.

Oils such as vegetable oils and animal oils; for example, soybean oil, sesame oil, peanut oil, sheep oil, butter, fish oil, chicken oil, kerosene, gasoline, diesel, etc.

Esters such as methyl formate, ethyl acetate, sodium nitrate, sodium stearate, etc.

Organic solvents such as dimethyl sulfoxide, carbonic ester, methanol, ethanol, etc.

Carbon materials such as activated carbon, graphite, etc.

Magnetic materials such as FeCr(Co), FeCrMo, FeAlC, magnet, etc.

Alkali such as sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium bicarbonate, potassium bicarbonate, etc.

Conductive agents such as graphite (ks-6), carbon black (KB), acetylene black (AB), metal fiber, metal powder, vapor-grown carbon fiber (VGCF), carbon nano-tube CNTs, etc.

For example, the following formula can be used to produce the electrolyte 5:

Dextrin: Methanol: Magnet: Butter: Sodium hydroxide = X:Y:Z:W:U...etc.
(each of them greater than 0)

The formula and the proportion of electrolyte

Dextrin (g)	Methanol (g)	Magnet (g)	Butter (g)	Sodium hydroxide (g)
5	50	27	3	6
7	70	40	5	8
8	60	30	6	7
10	100	60	10	12
1	9	5	1	2
Dextrin (g)	Methanol (g)	Magnet (g)	Butter (g)	Potassium hydroxide (g)
5	50	27	3	6

7	70	40	5	8
8	60	30	6	7
10	100	60	10	12
1	9	5	1	2
Starch (g)	Methanol (g)	Magnet (g)	Butter (g)	Sodium hydroxide (g)
5	50	27	3	6
7	70	40	5	8
8	60	30	6	7
10	100	60	10	12
1	9	5	1	2
Starch (g)	Methanol (g)	Magnet (g)	Butter (g)	Potassium hydroxide (g)
5	50	27	3	6
7	70	40	5	8
8	60	30	6	7
10	100	60	10	12
1	9	5	1	2

Inside the membrane bag, tightly bonded with the metal fuel 24, and with the inner part of the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3.

Out of the membrane bag, tightly bonded with the external part of the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3 as well as with the high temperature-resistant anti freezing material for the siphon film 4.

(B) Operation characteristics: providing an ion channel for the positive electrode and negative electrode of the battery, and providing an electrolyte fluid for the ionic run of the battery's negative electrode.

No electrolyte 5 is passable in some battery structures, for instance, as shown in Figure 28 and 29.

Component 6 – Core 6

Shape: flake-like, similar in shape to the metal fuel 24;

Its thickness can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, greater than 1 m or a value within the range of 1 μ m-100 μ m. Its length, width, diameter, and limit can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, or greater than 1 m.

The core 6 features adsorption properties, so that materials with adsorption capacity can be chosen, for instance, from membranes such as polyethylene membrane, polypropylene membrane, glass fiber membrane, PVC membrane and more, as well as from carbon foam, cotton, flax, etc. It is positioned inside the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3, with adsorbed negative electrolyte fluid 8; with its one side tightly connected to the metal fuel 24 and its other side to the inner part of the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3, it stores and adsorbs negative electrolyte fluid for the negative electrode to maintain a tight connection between the negative electrode and the electrolyte. After the collision and vibration of the battery, it can also play a buffering role and keep the internal components of the battery tightly combined. Meanwhile, the negative electrolyte fluid 8 penetrates into the core 6 to meet the requirements of the storage tank, which can be decided according to the actual requirements.

The advantage of this structure is that it can maintain the properties of the negative electrolyte fluid 8, existing in solid or semi-solid form, having very good fusion connection to the electrolyte 5, and at the same time, maintaining the basic boundaries with the electrolyte 5.

In some battery structures, there is no core 6, for example, as shown in Figure 22, Figure 23, Figure 26, Figure 27, Figure 28 and Figure 29.

Component 7 – Shockproof buffer layer 7

Shape: flake-like, similar in shape to the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3.

Its thickness can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, greater than 1 m, or a value within the range of 1 μ m-100 μ m. Its length, width, diameter, and limit can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm or greater than 1 m.

It features a certain degree of softness and flexibility. Its materials can be chosen, for instance, from rubber, sponge, shock absorbing rubber, foam board, spring, etc. Positioned between the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3 and the battery casing and supporting/fixing device, it can maintain a tight connection between various components of the battery. When the battery vibrates, it keeps various internal components of the battery tightly combined, so as to prevent sudden blackout or current changes. In some battery structures, the shockproof buffer layer 7 can be chosen, for example, as shown in Figure 22 and Figure 23.

Component 8 – Negative electrolyte fluid 8

Negative electrolyte 8: providing an ion channel for the positive and negative electrodes of the battery, and providing the electrolyte fluid for the operation of ion of the battery's negative electrode. Positioned inside the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3, and partially stored in the core 6. It has no chemical reaction with the metal fuel 24, and can also protect it from being corroded by other materials. It is crucial in the process of prevention and protection. In some battery structures, the negative electrolyte fluid 8 may not be required; for example, when the negative fuel is surrounded by the ionic solid electrolyte, the electrolyte fluid 8 is not required or can be used accordingly, which shall be determined and designed according to the actual needs and conditions of the battery.

Taking metal aluminum as an example: The negative electrolyte fluid 8 can be: methanol sodium hydroxide solution, methanol potassium hydroxide solution, methanol lithium hydroxide solution, ethanol sodium hydroxide solution, ethanol potassium hydroxide solution, ethanol lithium hydroxide solution, etc.

For example, the concentration of electrolyte fluid in the chart:

Methanol sodium hydroxide solution (%)	Methanol potassium hydroxide solution (%)	Methanol lithium hydroxide solution (%)
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
Ethanol sodium hydroxide solution (%)	Ethanol potassium hydroxide solution (%)	Ethanol lithium hydroxide solution (%)
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

10	10	10
11	11	11
12	12	12
13	13	13
14	14	14

The combination of the electrolyte fluid formula with the metal fuel 24, the core 6 and the electrolyte 5 is the exclusive invention and innovation of our company, in which the core 6 is not necessary but it is better and more advantageous to have a core 6, as well as the electrolyte 5.

The negative electrolyte fluid 8 can be an alkaline electrolyte fluid, an acidic electrolyte fluid, a neutral electrolyte fluid, an organic electrolyte fluid, etc.

Alkaline electrolyte fluid: a negative electrolyte fluid 8 of a certain concentration which can be prepared from a combination of sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium bicarbonate, calcium hydroxide, aluminum hydroxide, zinc hydroxide, sodium methoxide, potassium methoxide and other inorganic strong alkali or weak base or organic base with organic solvents such as ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester, etc. Acid electrolyte fluid: a negative electrolyte fluid 8 of a certain concentration which can be prepared from a combination of formic acid, acetic acid and other organic or inorganic weak acids with organic solvents such as ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester, etc.

Neutral electrolyte: a negative electrolyte fluid 8 of a certain concentration which can be prepared from a combination of sodium chloride, sodium fluoride, sodium iodide, potassium chloride, potassium fluoride, potassium iodide and some salts with organic solvents such as ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester, etc.

Metal halide and quaternary ammonium salt can be used to prepare the negative electrolyte fluid 8 of a certain concentration. Metal halide can be, for

example, aluminum chloride, ferric chloride, zinc chloride, sodium chloride, sodium fluoride, sodium iodide, potassium chloride, fluoride potassium, potassium iodide, etc.

The choice of negative electrolyte 8 should be decided and designed based on the actual requirements and conditions of the battery.

Component 9 – Positive electrolyte fluid 9

Positive electrolyte fluid 9: providing an ion channel for the positive and negative electrodes of the battery, and providing the positive electrode of the battery with an electrolyte fluid for its ionic operation. It is positioned in the positive electrolyte storage chamber 91 and the high temperature-resistant anti freezing material for the siphon film 4.

The positive electrolyte fluid 9 can be an alkaline electrolyte fluid, an acidic electrolyte fluid, a neutral electrolyte fluid, as well as an organic electrolyte fluid.

Alkaline electrolyte: a positive electrolyte fluid 9 of a certain concentration which can be prepared from a combination of inorganic strong alkali or weak base organic bases such as sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium bicarbonate, calcium hydroxide, aluminum hydroxide, sodium methoxide, potassium methoxide, etc. with organic solvents such as ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester, etc.

Acid electrolyte fluid: a positive electrolyte fluid 9 of a certain concentration which can be prepared from a combination of organic or inorganic weak acids such as formic acid, acetic acid, etc. with organic solvents such as ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester, etc.

Neutral electrolyte: a positive electrolyte fluid 9 of a certain concentration which can be prepared from a combination of salts such as sodium chloride, sodium fluoride, sodium iodide, potassium chloride, potassium fluoride, potassium iodide, etc. with organic solvents such as ethanol, methanol, acetonitrile, dimethyl sulfoxide, carbonic ester, etc.

Aluminum chloride and quaternary ammonium salt can be used to prepare positive electrolyte fluid 9 of a certain concentration.

The choice of positive electrolyte fluid 9 should be decided and designed based on the actual requirements and conditions of the battery.

In the existing metal-air fuel, the above-mentioned positive electrolyte fluid 9 can be only used in the air zinc battery, such as in a micro power disposable metal-air zinc battery, but high-power series/parallel metal-air fuel cells in particular, when used in the experiment, fail to avoid universal difficulties such as self-discharge, overheating, expansion, spontaneous combustion, etc. However, our method of combining the positive electrolyte fluid 9 with the high temperature-resistant anti-freezing material for the siphon film 4 can effectively solve the above-mentioned unavoidable and universal problems.

The innovative structure to combine the positive electrolyte fluid 9 with the high temperature-resistant anti-freezing material for the siphon film 4 has the advantages of maintaining the liquid property of the positive electrolyte fluid 9, which exists in a solid or a semi-solid form, and being well connected to the air positive electrode 1, the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3, and, at the same time, maintaining the basic boundaries with the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3, which not only greatly decreases and saves the usage amount of the positive electrolyte fluid 9 and reduces the cost, but also stabilizes the running condition of the electrolyte fluid and reduces the volume and the weight of the battery.

More important, it effectively controls and adjusts the supply quantity of positive electrolyte fluid 9, and simultaneously controls and regulates the operating temperature of the battery and the stability of the current. It also completely solves the problems of overheating, expansion and spontaneous combustion of the battery with the help of the membrane, membrane bag, bioactive membrane bag and bioactive membrane 3, and it ensures that its operating condition is as perfect with high or low temperatures as it is with normal temperatures.

Positive electrolyte fluid storage chamber 91: a hollow cavity in the shape of a cuboid, cube, cylinder, sphere or other shape for storing the positive electrolyte fluid 9, with at least two openings. One of these two openings is the inlet opening of the siphon end of the siphon film 41, which is used to adsorb

the positive electrolyte fluid 9 and then to transport it to the ion end of the siphon membrane; and the other opening is an opening for the supply of positive electrolyte fluid 9.

The positive electrode fluid storage chamber 91 can be connected with the battery, so that it can share the battery shell and the supporting/fixing device 10 with the other components of the battery, and it can also be separated from the battery; alternatively, two or more cells share one positive electrolyte fluid storage chamber 91.

In order to prevent a leakage of positive electrode fluid 9 from the two openings in the positive electrolyte fluid storage chamber 91, some adsorbing materials can be filled in the positive electrode fluid storage chamber 91 to secure the positive electrode fluid 9 to the adsorbing materials, which can be chosen from sponge, absorbent cotton, foam carbon nanomaterials, glass fiber, etc., and materials such as ABS, polyethylene, polypropylene, PVC, alloy, metals, etc.

Positive electrolyte fluid isolation device 92: The positive electrode fluid storage chamber 91 is provided with an inlet, into which the siphon end of the siphon film can enter; in order to prevent the electrolyte fluid from leaking from this opening as well as from the siphon end of the siphon film 41, the positive electrode fluid storage chamber 91 features a positive electrode electrolyte isolation device, which will not affect the adsorption capacity of the siphon end of the siphon film; as a sealing device, it can use a rubber ring, a PTFE sealing rubber ring, graphite sealing mud, etc.

Positive electrolyte fluid storage chamber access channel 93: an opening on the positive electrolyte fluid storage chamber 91, used for supplementing the positive electrode electrolyte fluid, and also used for discharging positive electrolyte fluid 9. A switch is provided on the positive electrolyte fluid storage chamber access channel 93, which is on when supplementing the positive electrode electrolyte fluid, and off when finished. It is the same with discharging the positive electrolyte fluid 9.

Component 10 – Battery shell and supporting/fixing device 10

Combining the various components of the battery tightly and effectively, and maintaining the environmental stability of each component of the battery, so as to ensure the stable and effective discharge of the cell.

Each part of the cell can be secured and shaped by the battery shell and supporting/fixing device 10 by means of spraying, welding, adhesive agents and binding, etc.

The principle for the assembly and installation of a cell is that a closer attachment and less air are better for the current stability, high power and savings and reduction in consumption. Its assembly and installation, completed using full automation in a vacuum, are considered the most advantageous approach.

It can be opened so as to facilitate the replacement of the metal negative electrode 2 and maintenance of a cell; alternatively, it can also be disposable, in which case it cannot be opened.

Its materials can be chosen, for example, from ABS, polyethylene, polypropylene, polyvinyl chloride, plastic steel, alloys, metals, etc.

Component 11 – Shell of metal-air fuel cell or battery pack and ventilation device

A: Air inlet and outlet device of a single cell or a series-parallel battery pack without a shell:

It can be applied to the power supply of a family room, a residential area, a power plant, or a large power plant.

A battery pack of single cells 102, not limited to one piece of single cells 102, is combined in a series-parallel format and is placed in a family room, a residential building, a power plant, or a large power plant.

As shown in Figure 91: six sets of Monocell 102 are connected in series to form a battery pack, which is installed in a plant 105. An air inlet and outlet device 101 is arranged on the window, air inlet and door of the plant 105. The air inlet and outlet device 101 is an air filtering device which features an air

filter element, an air purifier, an air filter membrane, etc. The air inlet and outlet device 101 can filter impurities, dust and other solid substances in the air, in order to prevent impurities, dust and other solid substances in the air from entering the plant 105, while the air inside and outside the plant 105 can freely pass through the air inlet and outlet device 101. The free entry and exit of air can provide sufficient oxygen for the normal operation of a single cell in the battery pack in the plant 105.

B: Single cell or series-parallel battery pack with shell:

According to the actual demand and changing conditions, the air inlet and outlet device 101 on the shell is used to effectively control, as well as close and open the carbon dioxide inlet and outlet channels in a single cell or in a high power series-parallel battery pack. The main purpose of closing and opening the carbon dioxide inlet and outlet channels is to allow the carbon dioxide to freely enter and exit the air inlet and outlet device 101 of the shell in a battery or the battery pack when the battery works under natural air conditions.

At this point, a small amount of carbon dioxide has few effects on a working battery or battery pack, but if it is not used, in the long term, if carbon dioxide passes freely through the shell of the air inlet and outlet device 101 in a battery or battery pack which has not working for a long period of time, the longtime exposure between carbon dioxide and battery electrolyte fluid will cause electrolyte fluid damage, such as curing, neutralization, carbonation, etc. Therefore, we can solve this problem by closing and opening up the carbon dioxide inlet and outlet channels, that is, when the battery is working, allowing the carbon dioxide to pass freely in the shell of a battery or battery pack; when the battery is not operated for a long time, the air inlet and outlet device 101 on the shell of a battery or battery pack is completely closed, which will effectively avoid the damage caused to the electrolyte fluid in a battery or battery pack by carbon dioxide (such as curing, neutralization, carbonation and so on).

This technology can be applied to: electric vehicles, street lamp power supply, cameras, video cameras, personal desktop lighting, table lamps, mobile phone charging devices, marine lighthouses, night lights, etc.

The technique is not suitable for a single cell or for high power series battery stacks that work for long periods without stopping. The inlet and outlet of this battery or battery pack serve a dual purpose, that is, the inlet and outlet are the same channel with few distinctions.

Figure 84, Figure 85, Figure 89, and Figure 86 show a battery pack consisting of three single cells 102. The battery pack is arranged in the shell 103, the “front” and the “back” of which are equipped with an air inlet and outlet device 101 which can open and close automatically according to the actual demand and changing conditions.

As is mentioned above, the air inlet and outlet device 101, which can turn on and off automatically based on changing actual demand and conditions, is composed of three parts: the filter device 1011, the switch device 1012 and the switch control device 1013. The operation of the three parts is described below.

1) When the battery is in operation, the switch device 1012 is opened under the control and action of the switch control device 1013, and the outside air is first filtered through the filter device 1011, before entering the battery or the battery pack in the shell 103 through an open switch device 1012. At the same time, the air in the shell 103 passes through the switch device 1012, and then passes through the filter device 1011 to the outside air.

2) When the battery is idle for a long period of time, the switch device 1012 is closed under the control and action of the switch control device 1013, and the outside air cannot enter into the battery or the battery pack in the shell 103, while the air inside the shell 103 cannot be exported outside.

Thus, on the one hand, the free entry and exit of air can provide sufficient oxygen for the normal operation of a single cell in the battery pack; on the other hand, it can effectively avoid the damage caused by carbon dioxide to the electrolyte fluid in the battery or battery pack (such as solidification, neutralization, carbonation, etc.)

The filter device 1011, as an air filtering device, can filter solid substances such as impurities, dust and more from the air to prevent them from entering into the battery pack.

The switch device 1012, as a channel on the air inlet and outlet device 101, can be automatically opened and closed according to actual demand and changing conditions, which is performed under the control and action of the switch control device 1013.

The switch control device 1013, as a control and power device of the switch device 1012, controls the opening and closing of the switch device 1012 based on the changing actual requirements and conditions. The power of the switch control device 1013 is derived from the power of a single battery or battery pack, and can also be derived from the external power or the manual power.

Figure 84, showing the front view of an air fuel cell battery pack, indicates the orientations of the battery pack: "front," "left," "right," "up," and "down."

In Figure 84, the "front" of the battery pack features an air inlet and outlet device 101 which can turn on and off automatically according to actual requirements and conditions.

In Figure 84, the "up" of the shell 103 can be opened to facilitate the installation of a single cell in the shell 103.

Figure 85, showing a rear view of the air fuel cell stack, indicates the orientations "back," "left," "right," "up," and "down" of the battery pack.

In Figure 85, the "back" of the battery pack features an air inlet and outlet device 101 which can turn on and off automatically according to actual requirements and conditions.

Figure 89, showing a sectional view of Figures 84 and 85 in the A-A direction, indicates the orientations of the battery pack, "front," "back," "left," and "right."

In Figure 89, the "front" of the battery pack features an air inlet and outlet device 101 which can turn on and off automatically according to actual requirements and conditions.

The "back" of the battery pack also features an air inlet and outlet device 101 which can turn on and off automatically according to actual requirements and conditions. Although the battery pack, as shown in Figure 9, is composed of

three single cells, in practice, according to the actual needs and conditions, the battery pack is not limited to the composition of the three single cells.

Figure 86, showing a sectional view of Figure 89 in the direction of the B-B, indicates the orientation of the battery pack, "up," "down," "left," and "right." In Figure 86, the battery pack is composed of three single cells connected in parallel, and the three single batteries are fixed on the inner bottom surface of the battery shell. The battery pack, as shown in Figure 86, is composed of three single cells. In practice, according to the actual needs and conditions, the battery pack is not limited to the composition of the three single cells.

In Figure 87, Figure 89, Figure 90, and Figure 86, three pieces of monocr cell 102 are connected in parallel to form a battery pack, which is arranged in the shell 103; and the "front" and "back" of the shell 103 feature an air inlet and outlet device 101 which can automatically turn on and off based on the changing actual demand and conditions.

C: A monocr cell or battery pack with a shell effectively preventing and controlling the entry and exit of carbon dioxide

Based on actual demand and changing conditions, the shell 103 of the battery or the battery pack features an air inlet and outlet device 101 which is provided with a carbon dioxide isolation film that can effectively prevent carbon dioxide from passing through. The carbon dioxide isolation film can prevent carbon dioxide in the air from entering into the shell 103 through the air inlet and outlet device 101 while the other gas components in the air are unrestricted, which can effectively prevent damage caused by carbon dioxide to the electrolyte fluid in the battery or the battery pack (such as solidification, neutralization, carbonation, etc), in particular, to a monocr cell or a series-parallel large power battery stack used for non-stop long-term work, such as in communication data towers, mine tunnel lighting, tunnel lighting, mobile phones, tablet PCs, notebook computers, field portable power supply, outdoor billboards, etc.

In Figure 84, Figure 85, Figure 92, and Figure 86, a battery pack of three monocr cells 102 in parallel is arranged in the shell 103, and the front and the back of the shell 103 feature an air inlet and outlet device 101 which can effectively prevent carbon dioxide from passing freely.

The air inlet and outlet device 101 effectively preventing carbon dioxide from passing freely consists of the following two parts: a filter device 1011 and a carbon dioxide membrane 1014. Their functions are described below.

1) When the battery is operating, the outside air is first filtered through the filter device 1011, and then enters the battery or the battery pack in the shell 103 through the carbon dioxide separation membrane 1014. At the same time, carbon dioxide in the air is effectively stopped outside the shell 103, while the other gases in the air can pass through or exit the shell 103 freely without any restrictions. At the same time, the air inside the shell 103 passes through the carbon dioxide separation membrane 1014 and then through the filter device 1011, and then enter into the air outside.

2) When the battery is not operating and is idle for a long period of time, the carbon dioxide in the air outside the shell 103 cannot enter into the shell 103 due to the effective prevention of the carbon dioxide separation membrane 1014 on the air inlet and outlet device 101, which can effectively and thoroughly prevent damage caused by carbon dioxide to the electrolyte fluid in the battery or battery pack (such as solidification, neutralization, carbonation, etc.).

The filter device 1011 is positioned in front of the carbon dioxide separation membrane 1014.

The filter device 1011, as an air filtering device, can filter solid substances in the air, such as impurities and dust, to prevent them from entering into a battery pack. The carbon dioxide separation membrane 1014, as a selective membrane, can effectively prevent carbon dioxide in the air from passing through, while the other gases in the air are not restricted and can freely enter and exit the shell 103.

Figure 84, showing a front view of the air fuel cell battery pack, indicates the orientations of the battery pack: "front," "left," "right," "up," and "down."

In Figure 84, the "front" of the battery pack is shown featuring an air inlet and outlet device 101 which can effectively prevent carbon dioxide from passing through freely.

Figure 85, showing a rear view of the air fuel cell stack, indicates the orientations of the air fuel cell stack: "back," "left," "right," "up," and "down."

In Figure 85, the "back" of the battery pack is also shown featuring an air inlet and outlet device 101 which can effectively prevent carbon dioxide from passing through freely.

Figure 92, showing a sectional view of Figure 84 and Figure 85 in the A-A direction, indicates the orientations of the battery pack: "front," "back," "left," and "right."

In Figure 89, the "front" of the battery pack is shown featuring an air inlet and outlet device 101 which can effectively prevent carbon dioxide from passing through freely.

The "back" of the battery pack is also shown featuring an air and outlet device 101 which can effectively prevent carbon dioxide from passing freely.

Figure 86, showing a sectional view of Figure 89 in the direction of B-B, indicates the orientations of the battery pack: "up," "down," "left," and "right." In Figure 86, the battery pack is composed of three single cells connected in parallel, and the three single batteries are fixed on the inner bottom surface of the battery pack's shell. The battery pack is composed of three single cells, as shown in Figure 86. In practice, based on the actual needs and conditions, the battery pack is not limited to the composition of the three single cells.

As shown in Figure 87, Figure 89, Figure 93, and Figure 86, the battery pack composed of three pieces of monocrystal 102 connected in parallel is arranged in the shell 103, and both the "front" and the "back" of the shell 103 feature three air inlet and outlet devices 101 which can effectively prevent carbon dioxide from passing through the air inlet and outlet device 101 freely. The battery pack is composed of three single cells, as shown in the above figures. In practice, according to the actual needs and conditions, the battery pack is not limited to the composition of three single cells.

D: A monocell or battery pack with pure or solid oxygen as a positive electrode material and with a shell but without an inlet or outlet device

Based on the actual needs and conditions, pure oxygen, such as solid oxygen and liquid oxygen, can be effectively controlled and deployed as a monocell or battery pack's positive electrode materials.

For example, it can be used in places with thin air or lack of oxygen or no oxygen, such as the atmosphere, outer space, the deep sea, or underwater and subspace, and it can also be used in aerobic normal air environment.

Pure oxygen, including, but not limited to, liquid oxygen, solid oxygen, gaseous oxygen, gaseous compressed oxygen, etc.

Figure 94 and Figure 86 describe a metal fuel (bio) cell with pure oxygen as a positive electrode material.

The battery or battery pack is divided into three parts; one part is the storage part of the positive electrode material, one part is a power generating part, and the third is the connecting part of the storage part and the power generating part.

The storage part of the positive electrode material is composed of a pure oxygen storage tank 106, an aerator 1062, an oxygen supply device 1063 and pure oxygen 1061.

The power generation part is composed of the shell 103, the monocell 102, and a pure oxygen device 1016.

The connecting part of the storage part and the power generating part are composed of a voltage regulating switch device 107.

In the storage part of the positive electrode material: A pure oxygen storage tank 106 is used to store pure oxygen 1061, and pure oxygen 1061 is added to the pure oxygen storage tank 106 through the aerator 1062, and the pure oxygen in the pure oxygen storage tank 106 is supplied to the power generation part via the oxygen supply device 1063. The positive material is used as a power generating part to participate in power generation.

In the power generation part: A battery pack, composed of three groups of single cells connected in series/parallel, is mounted in the shell 103, which is configured with a pure oxygen supply device 1016; and the pure oxygen supply device 1016 is connected to the oxygen supply device 1063 on the pure oxygen storage tank via the voltage regulating switch device 107, and transports pure oxygen 1061 from the pure oxygen storage tank 106 to the power generating part.

The voltage regulating switch device 107 connects the storage part and the power generating part, and transports pure oxygen 1061 from the storage part to the power generation part through pressure regulation based on the actual demand and change in conditions. The positive material is used as a power generating part to participate in power generation.

The pure oxygen storage tank 106 can be set in a proper and relevant position based on actual requirements and conditions. Under standard conditions, the shape, size and volume of the pure oxygen storage tank 106 is designed based on varying actual needs and conditions, such as the different designs of a pure oxygen storage tank 106 in a car versus a mobile phone.

The operation of the above three parts:

1. Based on changes in actual needs and conditions, the pure oxygen supply device 1016 on the shell 103 is connected to the oxygen supply device 1063 on the pure oxygen storage tank 106 by means of the voltage regulating switch device 107. At this time, the voltage regulating switch device 107 is in a completely closed state;
2. Then, according to changes in actual needs and conditions, pure oxygen 1061 is added to the pure oxygen storage tank 106 through the aerator 1062.
3. According to changes in actual needs and conditions, the voltage regulating switch device 107 is switched to ON to adjust the relevant pressure of oxygen by means of the pure oxygen supply device 1016 and to provide oxygen to a single cell or battery pack. The positive material is used as a power generating part to participate in power generation.

Figure 86, showing a sectional view of Figure 94 in the direction of B-B, indicates the orientations of the battery pack: "up," "down," "left" and "right." In Figure 86, the battery pack is composed of three single cells in parallel, and the three single batteries are fixed on the inner bottom surface of the battery shell. As shown in Figure 86, the battery pack is composed of three monocells. In practice, based on actual needs and conditions, the battery pack is not limited to the composition of the three monocells.

In Figure 86, the "up" part of the shell 103 can be opened to facilitate the installation of a monocell to the shell 103.

E: A metal fuel bio cell with a shell that can restrict the entry of other gases while allowing oxygen only to enter a monocell or battery pack with oxygen selective membranes

The battery can be provided with a pure oxygen air inlet outside the battery shell, and an oxygen usage condition tester is arranged inside the shell.

For example: for residential power plants, large power plants, household battery packs, special high-power power demands, other tools, etc.

In Figure 95, a battery pack is composed of three monocells arranged in series/parallel. The battery pack is arranged in the shell 103, and the shell is configured with a pure oxygen inlet device 1017 and an oxygen usage condition tester 1018.

The pure oxygen inlet device 1017, as a switching device, can add pure oxygen to the shell 103 through the pure oxygen inlet device 1017. As the positive material of a single cell, it participates in power generation.

The oxygen usage condition tester 1018 is a test instrument for the oxygen pressure, temperature, concentration and other parameters in the shell 103, which is used to detect the dynamic state of oxygen in the shell 103.

In Figure 95, a battery pack is composed of three monocells arranged in series/parallel. The battery pack is arranged in the shell 103, and the shell is configured with an air inlet and outlet device 101 which can restrict the entry of other gases while allowing only oxygen to enter.

The air inlet and outlet device 101, which can effectively prevent carbon dioxide from passing freely, consists of the following two parts: a filter device 1011 and an oxygen selective membrane 1019, which function as follows:

The outside air is first filtered through the filter device 1011, and then enters the battery or the battery pack inside the shell 103 through the oxygen selective membrane 1019. The oxygen selective membrane 1019 can effectively stop the other gases and allow only oxygen to enter. As the positive material of the battery or battery pack, it participates in power generation. It effectively solves the problem of damage caused by carbon dioxide to the electrolyte fluid in a battery or battery pack (such as curing, neutralization, carbonation, etc.).

F. A metal fuel battery pack of positive and negative electrode integration and separation with a shell

See Figure 97 for its specific structure. In Figure 97, the side surface of the shell 103 is configured with an air inlet and outlet device 101, and the bottom surface of the shell 103 is configured with a positive electrode electrolyte fluid storage chamber 91 for storing positive electrode electrolyte fluid 9.

The positive electrode storage chamber 91, located at the bottom of the shell, is made into one piece with its shell, and the whole battery pack uses the same positive electrode electrolyte fluid storage chamber 91; the positive electrolyte storage chamber 91 is configured with multiple openings, each of which corresponds to at least one high temperature-resistant anti freezing material for the siphon film 4. In Figure 97, the positive electrolyte fluid storage chamber 91 is configured with 8 openings corresponding to 8 high temperature-resistant anti-freezing materials for the siphon film 4. The positive electrode fluid 9 is transported to or discharged from the positive electrolyte fluid storage chamber outlet and inlet channel 93.

(F-1) The basic structure of the positive electrode integration:

A group or multiple groups of air positive electrodes 1 and a part of the ion terminal of siphon films 42 on the high temperature-resistant anti freezing materials for the siphon film 4 are tightly glued together to form a positive electrode unit; and a part of the siphon end of the siphon film 41 which is used

in the high temperature-resistant anti-freezing material for the siphon film 4 in the positive electrode unit is inserted into the corresponding opening of the positive electrolyte fluid storage chamber 91 so that the electrolyte fluid in the positive electrolyte fluid storage chamber 91 is adsorbed to the whole high temperature-resistant anti-freezing material for the siphon film 4 and is supplied to the air positive electrode 1 by diffusion. A part of the siphon end of the siphon film 41 on the high temperature anti-freezing material for the siphon film 4 in the positive unit is inserted into the positive electrolyte fluid chamber 91, while the positive unit is fixed on the shell 103 by means of an adhesive agent or screws, or by directly embedding a single cell into a card slot on the shell or by other means.

Based on changes in actual needs and conditions, a group or multiple groups of positive electrode units are formed into the positive electrode integration in a corresponding sequence and arrangement; a corresponding spatial distance between the positive electrode units is helpful to facilitate the flow and diffusion of air and pure oxygen. The air positive electrode outlet circuits 13 of each positive electrode unit are connected to each other through welding, stamping, printing, spraying, high-pressure/high temperature spraying, coating, etc., so as to form the positive electrode of the battery pack.

In Figure 97, the positive integration consists of 4 positive units.

(F-2) Basic structure of the negative electrode integration:

The negative electrolyte fluid 8, the core 6, the electrolyte 5 and the metal negative electrode 2 are put together into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, or into the middle of the double membrane bag. The electrolyte 5 and the negative electrolyte fluid 8 are bonded with the inner surface film holes of the membrane, membrane bag, bioactive film bag, bioactive film 3; and the metal negative electrode 2 is clamped between the core 6 and the electrolyte 5, and they tightly adhere to, and are combined with, each other. Then, the opening of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is sealed by the membrane bag sealing device 31. Afterwards, one or multiple groups of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, configured with the negative electrolyte fluid 8, core 6, electrolyte 5 and

metal negative electrode 2, are pasted together and closely fixed to a part of the siphon end of the siphon film 42 on the high temperature-resistant anti-freezing material for the siphon film 4 to form a negative electrode unit.

A part of the siphon end of the siphon film 41 on the high temperature-resistant anti-freezing material for the siphon film 4 in the negative unit is inserted into the corresponding opening of the positive electrolyte fluid storage chamber 91 so as to adsorb the electrolyte fluid in the positive electrolyte fluid storage chamber 91 to the whole high temperature-resistant anti-freezing material for the siphon film 4 and transport the positive electrolyte fluid 9 to the outmost surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

While a part of the siphon end of the siphon film 41 on the high temperature-resistant anti-freezing material for the siphon film 4 in the negative unit is inserted into the positive electrolyte fluid storage chamber 91, the negative unit is fixed on the shell 103 by means of an adhesive agent or screws or by directly embedding a single cell into a card slot of the shell or by other means.

Based on the actual demand and changes in conditions, a group or multiple groups of negative units are formed into the negative electrode integration in a corresponding sequence and arrangement; and the negative units can be closely stuck together or have a corresponding special distance, which contributes to heat dissipation of the negative electrode.

The metal negative outlet circuits 23 of each negative unit are connected to each other by means of welding, stamping, printing, spraying, high pressure/high temperature spraying, coating and the like.

In Figure 97, the negative electrode integration consists of 4 negative electrode elements.

Thus, the battery pack is composed of a positive electrode integration, a negative electrode integration, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a shell 103, etc.

In the battery pack, the ion channels are integrated on the positive and the negative electrodes, and the high temperature-resistant anti freezing material

for the siphon film 4 on the integration of the positive and the negative electrodes is connected to the positive electrolyte fluid 9 in the positive electrolyte fluid storage room 91.

The advantage of this structure of the battery is: The metal fuel 24 can be replaced quickly and conveniently based on changes in actual demand and conditions; the replacement of the metal fuel 24 will not affect the air positive electrode 1.

To sum up the above introduction of A, B, C, D, E, and F, the advantages of pure oxygen as a positive material for the battery or battery pack include high power, high current density, and current stability. If used in vehicles, it can reduce the volume and weight of the battery.

Because, at present, the metal fuel (bio) cell of this invention is unique in the world, the corresponding battery accessory structure is the only original invention. For example, the above air supply structure is also the only original invention, especially the air supply structure of high power series/parallel battery packs.

G: Special descriptions

Issues of sealing positive electrolyte fluid (to prevent evaporation)

In order to prevent leakage of the positive electrolyte fluid 9 from the opening of the positive electrolyte fluid storage chamber 91, some absorbent materials can be filled in the positive electrolyte fluid storage chamber 91 to solidify the positive electrolyte fluid 9 to the optional absorbent materials: sponge, absorbent cotton, foam carbon nano-material, glass fiber, etc. This item is stated in words only, and does not involve high technology.

In order to prevent leakage of the positive electrolyte fluid 9 from the opening of the positive electrolyte fluid storage chamber 91 and the siphon end of the siphon film 41, the positive electrolyte fluid isolation device 92 serves as a sealing device of the utility model and does not affect the adsorption capacity of the siphon end of the siphon film 41; rubber rings, PTFE sealing rubber rings, graphite sealing agent, etc., can be used for sealing.

Examples of metal-air fuel cells:

Example I:

Figure 1, Figure 2, Figure 3, Figure 13, and Figure 68 cover a rectangular bulk-shaped metal-air fuel cell. Its thickness can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, greater than 1 m or any value within the range of 1 μ m-100 μ m. Its length and width can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, or greater than 1 m.

Figure 1 shows a main view; Figure 2 shows a sectional view of Figure 1 on E-E; Figure 3 shows a sectional view of Figure 1 on B-C-D; Figure 13 shows a sectional view of Figure 1 on A-A, and Figure 68 is a schematic diagram of Example 1.

Example 1 consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode output circuit 13, an air positive electrode inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a core 6, a shockproof buffer layer 7, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and a supporting/fixing device 10, etc.

In this example, the catalyst 16 (in the air positive electrode 1), the membrane bag sealing device 31 (on the membrane bag sealing device 31), the membrane bag edge bonding part 32, the separation membrane 33, the septum 34, the daub coating 35 and the daub coating B 36, the siphon end of the siphon film 41, as well as the ion terminal of the siphon film 42 (on the high temperature anti-freezing material for the siphon film 4) are not marked in

Figure 1, Figure 2, Figure 3, Figure 13, and Figure 68. By way of explanation, an absence of marking does not imply these structures do not exist in Example 1; in fact, they do. See the above descriptions of the corresponding components for details.

Each component of Example 1 is installed in accordance with Figure 68 and the characteristics of each component as well as the actual requirements.

(A) Assembly preparation (Methods and Techniques)

(A-1) Preparation for assembly of the air positive electrode 1 (Methods and Techniques)

The “all around” and “surrounding” parts of the air positive electrode inlet device are directly glued to, fixed to, or extruded mechanically on the battery shell and supporting/fixing device 10 by means of glue, adhesive agents, etc. The air positive electrode current collector 11 is connected to the air electrode carrier 15 by means of stamping, embedding, welding, printing, clamping, casting, spraying, high pressure/high temperature spraying, coating, etc. The air positive electrode lug 12 is connected to the air positive electrode current collector 11 by means of welding, stamping, printing, spraying, high pressure/high temperature spraying and coating, etc. The air positive electrode outlet circuit 13 is connected to the air positive electrode lug 12 by means of welding, punching, printing, spraying, high pressure and high temperature spraying, and film coating, etc. The catalyst 16 can be bonded to the air electrode carrier 15 using the chemical deposition method, vapor deposition method, ion plating method, electrolysis plating method, spraying method, hydrothermal method, normalization method, microwave method, normalization and microwave method, reduction method of acetylene black with potassium permanganate, manganese nitrate and cobalt nitrate decomposition method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria method, biological fermentation method, biological bonding method and other methods or techniques. The “all around” and “surrounding” parts of the air electrode carrier 15 are fixed on the battery shell and supporting/fixing device 10 as an adjunct support. Then the above-mentioned fixed air positive

electrode inlet device 14 is evenly and tightly glued to the air electrode carrier 15 that is filled with catalyst. During the process of achieving adherence with a uniform paste, the air between these two items should be discharged; thus, the preparatory work of the air positive electrode 1 is completed.

After the application of the above technology and the special processing techniques, the air electrode positive current collector 11, the air electrode positive lug 12, and the air electrode positive output circuit 13 can be considered as a whole unit.

(A-2) Assembly preparation of the metal negative electrode 2, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, the electrolyte fluid 8, the core 6, and the electrolyte 5 (Methods and Techniques)

The metal negative current collector 21 is connected to the metal fuels 24 by means of stamping, embedding, welding, printing, clamping, casting, spraying, high pressure and high temperature spraying, coating, etc.

The metal negative lug 22 is connected to the metal negative current collector 21 by means of welding, stamping, printing, spraying, high pressure and high temperature spraying, coating and other methods; and the metal negative outlet circuit 23 is connected to the metal negative lug 22 by means of welding, stamping, printing, spraying, high pressure and high temperature spraying and coating, etc.

After the application of the above technology and the special processing techniques, the metal negative electrode collector 21, the metal negative lug 22, and the metal negative outlet circuit 23 can be considered as a whole unit. Thus, the preparation of the metal negative 2 is completed.

According to the required sizes and thicknesses, as well as the different membrane materials and shapes, the separation membrane 33 and the septum 34 are made into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which can be a single layer membrane bag, a double-layer membrane bag, or a multilayer membrane bag, and which can be a single layer membrane, a double-layer membrane, or a multilayer membrane.

As to the thickness of the above item, it can be changed according to different requirements and conditions; for example, the thickness for micro batteries (such as pearl batteries, button batteries, etc.), neutral batteries (such as batteries for mobile phones, motorcycles, etc.), large batteries (such as batteries for cars, means of transport, etc.), and ultra-large batteries (such as batteries for large power stations, etc.). The thicknesses of the membrane, membrane bag, bioactive membrane bag, bioactive membrane are also different.

According to a certain method, a daub coating 35 and a daub coating B 36 are applied to the corresponding parts of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The single layer membrane bag can be coated on its inner or outer surface or both the inner and outer surfaces. The double layer membrane bag can be coated in the middle of the two layers of the double-layer membrane 33, or the coating can be applied to the middle, the inner part and the outer layer of a double layer membrane bag at the same time; it can be applied to the middle of the two layers of the double-layer membrane bag and the inner part of the double-layer membrane bag at the same time; it can be coated on the middle of the double-layer membrane bag and the outer part of the double-layer film bag at the same time; this choice and decision is based on the actual requirements and conditions of the different changes. At the same time, the membrane bag sealing device 31 is prepared, so that the preparation of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is completed.

The negative electrolyte fluid 8, core 6, electrolyte 5 and metal negative electrode 2 are arranged inside the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, or sandwiched in the middle of the double membrane bag. The electrolyte 5 and the negative electrolyte fluid 8 are bonded with the inner surface film holes of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; and the metal negative electrode 2 is sandwiched between the core 6 and the electrolyte 5 and is tightly bonded and combined; at the same time, the negative electrolyte fluid 8 is mainly introduced into the core 6 to meet the reserve requirement, which can be decided based on the actual requirements. The advantage of this structure is that it can maintain the properties of the negative electrolyte fluid

8, which exists in solid or semi-solid form; and it maintains a very good engaged connection to the electrolyte 5 and, at the same time, retains its basic boundary with the electrolyte 5. The sealing of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is best carried out under vacuum (also in a natural environment) by using the membrane bag sealing device 31 for sealing the mouth of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

(A-3) Assembly preparations of the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid 9 (Methods and Techniques)

Part of the siphon end of the siphon film 41 of the high temperature-resistant anti freezing material for the siphon film 4 is inserted into the positive electrolyte fluid storage chamber 91 containing the positive electrolyte fluid 9; and the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

The thickness, size and shape of the high temperature anti-freezing material for the siphon film 4 can be decided based on the actual needs and conditions.

The advantage of this structure is that it maintains the liquid property of the positive electrolyte 9, which exists in the form of a solid state and a semi-solid state; and it maintains a very good engaged connection with the air positive electrode 1, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, while at the same time retaining its basic boundary with the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane, which not only greatly reduces and saves on the usage amount of the positive electrolyte fluid 9 and lowers the cost, but also stabilizes the running state of the electrolyte fluid and reduces the volume and the weight of the battery.

Based on the actual needs and conditions change, the thickness, size and shape of the high temperature anti-freezing material for the siphon film 4 can be determined so as to regulate the supply quantity and supply temperature of the positive electrolyte fluid 9 and maintain the stability of the current. Also,

the problems of over-heating, expansion and spontaneous combustion of the battery are completely solved, provided that the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is well matched to ensure its running condition at high or low temperatures is as perfect as with normal temperatures.

The positive electrolyte fluid 9 is added to the positive electrolyte fluid storage chamber 91 through the positive electrolyte fluid storage chamber access channel 93. After the high temperature-resistant anti-freezing material for the siphon film 4 is inserted into the positive electrolyte fluid storage chamber 91, the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91, which is mainly used for isolating the water in the positive electrolyte fluid 9 to prevent water penetration.

(B) Assembly of the metal-air fuel (bio) cell

According to Figure 68 and the characteristics of each component, as well as the actual demands, the air positive electrode 1, which is ready to be completed, is tightly connected to a part of the siphon end of the siphon film 42 on the high temperature-resistant anti-freezing material for the siphon film 4. Part of the siphon end of the siphon film 42 of the high temperature-resistant anti-freezing material for the siphon film 4 is tightly connected to the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. The membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is tightly bonded with the shockproof buffer layer 7; and when part of the ion terminal of the siphon film 42 of the high temperature-resistant anti-freezing material for the siphon film 4 is closely connected to the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, part of the siphon end of the siphon film 42 of the high-temperature-resistant anti-freezing material for the siphon film 4 has already been immersed in the positive electrolyte fluid 9 of the positive electrolyte fluid storage chamber 91. Then, all these parts of the battery are shaped and affixed to the battery shell and supporting/fixing device 10 by means of spraying, welding, bonding, binding, etc.

The assembly and installation principle of a cell is that the closer the attachment and the less air, the better the conditions for current stability, high power and savings and reduction in consumption. A mechanical, fully automated completion of the assembly and installation in a vacuum is considered the most advantageous approach. (Our current successful completion is achieved with all-manual techniques and hand tools. Therefore, there is still much room for further improvement and perfection in terms of technical skills. As a result, the battery itself has a lot of room for improvement and perfection in all aspects).

(C) Operation of the metal-air fuel (bio) cell:

(C-1) Metal hydroxide is formed in the negative electrode of the battery: Negative electrode fluid 8 as an alkaline electrolyte.

After assembling the battery according to the above-mentioned methods, under the adsorption of the high temperature-resistant anti-freezing material for the siphon film 4, the positive electrolyte fluid 9 is adsorbed to the whole siphon end of the siphon film 42 of the high temperature-resistant anti-freezing material for the siphon film 4. When the positive electrolyte fluid 9 is adsorbed to the siphon end of the siphon film 42, at the same time, the positive electrolyte 9 is also adsorbed to the air electrode carrier 15 which is in close contact with the high temperature-resistant anti-freezing material for the siphon film 4; thus, the preparation procedure for the pre-discharge of the battery is completed.

At this time, the positive and negative electrodes of the load (load being the transformation of the current, such as testing instruments, multimeters, resistance, light bulbs, appliances for electrical purposes, coffee pots, mobile phones, various electrical appliances, etc.) are connected to the air positive electrode outlet circuit 13 and the metal negative outlet circuit 23, respectively (the outlet circuits of the positive electrode and the negative electrode are connected to the lugs of the positive electrode and the negative electrode, respectively; and the lugs of the positive electrode and the negative electrode are respectively connected to the current collectors of the positive electrode and the negative electrode, respectively; the current collectors of the positive electrode and the negative electrode are connected to the positive electrode

and the negative electrode, respectively.). When the positive and negative electrodes are switched on (turn on the power supply and start to discharge), oxygen in the positive air enters into the air electrode carrier 15 through the air positive electrode inlet device 14; oxygen molecules are combined with the catalyst 16 on the air electrode carrier 15, and under the catalysis of the catalyst 16, oxygen molecules are dissociated into oxygen ions; the hydroxyl ions react with the water in the positive electrolyte fluid 9 to form hydrated hydroxyl ions. With the help of the battery positive and negative electric field, the hydrated hydroxyl ions can pass through the siphon end of the siphon film 42 and reach the surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Because the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 are coated with daub coating 35, which is a kind of hydrophobic substance, water molecules cannot enter into the electrolyte 5 and negative electrolyte fluid 8 through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, while the negative electrolyte fluid 8 and daub coating 35 are materials of the same nature (that is, non-polar substances), which can be mutually compatible. The negative electrolyte fluid 8 is stored in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and is attached to the membrane holes of the inner surface of the membrane. At this time, the hydroxyl ions are transferred to the negative electrolyte 8 by the hydrated hydroxyl ions in the positive electrolyte fluid 9, and thus, the hydroxyl ions can pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and enter into the negative electrolyte fluid 8 and electrolyte 5, and then continue to move under the influence of the positive and negative electric field of the battery in the negative electrolyte fluid 8 and electrolyte 5 up to the surface of the metal fuel 24, and combine themselves with metal ions on the surface of the metal fuel 24 to form a metal hydroxide; at the same time, when hydroxyl ions and metal ions are combined, the electrons released from the metal ions on the surface of the metal fuel 24 pass through the metal fuel 24 and enter into the metal negative current collector 21, which allows the collected electrons to be transmitted to the load through the metal negative lug 22 and the metal negative outlet circuit 23, and then, through the load, the collected electrons enter into the air positive electrode outlet circuit 13, the air positive

electrode lug 12 and the air positive electrode current collector 11. Under the conduction of the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11, the electrons are moved on to the air electrode carrier 15 to form a continuous and stable current.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell coated with daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and electrolyte 5, or, even less likely, into the surface of the metal fuel 24. As a result, this provides a universal solution to the problems of metal fuel 24 corrosion, gas production, battery voltage hysteresis, overheating, expansion, self-combustion, explosion, and other universal problems.

The advantage of the high temperature-resistant anti-freezing material for the siphon film 4 is that it maintains the liquid property of the positive electrolyte fluid 9, which exists in the form of a solid state and a semi-solid state, and is well connected to the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 at the same time, retaining its basic boundaries with the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; not only do all these features greatly reduce and save on the usage amount of positive electrolyte fluid 9 and lower costs, they also stabilize the running state of the electrolyte fluid and reduce the volume and weight of the battery.

At the same time, it is effective to control and adjust the supply quantity and supply temperature of the positive electrolyte fluid 9 and control the stability of the current. Also, the problems of over-heating, expansion and spontaneous combustion of the battery are completely solved, provided that the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is well matched to ensure its running condition at high or low temperatures is as perfect as with normal temperatures.

The above operation processes of hydroxyl ions and electrons occur at instant speed, that is, at the speed of light.

In addition, after the load connected to the battery is disconnected, the hydroxyl ions and electrons in the battery will also stop the above movement.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which is coated with daub coating, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and electrolyte 5 or, even less likely, into the surface of the metal fuel 24; therefore, there are no issues with the battery self-discharging during the process of battery placement.

(C-2) The metal hydroxides are formed in the positive electrode of the cell, and the metal oxide is formed in the positive electrode of the cell: the negative electrolyte fluid 8 is the neutral electrolyte. Taking aluminum metals as an example, the negative electrolyte fluid 8 is the organic solution of aluminum chloride.

After assembling the battery in the above-mentioned methods, under the adsorption of the high temperature-resistant anti-freezing material for the siphon film 4, the positive electrolyte fluid 9 is adsorbed to the whole siphon end of the siphon film 42 of the high temperature anti-freezing material for the siphon film 4. When the positive electrolyte fluid 9 is adsorbed to the siphon end of the siphon film 42, the positive electrolyte fluid 9 is also adsorbed on the air electrode carrier 15 which is in tight contact with the high temperature-resistant anti-freezing material for the siphon film 4; thus, the preparation procedure for the pre-discharge of the battery is completed.

At this time, the positive and negative electrodes of the load (load being the transformation of the current, such as testing instruments, multimeter, resistance, light bulbs, electric appliances for electrical purposes, coffee pots, mobile phones, various electrical appliances, etc.) are connected to the air positive electrode outlet circuit 13 and the metal negative outlet circuit 23, respectively (the outlet circuits of the positive electrode and the negative electrode are connected to the lugs of the positive electrode and negative electrode, respectively, and the lugs of the positive electrode and negative electrodes are connected to the current collectors of the positive electrode

and negative electrode, respectively; the current collectors of the positive electrode and the negative electrode are connected to the positive electrode and the negative electrode, respectively). When the positive and negative electrodes are switched on (i.e. turn on the power supply and start to discharge), oxygen in the positive air enters into the air electrode carrier 15 through the air positive electrode air inlet device 14; oxygen molecules are combined with the catalyst 16 on the air electrode carrier 15 and the positive electrolyte fluid 9, and under catalysis of the catalyst 16, oxygen molecules are dissociated into hydroxyl ions.

Under the influence of the positive and negative electric field, the metal ions on the surface of the metal fuel 24 enter into the negative electrolyte fluid 8 and the electrolyte 5, and move through the negative electrolyte fluid 8 and the electrolyte 5 to the membrane holes and the outer membrane surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

At the same time, the positive electrolyte fluid 9 is attached to the outer surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and because the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is coated with daub coating 35, which is a hydrophobic substance, the water molecules cannot enter into the electrolyte 5 and the negative electrolyte fluid 8 through the membrane, membrane bag, bioactive film bag, bioactive film 3, and can only attach themselves to the outer membrane surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; under the influence of the positive and negative electric field, the metal ions which have moved to the membrane holes and the outer surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 enter into the positive electrolyte fluid 9 and are combined with the water in the positive electrolyte fluid 9 to form hydrated metal ions; when moving to the air positive electrode 1, hydrated metal ions are combined with hydrated hydroxide ions in the positive electrolyte fluid 9 to form metal hydroxide; at the same time as this combination occurs, metal atoms on the surface of the metal fuel 24 release electrons, and the dissociated electrons enter the negative electrolyte fluid 8 and electrode 5. The electrons, released from the metal ions on the surface of

the metal fuel 24, pass through the metal fuel 24 and enter into the metal negative current collector 21, which allows the collected electrons to be transmitted to the load through the metal negative lug 22 and the metal negative outlet circuit 23, and then, through the load, the collected electrons enter into the air electrode positive outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11. Under the conduction of the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11, the collected electrons are moved to the air electrode carrier 15 to form a continuous and stable current.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell, which is coated with daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24, thus providing a universal solution to the problems of metal fuel 24 corrosion, gas production, battery voltage hysteresis, overheating, expansion, self-combustion, explosion, and other universal problems.

The advantage of the high temperature-resistant anti-freezing material for the siphon film 4 is that it maintains the liquid property of the positive electrolyte fluid 9, which exists in the form of a solid state and a semi-solid state, and is well connected to the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 at the same time, retaining its basic boundaries with the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; not only do all these features greatly reduce and save on the usage amount of positive electrolyte fluid 9 and lower costs, they also stabilize the running state of the electrolyte fluid and reduce the volume and weight of the battery.

At the same time, it effectively controls and adjusts the supply quantity of positive electrolyte fluid 9, and simultaneously controls and regulates the operating temperature of the battery and the stability of the current. Also, the problems of over-heating, expansion and spontaneous combustion of the battery are completely solved, provided that the membrane, membrane bag,

bioactive membrane bag, bioactive membrane 3 is well matched to ensure its running condition at high or low temperatures is as perfect as with normal temperatures.

The above operation processes of hydroxyl ions and electrons occur at instant speed, that is, at the speed of light.

In addition, after the load connected to the battery is disconnected, the hydroxyl ions and electrons in the battery will also stop the above movement.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which is coated with daub coating, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and electrolyte 5 or, even less likely, into the surface of the metal fuel 24; therefore, there are no issues with the battery self-discharging during the process of battery placement.

Example II:

In this case, the metal-air fuel power is a double-positive battery composed of two air positive electrodes 1 and one metal negative electrode 2, along with other components. Its structure is shown in Figure 1, Figure 22, Figure 23, and Figure 69.

Figure 1 shows a main view. Figure 22 shows a sectional view of Figure 1 on E-E. Figure 23 shows a sectional view of Figure 1 on A-A, and Figure 69 shows a schematic diagram of the part of Example II.

This example consists of an air positive electrode 1, and air positive electrode positive current collector 11, an air positive electrode positive 12, an air electrode positive outlet circuit 13, an air positive electrode inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing

material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and supporting/fixing device 10, etc.

In this example, the catalyst 16 on the air positive electrode 1, the membrane bag sealing device 31 on the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, the membrane bag edge bonding part 32, the separation membrane 33, the septum 34, the daub coating 35, the daub coating B 36, the siphon end of the siphon film 41 and the ion terminal of the siphon film 42 on the high temperature-resistant anti-freezing material for the siphon film 4 are not marked in Figure 1, Figure 22, Figure 23, and Figure 69. By way of explanation, an absence of marking does not imply these structures do not exist in Example II; in fact, they do. See the above description of the corresponding components for details and the same below.

Each component of Example II is installed in accordance with the characteristics of Figure 69 and the characteristics of each component as well as the actual requirements.

The assembly and operation of the battery is essentially the same as in Example I.

Example III:

Figures 1, Figure 24, Figure 25, and Figure 70 relate to a rectangular bulk-shaped electrolyte-free metal-air fuel cell.

Figure 1 shows a main view, Figure 22 shows a sectional view of Figure 1 on E-E, Figure 25 shows a sectional view of Figure 1 on A-A, and Figure 70 shows a schematic diagram of the part of Example III.

In Example III, there is no electrolyte 5 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

Example III consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode

outlet circuit 13, an air positive electrode inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, a core 6, a shockproof buffer layer 7, an electrolyte 5, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and supporting/fixing device 10, etc.

Each component of Example III is installed in accordance with the characteristics of Figure 70 and the characteristics of each component, as well as the actual requirements.

In this example, the negative electrolyte fluid 8, the core 6 and the metal negative electrode 2 are arranged together inside the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, or sandwiched in the middle of a double membrane bag. The negative electrolyte fluid 8 is bonded with the inner surface film holes of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; and the metal negative electrode 2 is tightly affixed to the core 6; at the same time, the negative electrolyte fluid 8 is mainly introduced into the core 6 to meet the reserve requirement, which can be decided according to actual requirements. The advantage of this structure is that it can maintain the properties of the negative electrolyte fluid 8, which exists in solid or semi-solid form. The sealing of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is best carried out under vacuum (also in a natural environment) by using the membrane bag sealing device 31 for sealing the mouth of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

In this example, the assembly and operation of the battery is essentially the same as in Example I; however, because of the absence of electrolyte 5, the ions in the negative unit are run through negative electrolyte fluid.

Example IV:

Figures 1, Figure 26, Figure 27, and Figure 71 relate to a rectangular bulk-shaped metal-air fuel cell without a core.

In this example, the membrane, membrane bag, bioactive film bag, bioactive film 3 is not provided with the core 6.

Figure 1 shows a main view. Figure 26 shows a sectional view of Figure 1 on E-E. Figure 27 shows a sectional view of Figure 1 on A-A, and Figure 71 shows a schematic diagram of the parts of Example IIII.

This example consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode air inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a negative electrolyte 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and supporting/fixing device 10, etc.

Each component of Example IIII is installed in accordance with the characteristics of Figure 71 and the characteristics of each component, as well as the actual requirements.

The assembly and operation in this example are essentially the same as in Example I, but no core 6 is involved.

Example V:

Figure 1, Figure 28, Figure 29, and Figure 72 relate to a rectangular bulk-shaped metal-air fuel cell without **electrolyte and core in a membrane bag**.

In the Example V, the membrane, membrane bag, bioactive membrane bag, bioactive membrane is not provided with an electrolyte 5 and a core 6.

Figure 1 is a main view. Figure 28 shows a sectional view of Figure 1 on the E-E. Figure 29 shows a sectional view of Figure 1 on the A-A, and Figure 72 shows a schematic diagram of the parts of Example V.

Example V consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, a shockproof buffer layer 7, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and support/fixing device 10, etc.

Each component of this example is installed in accordance with the characteristics of Figure 72 and the characteristics of each component, as well as the actual requirements.

Its assembly and operation are essentially the same as in Example I, but without a core 6 and an electrolyte 5.

Example VI:

Figure 1, Figure 4, Figure 7, and Figure 73 relate to a rectangular bulk-shaped metal-air fuel cell.

A layer of air electrode catalyst coating 17 is arranged between the air electrode carrier 15 and the air positive electrode inlet device 14 of the air positive electrode 1.

Figure 1 is a main view, Figure 4 is a sectional view of Figure 1 on the E-E, Figure 7 is a view of the enlarged area of Figure 4, and Figure 73 is a schematic diagram of the parts of Example VI.

Example VI consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode inlet device 14, an air electrode carrier 15, a catalyst 16, an air electrode catalyst coating 17, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative output circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a core 6, a shockproof buffer layer 7, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and support/fixing device 10, etc.

Each component of Example VI is installed in accordance with the characteristics of Figure 73 and the characteristics of each component, as well as the actual requirements, but the air positive electrode inlet device 14 and the air electrode carrier 15, the air electrode catalyst coating 17 and the air electrode carrier 15 are combined with a uniform paste. The air electrode catalyst coating 17 is involved in oxygen catalysis and current conduction.

Example VII: Figure 66 relates to a triangular metal-air fuel cell.

Example VIII: Figure 67 relates to a circular metal-air fuel cell.

Example IX:

A single battery or series-parallel battery pack with a shell

As to a single cell or series-parallel battery pack with a shell, the carbon dioxide inlet and outlet channels in a single cell or series-parallel high-power battery can be effectively controlled or opened/closed by the air inlet and outlet device 101 according to the actual demand and the change in conditions. The main purpose of closing and opening the carbon dioxide inlet and outlet channels is to allow the carbon dioxide to freely enter and exit the air inlet and outlet device 101 of the shell in a battery or a battery pack when a battery works under a natural air condition.

At this point in time, a small amount of carbon dioxide has little effect on a working battery or battery pack, but if a cell or battery pack is idle for a long period of time, and if carbon dioxide can freely enter or exit the air inlet and outlet device 101 of the shell of a cell or battery pack, the long-term exposure of the positive electrolyte fluid of the cell to carbon dioxide will cause damage to the electrolyte fluid, such as curing, neutralization, carbonation, etc. Therefore, we can solve this problem by closing and opening up the carbon dioxide inlet and outlet channels, i.e., when the battery is working, the carbon dioxide is allowed to enter or exit the air inlet and outlet device 101 of a cell or battery pack; when the battery is not put into operation for a long time, the air inlet and outlet device 101 of the shell of a battery or battery pack is completely closed, which will effectively prevent carbon dioxide from causing damage to the electrolyte fluid in a battery or battery pack (such as curing, neutralization, carbonation, etc.).

I. Preparation of a monocell:

Figure 1, Figure 2, Figure 3, Figure 13 and Figure 68 relate to a metal-air fuel monocell innovated by the invention.

This example consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a

daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a core 6, a shockproof buffer layer 7, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and support/fixing device 10, etc.

Each component of the air metal fuel single cell is installed in accordance with the characteristics of Figure 68 and the characteristics of each component, as well as the actual requirements. Its assembly and operation are essentially the same as in Example I.

II. Preparation of a battery pack and preparation of its shell:

In Figure 84, Figure 85, Figure 89 and Figure 86:

Figure 84 is a front view of the shell of a metal-air fuel battery pack.

Figure 85 is a rear view of the shell of a metal-air fuel battery pack.

(A) Installation of the air inlet and outlet device 101 in the shell of a metal-fuel battery pack

The air inlet and outlet device 101 is composed of three parts: a filter device 1011, a switch device 1012 and a switch control device 1013. The filter device 1011 is an air filtering device, which can filter solid matter such as impurities and dust in the air to prevent them from entering into the battery pack.

The switch device 1012 is a channel on the air inlet and outlet device 101 which can be automatically opened and closed according to actual demand and changing conditions; the opening or closing of the switch device 1012 is performed under the control and function of the switch control device 1013.

The switch control device 1013 is a control and power device of the switch device 1012, which controls the opening and closing of the switch device 1012 based on changes in actual requirements and conditions. The power of the switch control device 1013 is derived from the power of a single battery or battery pack itself, and can also be derived from an external or manual power source.

1) First, the switch device 1012 is installed on the “front” surface of the shell according to actual requirements and conditions; then, another switch device 1012 is installed on the “back” surface of the shell according to actual requirements and conditions.

2) After the installation of the two switch devices 1012 on the “front” and “back” of the shell, the switch control device 1013 is installed on the corresponding part of the shell according to actual requirements and conditions.

3) After the two switch devices 1012 on the “front” and “back” of the shell and the switch control device 1013 have been installed, a filter device 1011 is arranged on the switch device 1012 on the “front” surface of the shell.

Another filter device 1011 is arranged on the switch device 1012 on the “back” surface of the shell.

This completes the installation of the air inlet and outlet device 101 on the “front” and “back” surface of the shell of the metal-air fuel battery pack .

(B) Single cell’s fixing, and battery series-parallel connection

It should be noted here that, because the “up” part of the metal-air fuel battery pack can be opened, after the installation of the air inlet and outlet device 101 on the front and back surfaces of the air fuel cell battery pack by means of the above-mentioned technical methods, the following installation work begins.

Attention: The switch device 1012 on the "front" and "back" surface is turned off.

- (1) Open the “up” part of the shell of an air fuel battery pack.
- (2) The above prepared single cells follow the structure as shown in Figure 89 and Figure 86; one side of the air positive electrode 1 of three sets of single cells faces the “right” surface of the shell of the metal fuel battery pack, and the single cells are placed evenly on the bottom of the shell in accordance with the "before" - "after" trends.
- (3) After three sets of single cells have been evenly placed on the bottom of the shell, they can be secured by adhesive agents or screws, or

embedded in the card slot of the shell set directly for a single cell, or by other methods.

(4) The three single cells are connected in parallel according to the single cell parallel structure shown in Figure 86. The air positive electrode outlet circuits 13 of the three sets of single cells are connected to each other by means of welding, stamping, printing, spraying, high pressure-high temperature spraying, coating, etc., and form the positive electrode of the battery pack; and the metal negative outlet circuits 23 of the three sets of single cells are connected to each other by means of welding, stamping, printing, spraying, super pressure-high temperature spraying, coating, etc., and form the negative electrode of the battery pack. Thus, the battery pack in this example is formed.

(5) Close and seal the “up” part of the shell.

This completes the process of attaching the single cells and the series-parallel of the battery pack.

To sum up, the installation work of the metal-air fuel battery in Example IX is completed by following the A and B installation technology mentioned above.

The installation is best carried out under the conditions of a vacuum environment or dust-free environment, but can also be completed in a natural environment.

III. Operation of a metal-air fuel battery pack

(III-1) Air running in and out of the shell of a metal -air fuel battery pack

The switch control device 1013 can be activated by the power of the battery pack itself, the external power, or the manual mode. Under the control and the function of the switch control device 1013, the switch device 1012 is opened, and the outside air is filtered first through the filtering device 1011, and then enters the opened switch device 1012 to the battery or the battery pack inside the shell 103. At the same time, the air in the shell 103 passes through the opened switch device 1012, and then passes through the filtering device 1011 into the outside air.

(III-2) Connected load, with power turned on

The positive and negative electrodes of an assembled metal-air fuel battery pack are connected to the positive pole and negative pole of a load (the load being the transformation of the current, such as testing instruments, multimeter, resistance, light bulbs, appliances for electric purposes, coffee pots, mobile phones, various electrical appliances, etc.). When the positive and negative poles are connected, the power supply is switched on and the discharge is started.

(III-3) Generation process of a monocell

According to the different nature of the negative electrolyte fluid 8, the generating process of a single cell can be divided into two kinds of operation scheme: when the electrolyte fluid 8 is alkaline, it is the first operation scheme; when the electrolyte fluid 8 is a neutral electrolyte fluid, it is the second operating scheme.

(III-3-1) The first operation scheme

Passing through the air inlet and outlet device 101 in the shell and going into the shell, the oxygen enters the air electrode carrier 15 through diffusion; under the catalysis of the catalyst 16, oxygen molecules dissociate themselves into hydroxyl ions; the hydroxyl ions and the water in the positive electrolyte fluid 9 form hydrated hydroxyl ions; and under the influence of the battery's positive and negative electric field, the hydrated hydroxyl ions go through the ion terminal of the siphon film 42 to the surface of the outer membrane of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. Because the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is coated with daub coating 35, which is a hydrophobic substance, the water molecules cannot enter into the electrolyte 5 and the negative electrolyte fluid 8 through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, while the negative electrode fluid 8 and daub coating 35 are materials of the same nature (that is, non-polar substances), which can be mutually compatible; the negative electrode fluid 8 is enclosed in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and attached to the membrane hole of the inner surface of the membrane. At this time, hydrated hydroxyl ions in the positive electrolyte fluid 9 will transfer hydroxyl ion to the negative electrolyte fluid 8,

and as a result, the hydroxyl ion will pass across the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and enter into the negative electrolyte fluid 8 and the electrolyte 5, and then continues to move into the negative electrode 8 and the electrolyte 5 under the influence of the positive and negative electric field of the battery up to the surface of the metal fuel 24; wherein it is combined with metal ions on the surface of the metal fuel 24 to form a metal hydroxide; at the same time when hydroxyl ions are combined with metal ions, the electrons, released from the metal ions on the surface of the metal fuel 24, pass through the metal fuel 24 and enter into the metal negative current collector 21, which helps the collected electrons get transmitted to the negative electrode of the battery pack through the metal negative lug 22 and the metal negative outlet circuit 23, and then to the load through the connection line between the negative of the battery pack and the load; then enter onto the connection line between the load and the battery pack and further move to the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11. Under the conduction of the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11, the electrons are moved to the air electrode carrier 15 to form a continuous and stable current.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell and the applied daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24, which provides a universal solution to the problems of corrosion of the metal fuel 24, gas production and battery voltage hysteresis, overheating, expansion, self-combustion, explosion and other universal problems.

The structural advantage of the high temperature-resistant anti freezing material for the siphon film 4 is that it maintains the liquid property of the positive electrolyte fluid 9, which exists in the form of a solid state and a semi-solid state, and that it is well connected with the air positive electrode 1, the membrane, membrane bag, bioactive membrane bag, bioactive membrane

3, while at the same time retaining its basic boundaries with the air positive electrode 1, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, which not only greatly reduces and saves on the usage amount of positive electrolyte fluid 9 and lowers the cost, but also stabilizes the running state of the electrolyte fluid, and, as a result, reduces the volume and the weight of the battery.

At the same time, it effectively controls and adjusts the supply quantity and supply temperature of the positive electrolyte 9, and controls the stability of the current. Also, the problems of over-heating, expansion and spontaneous combustion of the battery are completely solved, provided that the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is well matched to ensure its running condition at high or low temperatures is as perfect as with normal temperatures.

The above operation processes of hydroxyl ions and electrons occur at instant speed, that is, at the speed of light.

In addition, after the load connected to the battery, is disconnected, the hydroxyl ion and electron in the battery will also stop their movement.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell, the applied daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24; as a result, there are no issues such as battery self-discharge, overheating, expansion, explosion, etc. in the process of battery placement.

(III-3-2) The second operation scheme

The oxygen in the air enters into the shell through the air inlet and outlet device 101 and later into the air electrode carrier 15 through diffusion, and under the catalysis of the catalyst 16, oxygen molecules dissociate themselves into hydroxide ions.

Meanwhile, under the influence of the positive and negative electric field of the cell, the metal ions on the surface of the metal fuel 24 enter into the

negative electrolyte fluid 8 and the electrolyte 5, and pass the negative electrolyte fluid 8 and the electrolyte 5 to the membrane pores and the surface of the outer membrane of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. At the same time, the positive electrolyte 9 is attached to the outer surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and because the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is coated with daub coating 35, which is a hydrophobic substance, the water molecules cannot enter into the electrolyte 5 and the negative electrolyte fluid 8 through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and can only attach themselves to the outer surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, while the metal ions which have moved to the membrane pores and the surface of the outer membrane of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 enter into the positive electrolyte fluid 9 under the influence of the positive and negative electric field and are combined with the water in the positive electrolyte fluid 9 to form the hydrated metal ions; when moving to the air positive electrode 1, hydrated metal ions are combined with hydrated hydroxide ions in the positive electrolyte fluid 9 to form metal hydroxide; while hydrated metal ions are combined with hydrated hydroxide ions in the positive electrolyte fluid 9, the electrons, released by metal atoms on the surface of the negative fuel 24, dissociate themselves and becomes metal ions which enter into the negative electrolyte fluid 8 and the electrode 5. The electrons, released by metal atoms on the surface of the negative fuel 24, pass through the negative fuel 24 and enter into the metal negative current collector 21; the metal negative current collector 21 conducts the collected electrons from the metal negative current collector 21 to the negative electrode of the battery pack through the metal negative lug 22, the metal negative outlet circuit 23, and then conducts them to the load through the connection line between the negative electrode of the battery pack and the load; then the collected electrons enter the connection line between the load and the battery pack and reach the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11; under the conduction of the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11, the

collected electrons come to the air electrode carrier 15 and thereby form the continuous and stable current.

(If the positive electrode material is pure oxygen, the current of the battery and the battery pack will be more stable, the electric power is greater, and the current density is higher, at least three times as high as when air is used as a cathode material.)

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell and because of the applied daub coating 35, water in the positive electrolyte 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24, which provides a universal solution to problems such as corrosion of the metal fuel 24, gas production and battery voltage hysteresis, overheating, expansion, self-combustion, explosion and other universal problems.

The advantage of the high temperature-resistant anti-freezing material for the siphon film 4 is that it maintains the liquid property of the positive electrolyte fluid 9, which exists in the form of a solid state and a semi-solid state, and is well connected to the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 at the same time, retaining its basic boundaries with the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; not only do all these features greatly reduce and save on the usage amount of positive electrolyte fluid 9 and lower costs, they also stabilize the running state of the electrolyte fluid and reduce the volume and weight of the battery.

At the same time, it is effective to control and adjust the supply quantity and supply temperature of the positive electrolyte fluid 9 and control the stability of the current. Also, the problems of over-heating, expansion and spontaneous combustion of the battery are completely solved, provided that the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is well matched to ensure its running condition at high or low temperatures is as perfect as with normal temperatures.

The above operation processes of hydroxyl ions and electrons occur at instant speed, that is, at the speed of light.

In addition, after the load connected to the battery, is disconnected, the hydroxyl ions and electrons in the battery will also stop the movement.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell and because of the daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24; as a result, there are no issues such as battery self-discharge in the process of battery placement.

(III-4) Shutdown process of metal-air fuel battery pack

When the battery is not operated for a long time, the connection between the battery pack and the load should be disconnected. After the disconnection, the discharge is stopped.

The switch control device 1013 is activated by the power of the battery pack itself, the external power, or the manual mode. Under the control and the function of the switch control device 1013, the switch device 1012 is closed, so that the outside air is not allowed to enter a battery or battery pack inside the shell 103. The air inside the shell 103 cannot enter the outside air, which effectively solves the problem of carbon dioxide causing damage to the electrolyte fluid in a battery or battery pack (such as curing, neutralization, carbonation etc.).

Example X: Metal fuel cell with pure oxygen as a positive electrode material

If the positive electrode material is pure oxygen, the current of a battery or battery pack will be more stable, the electric power is greater, and the current density is higher, at least three times as high as when air is used as a cathode material.

At the same time, the volume as well as the weight of a battery or battery pack can be reduced, and the cost of a battery or battery pack can be saved.

It can be used in a natural state as well as in places with thin air or a lack of oxygen or no oxygen, such as the atmosphere, outer space, the deep sea, or underwater and subspace.

I. Preparation of monocell:

Figure 1, Figure 2, Figure 3, Figure 13 and Figure 68 relate to this invention's innovated single metal fuel cell with pure oxygen as its positive electrode material.

This example consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a membrane 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a core 6, a shockproof buffer layer 7, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte storage chamber 91, a positive electrolyte isolation device 92, a positive fluid electrolyte storage chamber access channel 93, a battery shell and support/fixing device 10, etc.

Each component of the single metal fuel cell with pure oxygen as its positive electrode material is installed in accordance with Figure 68 and the characteristics of each component, as well as actual requirements. Their assembly and operation are essentially the same as in Example I.

II. Metal fuel cell with pure oxygen as its positive electrode material

Preparation of battery shell and preparation of battery pack:

In Figure 86 and Figure 94: Figure 94 is a sectional view of a metal fuel battery pack with pure oxygen as its positive electrode material; Figure 86 is a cross-sectional view of Figure 94 in the B-B direction.

This battery or battery pack is divided into three parts, one part is the storage part of the positive electrode material, one part is a power generating part, and one part is the connecting part between the storage part and the power generating part.

The storage part of the positive electrode material is composed of a pure oxygen storage tank 106, an aerator 1062, an oxygen supply device 1063 and pure oxygen 1061.

The power generation part is composed of a shell 103, a monocyte 102, and a pure oxygen supply device 1016.

The connecting part between the storage part and the power generating part is composed of a voltage regulating switch device 107.

(A) Configuration of a single metal fuel cell with pure oxygen as its positive electrode material, and series-parallel connection of a battery pack, i.e., assembly of the power generation part.

It should be noted here that the "up" part of the shell of the metal fuel battery pack with pure oxygen as its positive electrode material can be opened.

- (1) Open the "up" part of the shell of the metal fuel battery pack with pure oxygen as its positive electrode material.
- (2) The above prepared single cells follow the structure as shown in Figure 94 and Figure 86; one side of the air positive electrode 1 of three sets of single cells faces the "right" surface of the shell of the metal fuel battery pack, and the single cells are placed evenly on the bottom of the shell in accordance with the "before" - "after" trends.
- (3) After three sets of single cells have been evenly placed on the bottom of the shell, they can be secured by adhesive agents or screws, or embedded in the card slot of the shell set directly for a single cell, or by other methods.
- (4) The three single cells are connected in parallel according to the single cell parallel structure shown in Figure 86. The air positive electrode outlet circuits 13 of the three sets of single cells are connected to each other through welding, stamping, printing, spraying, high pressure-high

temperature spraying, coating, etc. to form the positive electrode of the battery pack. Also, the metal negative outlet circuits 23 of the three sets of single cells are connected to each other through welding, stamping, printing, spraying, high pressure-high temperature spraying, coating etc. to form the negative electrode of the battery pack. Thus, the battery pack in this example is formed.

(5) Close and seal the “up” part of the shell.

Thus, the assembly of a single cell and the series-parallel connection of a battery pack are completed.

(B) Assembly and deployment of three parts of a metal fuel cell with pure oxygen as its positive electrode

1. After the power generation part has been assembled, the storage part of the positive electrode material and the assembled power generation part are connected to the connecting part of the storage part and the power generation part. This means that the pure oxygen supply device 1016 of the shell 103 is connected to the oxygen supply device 1063 on the pure oxygen storage tank (106) through the voltage regulating switch device 107. At this time, the voltage regulating switch device 107 is in a completely closed state.

2. Then, according to the actual demand and the change in conditions, the pure oxygen 1061 is added to the pure oxygen storage tank 106 through the aerator 1062.

To sum up, by following the installation methods A and B mentioned above, the installation work of the metal fuel cell with pure oxygen as its positive electrode material in Example X is completed. The installation is best carried out under the conditions of a vacuum environment or pure oxygen environment, but can also be completed in a natural environment.

III. Operation of a metal fuel battery pack with pure oxygen as its positive electrode

(III-1) Based on actual demand and changes in conditions, open the voltage regulating switch device 107 to adjust the pressure accordingly; oxygen is supplied to a single cell or a battery pack through the pure oxygen supply device 1016 on the shell 103, and the positive electrode material as a power

generating part is used to participate in power generation. At this time, the shell is filled with the relevant pressure of oxygen.

(III-2) The positive and negative electrodes of the assembled metal fuel battery with pure oxygen as its positive electrode material are connected to the positive and negative electrodes of the load (load being the transformation of the current, such as testing instruments, multimeter, resistance, light bulbs, appliances for electric purposes, coffee pots, mobile phones, various electrical appliances, etc.). When the positive and negative poles are connected, the power supply is switched on and the discharge is started.

(III-3) Generating process of a single cell

According to the different nature of the negative electrolyte fluid 8, the generation process of a single cell can be divided into two kinds of operation scheme: When the negative electrolyte fluid 8 is alkaline, it is the first operation scheme; when the negative electrolyte fluid 8 is a neutral electrolyte fluid, it is the second operating scheme.

(III-3-1) The first operation scheme

After entering into the shell through the pure oxygen supply device 1016 on the shell, the oxygen enters into the air electrode carrier 15 through diffusion; oxygen molecules are combined with the catalyst 16 in the air electrode carrier 15 and, under the catalysis of catalyst 16, oxygen molecules dissociate themselves into hydroxide ions.

The hydroxyl ion and water in the positive electrolyte fluid 9 form hydrated hydroxyl ions, and under the influence of the battery's positive and negative electric field, hydrated hydroxyl ions can pass through the ion terminal of the siphon film 42 and reach the surface of the outer membrane of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. Because the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is coated with daub coating 35, which is a hydrophobic substance, the water molecules cannot enter into the electrolyte 5 and the negative electrolyte fluid 8 through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, while the negative electrode fluid 8 and the daub coating 35 are materials of the same nature (that is, non-polar substances), which can be

mutually compatible; the negative electrode fluid 8 is enclosed in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and is attached to the membrane pores of the inner surface of the membrane. At this time, the hydroxyl ions are transferred to the negative electrolyte 8 by hydrated hydroxyl ions in the positive electrolyte fluid 9, and then the hydroxyl ions go through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and enter into the negative electrolyte fluid 8 and the electrolyte 5, and continue to move in the negative electrolyte 8 and the electrolyte 5 under the action of the positive and negative electric field of the battery, and up to the surface of the metal fuel 24; they are combined with metal ions on the surface of the metal fuel 24 to form a metal hydroxide; at the same time when the combination of hydroxyl ions are combined with metal ions, the electrons, released from the metal ions on the surface of the metal fuel 24 pass through the metal fuel 24 and enter into the metal negative current collector 21, which conducts the collected electrons to the negative electrode of the battery pack through the metal negative lug 22 and the metal negative outlet circuit 23, and then conducts them to the load through the connection line between the negative electrode and the load; they then pass through the load and enter into the connection line between the load and the battery pack and reach the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11. Under the conduction of the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11, the electrons are moved to the air electrode carrier 15 to form a continuous and stable current.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell and because of its applied daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24, which is a universal solution to the problems of corrosion of the metal fuel 24, gas production and battery voltage hysteresis, overheating, expansion, self-combustion, explosion and other universal problems.

The advantage of the high temperature-resistant anti-freezing material for the siphon film 4 is that it maintains the liquid property of the positive electrolyte fluid 9, which exists in the form of a solid state and a semi-solid state, and is well connected to the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 at the same time, retaining its basic boundaries with the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; not only do all these features greatly reduce and save on the usage amount of positive electrolyte fluid 9 and lower costs, they also stabilize the running state of the electrolyte fluid and reduce the volume and weight of the battery.

The above operation processes of metal ions and electrons are done at instant speed, i.e., at the speed of light. In addition, it is effective to control and adjust the supply quantity of the positive electrolyte 9, and simultaneously control and regulate the operating temperature of the battery, and control the stability of the current. Also, the problems of over-heating, expansion and spontaneous combustion of the battery are completely solved, provided that the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is well matched to ensure its running condition at high or low temperatures is as perfect as with normal temperatures.

The above operation processes of hydroxyl ions and electrons are done at instant speed, that is, at the speed of light.

In addition, after the load connected to the battery, is disconnected, the battery in the hydroxyl ions and electrons will also stop the movement.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and because of the applied daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24, therefore, there is no problem with battery self-discharge in the process of battery placement.

(III-3-2) The second operation scheme

After entering into the shell through the pure oxygen supply device 1016 on the shell, the oxygen enters into the air electrode carrier 15 through diffusion; oxygen molecules are combined with the catalyst 16 in the air electrode carrier 15 and, under the catalysis of the catalyst 16, oxygen molecules dissociate themselves into hydroxide ions; under the influence of positive and negative electric fields of the cell, the metal ions on the surface of the metal fuel 24 enter into the negative electrolyte fluid 8 and the electrolyte 5, and move through the negative electrolyte fluid 8 and the electrolyte 5 to the membrane pores and the outer membrane surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

At this time, because the positive electrolyte fluid 9 is attached to the outer membrane surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and because the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is coated with daub coating 35, which is a hydrophobic substance, the water molecules cannot enter into the electrolyte 5 and the negative electrolyte fluid 8 through the membrane, membrane bag, bioactive film bag, bioactive film 3 and can only attach themselves to the outer membrane surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; under the influence of positive and negative electric fields, the metal ions which have moved to the membrane pores and the outer membrane surface of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 enter into the positive electrolyte fluid 9 and are combined with the water in the positive electrolyte fluid 9 to form hydrated metal ions; when moving to the air positive electrode 1, hydrated metal ions are combined with hydrated hydroxide ions in the positive electrolyte fluid 9 to form metal hydroxide; at the same time when this combination occurs, metal atoms on the surface of the metal fuel 24 release electrons, and the dissociated electrons enter the negative electrolyte fluid 8 and the electrode 5. The electrons released by the metal atoms on the surface of the metal fuel 24 pass through the metal fuel 24 and enter into the metal negative current collector 21 which conducts the collected electrons through the metal negative lug 22, the metal negative outlet circuit 23 to the negative electrode of the battery pack, and then conducts them to the load

through the connection line between the negative electrode of the battery pack and the load; they then pass through the load and enter into the connection line between the load and the battery pack and reach the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11. Under the conduction of the air positive electrode outlet circuit 13, the air positive electrode lug 12 and the air positive electrode current collector 11, the electrons are moved to the air electrode carrier 15 to form a continuous and stable current.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell and because of the applied daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, onto the surface of the metal fuel 24, which is a universal solution to the problems of corrosion of the metal fuel 24, gas production and battery voltage hysteresis, overheating, expansion, self-combustion, explosion and other universal problems.

The advantage of the high temperature-resistant anti-freezing material for the siphon film 4 is that it maintains the liquid property of the positive electrolyte fluid 9, which exists in the form of a solid state and a semi-solid state, and is well connected to the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 at the same time, retaining its basic boundaries with the air positive electrode 1 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; not only do all these features greatly reduce and save on the usage amount of positive electrolyte fluid 9 and lower costs, they also stabilize the running state of the electrolyte fluid and reduce the volume and weight of the battery.

At the same time, it is effective to control and adjust the supply quantity and supply temperature of the positive electrolyte fluid 9 and control the stability of the current. Also, the problems of over-heating, expansion and spontaneous combustion of the battery are completely solved, provided that the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is well

matched to ensure its running condition at high or low temperatures is as perfect as with normal temperatures.

The above operation processes of hydroxyl ions and electrons occur at instant speed, that is, at the speed of light.

In addition, after the load connected to the battery, is disconnected, and the battery in the hydroxyl ions and electrons will also stop the movement.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell, and because of the applied daub coating 35, water in the positive electrolyte 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24; as a result, there are no problems such as battery self-discharge with the process of battery placement.

(III-4) Shutdown process of a metal fuel battery pack with pure oxygen as its positive electrode

When the battery does not operate, the connection between the battery pack and the load is disconnected. After the disconnection, i.e., the stop of discharge, the battery pack stops operating.

Because of the structural characteristics of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the metal fuel (bio) cell and because of the applied daub coating 35, water in the positive electrolyte fluid 9 and other molecular substances cannot pass through the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 into the negative electrolyte fluid 8 and the electrolyte 5 or, even less likely, into the surface of the metal fuel 24; therefore, there are no problems such as battery self-discharge with the process of battery placement.

The positive electrode material used in a metal fuel battery pack with pure oxygen as its positive electrode material is pure oxygen, therefore, the battery and the battery pack are completely isolated from the outside air, and the air and the carbon dioxide in the air cannot enter into the battery and the battery pack, which helps to stabilize the current, increase the power, increase the

current density, and also effectively prevent the electrolyte of the cell or battery pack from damage caused by carbon dioxide (such as curing, neutralization, carbonation, etc.).

Example XI: Metal alloy “immerse” membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, electrolyte 5

Figure 74, Figure 75, Figure 76, Figure 77 and Figure 74 each show a sectional view of Figure 1 on G-G.

Figure 75, Figure 76, and Figure 77 each present an enlarged image of Figure 74 in the E area.

The word "immersion" means that metal alloy elements 37 and nonmetal alloy elements 38 are added using a certain method, to the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the electrolyte 5, just like the oil slowly infiltrated into the paper, but, at the same time, the ionic permeability and penetrability of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the electrolyte 5 should be ensured.

Based on the different requirements and conditions in practical applications, the metal alloy is selectively applied to the corresponding parts of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 using one or more of the following technological methods: chemical methods, such as chemical deposition, electroplating, ion plating, vapor deposition, vacuum ion plating, high pressure ion spraying coating, high temperature and high pressure ion spraying coating, synthesis, etc., and physical methods, such as the spraying method, molecular sputtering method, nano technology, ultrasonic mixing, etc., and biological methods such as biological bacteria, biological fermentation, biological bonding, etc.

Based on the different requirements and conditions in practical applications, the metal alloy is selectively applied to, or not applied to (no application is the most ideal and cost-effective,) the corresponding parts of the electrolyte 5 using one or more of the following technological methods: chemical methods, such as chemical deposition, electroplating, ion plating, vapor deposition, vacuum ion plating, high pressure ion spraying coating, high temperature and

high pressure ion spraying coating, synthesis, etc., and physical methods such as the spraying method, molecular sputtering method, nano technology, ultrasonic mixing, etc., as well as biological methods such as biological bacteria, biological fermentation, biological bonding, etc.

Using the techniques mentioned above, at least one nonmetal alloy element 38 is selectively applied to the responding parts of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

The most important factor is that by using the techniques mentioned above, at least one metal alloy element 37 (not limited to one) is combined with the membrane, membrane bag, bioactive film bag, biological active membrane 3, or at least one nonmetal alloy elements 38 (not limited to one) is combined with the membrane, membrane bag, bioactive film bag, biological active membrane 3, or also at least one (but not limited to one) metal alloy element 37 and at least one (but not limited to one) nonmetal alloy element 38 are combined with the membrane, membrane bag, bioactive film bag, biological active membrane 3 to form the inseparable, seamless, unique and original new structure and material of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 in the present world.

To summarize, the method above can also effectively solve a series of universal problems associated with metal-air fuel cells which have not been solved yet. For example: metal corrosion, discharge stop, current failure, power failure, high battery temperature, expansion, self-combustion in a short time, and other issues. Moreover, this method can more substantially reduce costs than the currently and widely used methods for the research and development and exploration of metal and make them simpler and easier.

A metal alloy membrane bag is effectively formed by the above-mentioned technical process, which effectively replaces the metal fuel alloy (in order to reduce metal corrosion and prevent the metal from corrosion, the other anti-corrosion metal elements are continuously added to the metal. This method has been used in experiments for many years with no ideal solution; the cost still stays high due to multiple synthesis of an alloy metal, such as

aluminum alloy, zinc alloy, iron alloy, etc.). Our original invention does not require the use of an alloy metal, but instead directly uses a single metal, such as aluminum, magnesium, zinc, iron, tin, etc. The cost can be greatly reduced by the fact that the metal alloy membrane bag can be used repeatedly and a series of difficult problems can be safely, reliably and completely solved.

In Figure 76, the nonmetal alloy elements 38 are "immersed" in the membrane, the membrane bag, the bioactive film bag, and the bioactive membrane 3, i.e., at least one nonmetal alloy element 38 is immersed in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

In this context, the nonmetal alloy elements 38 consist of at least one nonmetal element, which is added to the metal fuel 24 to form the alloy metal fuel; this is herein referred to as nonmetal alloy elements being immersed in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. These nonmetal alloy elements 38 can be nonmetals in the periodic table such as silicon, carbon, selenium, iodine, sulfur, etc.

In Figure 77, the metal alloy elements 37 and the nonmetallic element 38 are "immersed" in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, i.e., at least one metal alloy element 37 and at least one nonmetal alloy element 38 are immersed in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3.

In this context, the metal alloy elements 37 consist of at least one metal element, which is added to the metal fuel 24 to form the alloy metal fuel; this is herein referred to as nonmetal alloy elements being immersed in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. These nonmetal alloy elements 37 can be nonmetals in the periodic table such as silicon, carbon, selenium, iodine, sulfur, etc. In this context, nonmetal alloy elements 38 consist of at least one nonmetal element, which is added to the metal fuel 24 to form the alloy metal fuel; this is herein referred to as nonmetal alloy elements being immersed in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. These nonmetal alloy elements 38 can be nonmetals in the periodic table such as silicon, carbon, selenium, iodine, sulfur, etc. In the same way, metal alloy elements 37 and

nonmetal alloy elements 38 can be “immersed” in the electrolyte 5 in different ways and techniques.

The metallic alloy element 37 is “immersed” in the electrolyte 5, i.e., at least one metal alloy element 37, different from the metal fuel 24, is “immersed” in the electrolyte 5.

The nonmetal alloy element 38 is “immersed” in the electrolyte 5, i.e., at least one non-metallic alloy element 38 is “immersed” in the electrolyte 5.

Metal alloy elements 37 and nonmetal alloy elements 38 are “immersed” in the electrolyte 5, i.e., at least one of the nonmetal alloy elements 38 is “immersed” in the electrolyte 5.

Similarly, metal alloy elements 37 and nonmetal alloy elements 38 can be made into the same structure of ion permeability as that of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and electrolyte 5 in order to directly replace the membrane, membrane bag, bioactive membrane bag, biological active membrane 3, and the electrolyte 5. This structure can also be combined into a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and electrolyte 5 in making a battery.

The innovative structure and technology of the invention not only has the function of eliminating the corrosion of the metal by the method of the alloy, but can also reduce the cost of manufacturing the alloy. Under normal circumstances, metal fuel 24 is made into an alloy, which can reduce the corrosion of the electrolyte to the metal fuel 24, thus reducing the self-discharge of the battery. However, each time after the battery is discharged, the metal alloy elements 37 in the metal fuel 24 will undergo a process of reduction, which requires more programs. Even after the completion of the reduction, it is necessary to increase the number of steps of alloying for making alloy metal fuel 24, in particular, for some precious metals and rare elements. This will definitely increase the production process and production costs of the battery alloy metal fuel 24. The structure and technology of the invention only needs to “immerse” the metal alloy elements 37 and non-metal alloy element 38 in the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and electrolyte 5 one time,

which will become a long-term solution to the problem of the corrosion of the metal fuel 24 and, as a result, the production process of the metal fuel 24 is reduced, and the production cost of the metal fuel 24 is reduced as well.

Aluminum alloy (A1) is used as the substrate, in which indium (In), magnesium (Mg), tin (Sn), lead (Pb) and more are added to make the aluminum alloy as the negative electrode of the battery, which has a smaller corrosion rate.

With the help of the innovative structure and technology of this invention, only indium In, magnesium Mg, tin Sn, lead Pb and other elements are required to added to the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and electrolyte 5, which will become a long-term solution to the problem of the corrosion of aluminum (A1), and as a result, the production process of the metal fuel 24 is reduced, and the production cost of the metal fuel 24 is reduced as well.

Example XII: Dynamic metal-air fuel cell structure

Figure 78, Figure 79, Figure 80, Figure 81, and Figure 82 feature several metal-air fuel cells of this innovation.

I. Figure 78 features a metal-air fuel cell of this invention with the dynamic structure of movement in the negative electrolyte fluid 8.

(1-1) First, an introduction to several components of a battery:

Negative electrolyte fluid pump 25, fluid inlet device of negative electrolyte fluid pump 251, fluid discharging device of negative electrolyte fluid pump 252, negative electrolyte fluid storage chamber 81, negative electrolyte fluid isolation device 82, negative electrolyte fluid storage chamber access channel 83, second negative electrolyte fluid storage chamber 811, second negative electrolyte fluid isolation device 821, second negative electrolyte fluid storage access channel 831, high temperature-resistant anti-freezing material for negative electrolyte fluid siphon film 43, and daub coating 35.

(DT-1) Negative electrolyte fluid pump 25: a device capable of pumping and running negative electrolyte fluid 8, withstanding the corrosion of the negative

electrolyte fluid 8, and being in use for a long time. It can be a diaphragm pump, a peristaltic pump, a vacuum pump, and other devices.

The power of the negative electrolyte fluid pump 25 can come from an external power supply, from a battery or from other devices. Its operation and stop are controlled by the battery controlling system.

(DT-2) Fluid inlet device of negative electrolyte fluid pump 251: a tube in which negative electrolyte fluid 8 can flow, referred to as the suction end of the negative electrolyte fluid pump 25. One side is connected to the second negative electrolyte fluid storage chamber 811, and its other side is connected to the negative electrolyte fluid pump 25. The negative electrode fluid 8 can be conducted into the negative electrolyte fluid pump 25 by means of a fluid inlet device of negative electrolyte fluid pump 251.

(DT-3) Fluid discharging device of negative electrolyte fluid pump 252: a tube in which negative electrolyte fluid 8 can flow, the outlet end of the negative electrolyte fluid pump 25. One side is connected to the negative electrolyte fluid storage chamber 81, and the other side is connected to the negative electrolyte fluid pump 25. Under the action of the negative electrolyte fluid pump 25, the negative electrode fluid 8 can be conducted into the negative electrolyte fluid pump 25 by means of the fluid discharging device of the negative electrolyte fluid pump 252.

(DT-4) Negative electrolyte fluid storage chamber 81: a hollow cavity in the shape of a cuboid, cube, cylinder, sphere and other shapes for storing the negative electrode 8 with at least two openings, one of which is the opening of the fluid inlet end of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, which is used to adsorb the negative electrode fluid 8, and then to adsorb the negative electrolyte fluid to the supplementary opening for the negative electrolyte fluid between the metal fuel 24 and the high temperature-resistant anti-freezing material for the siphon film 4.

The negative electrode fluid storage chamber 81 can be connected to the battery, so that it can share the battery shell and the supporting/fixing device with the other components of the battery, and it can also be separated from

the battery; or two or more cells share one negative electrolyte fluid storage chamber 81.

In order to prevent leakage of negative electrode fluid 8 from the two openings in the negative electrolyte fluid storage chamber 81, a plurality of adsorbing materials can be filled into the negative electrolyte fluid storage chamber 81 in order to attach the negative electrode fluid 8 to the adsorbing material; these materials can be chosen from: sponge, absorbent cotton, foam carbon nano-materials, glass fiber, etc. and the materials used for the negative electrolyte fluid storage chamber: ABS, polyethylene, polypropylene, PVC, plastic steel, alloy, metals, etc.

(DT-5) Negative electrolyte fluid isolation device 82

The negative electrolyte fluid storage chamber 81 is provided with an inlet opening for high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 in order to prevent leakage of the electrolyte fluid from this opening and from the siphon end of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43; it is configured with a negative electrolyte fluid isolation device 82, which will not affect the adsorption capacity of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43. The negative electrolyte fluid isolation device 82 is a sealing device which can be chosen from rubber sealing rings, PTFE sealing rubber rings, graphite sealing agent, etc.

(DT-6) Negative electrolyte fluid storage chamber access channel 83: an opening on the negative electrolyte fluid storage chamber 81, which is used for supplementing the negative electrolyte fluid, and can also be used for discharging negative electrolyte fluid 8. A switch is arranged on the negative electrolyte fluid storage chamber access channel 83, which is in the ON position when supplementing negative electrolyte fluid 8 and in the OFF position when finished. When negative electrolyte fluid 8 needs to be discharged, the switch on the negative electrolyte fluid storage chamber access channel 83 will be turned on; when the discharge is completed, it will be turned off.

(DT-7) Second negative electrolyte fluid storage chamber 811: The second negative electrolyte fluid storage chamber 811 is used to store negative electrolyte fluid 8 which comes from the negative electrolyte fluid storage chamber 81; after the negative electrolyte fluid is adsorbed from the negative electrolyte fluid storage chamber 81 by the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, it flows at a certain speed into the second negative electrolyte fluid chamber 811.

The second negative electrolyte fluid chamber 811 features a hollow cavity in the shape of a cuboid, cube, cylinder, sphere, or other shape, with at least two openings, one of which is the inlet opening of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 for the negative electrolyte fluid 8 to flow into the second negative electrolyte fluid chamber 811; the other one is the opening for supplementing or discharging negative electrolyte fluid 8.

The second negative electrolyte fluid storage chamber 811 can be connected to a battery, so it can share the battery shell and the supporting/fixing device with the other components of the battery, and it can also be separated from a battery; or two or more cells can share the same second negative electrolyte fluid storage chamber 811.

In order to prevent leakage of negative electrode fluid 8 from the two openings in the second negative electrolyte fluid storage chamber 811, a plurality of adsorbing materials can be filled into the second negative electrolyte fluid storage chamber 811 in order to attach the negative electrode 8 to the adsorbing materials, which can be chosen from: sponge, absorbent cotton, foam carbon nano-materials, glass fiber, etc., and the materials used for the second negative electrolyte fluid storage chamber 811 can be chosen from: ABS, polyethylene, polypropylene, PVC, plastic steel, alloy, metals, etc.

(DT-8) Second negative electrolyte fluid isolation device 821

The second negative electrolyte fluid storage chamber 81 is provided with an inlet opening for high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43; in order to prevent leakage of the electrolyte from this opening and from the siphon end of the high temperature-resistant anti-freezing material for the negative electrolyte fluid

siphon film 43 , the second negative electrolyte fluid isolation device 821 is arranged, which will not affect the adsorption capacity of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, and the negative electrolyte fluid isolation device 821 is a sealing device which can be chosen from rubber sealing rings, PTFE sealing rubber rings, graphite sealing agent, etc.

(DT-9) Second negative electrolyte fluid storage access channel 831: an opening on the second negative electrolyte fluid storage chamber 811, which is used for supplementing and discharging the negative electrolyte fluid 8. A switch is arranged on the second negative electrolyte storage chamber access channel 831, which is in the ON position when supplementing negative electrolyte fluid 8 and in the OFF position when finished. When negative electrolyte fluid needs to be discharged, the switch on the negative electrolyte fluid storage chamber access channel 83 will first be turned on; when the discharge is completed, it will be turned off.

(DT-10) High temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43

Structural characteristics: It is in the shape of a sheet, strip, rectangle, bar, polygon, circle, ellipse, triangle, polygon, etc. Its thickness can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m-1000 μ m, 1 mm-1000 mm, greater than 1 m, or any value within the range of 1 μ m – 100 μ m. Its length, width, diameter, and limit can be any value within the range of 0.001 nm-1 nm, 1 nm-1000 nm, 1 μ m – 1000 μ m, 1 mm-1000 mm, greater than 1 m. The shape of the cross section can be a regular rectangle or a wave shape, similar to the shape of asbestos tile or color steel tile. One end of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 is arranged inside the negative electrolyte fluid storage chamber 81, and the other end is arranged inside the second negative electrolyte fluid storage chamber 811; and negative electrolyte fluid 8 is sucked from the negative electrolyte fluid storage chamber 81 to the second negative electrolyte fluid storage chamber 811 at a certain speed. In addition to the fact that its two ends are respectively situated inside the negative electrolyte fluid storage chamber 81 and the second negative electrolyte fluid storage chamber 811, most of the remaining part is sandwiched between the metal fuel 24 and

the high temperature-resistant anti-freezing material for the siphon film 4, which provides an ion channel for the positive and negative electrodes of the battery. In particular, it should be noted here that, in Figure 78 and Figure 80, we can see that the daub coating 35 is located between the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 and the high temperature-resistant anti-freezing material for the siphon film 4. In fact, the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 is coated with daub coating 35.

(A) Operating characteristics: Negative electrolyte fluid 8 is sucked from a negative electrolyte fluid storage chamber 81 to a second negative electrolyte storage chamber 811 at a certain speed; the negative electrolyte fluid 8 is adsorbed to somewhere between the metal fuel 24 and the high temperature-resistant anti-freezing material for the siphon film 4, which provides an ion channel for the positive and negative electrodes of the battery. At the same time, a metal oxide which is generated on the metal fuel 24 due to discharge is carried into the second negative electrolyte fluid storage chamber 811 through the flow of the negative electrolyte fluid 8. The materials with adsorption capacity for high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 can be chosen from polyethylene membrane, polypropylene membrane, glass fiber membrane, PVC separation membrane, and other membranes, as well as foam nanocarbon, absorbent cotton, flax, etc.

(DT-11) Daub coating 35: Daub coating 35 is applied to the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, instead of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, while the methods used and the materials chosen are the same with no need for any further detailed description.

(1-2) Introduction to a metal-air fuel cell with a dynamic structure of movement in the negative electrolyte fluid 8

A metal-air fuel cell with a dynamic structure of movement in the negative electrolyte fluid 8 consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode air inlet device 14, an air

electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a negative electrolyte fluid pump 25, a fluid inlet device of the negative electrolyte fluid pump 251, a fluid discharging device of the negative electrolyte fluid pump 252, a daub coating 35, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, a high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, a shockproof buffer layer 7, a negative electrolyte fluid 8, a negative electrolyte fluid storage chamber 81, a negative electrolyte fluid isolation device 82, a negative electrolyte fluid storage chamber access channel 83, a second negative electrolyte fluid storage chamber 811, a second negative electrolyte fluid isolation device 821, a second negative electrolyte fluid storage room access channel 831, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and support/fixing device 103, etc.

The structure of the air positive electrode 1, the high temperature-resistant anti-freezing material for the siphon film 4, the positive electrolyte fluid 9 and more is the same as in Example I.

For the air positive electrode 1, the “all around” and “surrounding” parts of the air positive electrode air inlet device 14 are fixed on the battery shell and supporting/fixing device 10. This attachment can be directly achieved with glue, adhesive agents, etc., or by a mechanical extrusion of a sealing ring and a sealing pad, or by a pressure device; alternatively, it can also be achieved by other methods.

For the air positive electrode 1, the air positive electrode current collector 11 is connected to the air electrode carrier 15, the air positive electrode lug 12 of the air electrode is connected to the air positive electrode current collector 11, and the air positive electrode outlet circuit 13 of the air electrode is connected to the air positive electrode lug 12. The catalyst 16 can be applied to the air electrode carrier 15 using the chemical deposition method, vapor deposition method, ion plating method, electrolysis plating method, spraying method,

hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black restoring potassium permanganate method, nitrate and cobalt nitrate decomposition method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria method, biological fermentation method, biological bio-adhesive method and other methods of bonding technology. The “all around” and “surrounding” parts of the air electrode carrier 15 is fixed on the battery shell and supporting/fixing device 10 for a subsidiary support; then the above-mentioned secured air positive electrode air inlet device 14 is closely combined with the air electrode carrier 15 carrying the catalyst. In the process of their close combination, the air in between is discharged; thus, the preparatory work for the installation of the air positive electrode 1 is completed.

For the metal negative electrode 2, the metal negative current collector 21 is connected to the metal fuel 24, the metal negative lug 22 is connected to the metal negative current collector 21, and the metal negative outlet circuit 23 is connected to the metal negative lug 22. Thus, the preparatory work for the installation of the metal negative electrode 2 is completed. The negative electrolyte fluid pump 25 is connected to the fluid inlet device of the negative electrolyte fluid pump 251 and the fluid discharging device of the negative electrolyte fluid pump 252; the fluid inlet device of the negative electrolyte fluid pump 251 is connected to the second negative electrolyte fluid storage chamber 811; the liquid discharging device of the negative electrolyte pump 252 is connected to the negative electrolyte fluid storage chamber 81.

For the high temperature-resistant anti-freezing material for the siphon film 4, part of the ion terminal of the siphon film 42 of the high temperature-resistant anti-freezing material for the siphon film 4 is placed into the positive electrolyte fluid storage chamber 91 filled with positive electrolyte fluid 9, and the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

For the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, a daub coating 35 is applied to the high

temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43; one end of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 is placed into the negative electrolyte fluid storage chamber 81, which is filled with negative electrolyte fluid 8, and the negative electrolyte fluid isolation device 821 is used to seal the junction between the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 and the negative electrolyte fluid storage chamber 92; the other end is placed into the second negative electrolyte fluid storage chamber 811, and the negative electrolyte fluid isolation device 821 is used to seal the junction between the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 and the second negative electrolyte fluid storage chamber 921.

For the negative electrolyte fluid 8, negative electrolyte fluid 8 is added to the negative electrolyte fluid storage chamber 81 through the negative electrolyte fluid storage chamber access channel 83.

For the positive electrode fluid 9, positive electrode fluid 9 is added to the positive electrolyte fluid storage chamber 91 through the positive electrolyte fluid storage chamber access channel 93. After the high temperature-resistant anti-freezing material for the siphon film 4 has been placed into the positive electrolyte fluid storage chamber 91, the positive electrolyte fluid isolation device 92 is used to seal the junction of the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

In this way, the air positive electrode 1, the metal negative electrode 2, the high temperature anti-freezing material for the siphon film 4, the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, the shockproof buffer layer 7, the negative electrolyte fluid 8, the negative electrolyte fluid storage chamber 81, the positive electrolyte fluid 9, the positive electrolyte fluid storage chamber 91, the battery shell and support/fixing device 10, which are ready to be installed, can be assembled into a battery in accordance with Figure 78 and the characteristics of each component, as well as the actual requirements. When the positive and negative poles of the battery are connected with the load, the current output can be obtained.

See above for specific materials and specific functions of each component of a metal-air fuel cell with a dynamic structure of movement in the negative electrolyte fluid 8.

II. Figure 79 features a metal-air fuel cell of this invention with a dynamic structure of movement in the positive electrolyte fluid 9.

(2-1) First introduction to several battery components:

Positive electrolyte fluid pump 18, fluid inlet device of the positive electrolyte fluid pump 181, fluid outlet device of the positive electrolyte fluid pump 182, second positive electrolyte fluid storage chamber 911, second positive electrolyte fluid isolation device 921, second positive electrolyte fluid storage chamber access channel 931.

(DT-12) Positive electrolyte fluid pump 18: a device capable of pumping and running positive electrolyte fluid 9, withstanding the corrosion of the positive electrolyte fluid 9, and being in use for a long time. It can be a diaphragm pump, a peristaltic pump, a vacuum pump, and other devices.

The power of the positive electrolyte fluid pump 18 can come from an external power supply, from a battery or from other devices. Its operation and stop are controlled by the battery controlling system.

(DT-13) Fluid inlet device of the positive electrolyte fluid pump 181: a tube in which positive electrolyte fluid 9 can flow, referred to as the suction end of the positive electrolyte fluid pump 18. One side is connected to the second positive electrolyte fluid storage chamber 911, and its other end is connected to the positive electrolyte fluid pump 18. The positive electrolyte fluid 9 can be conducted into the positive electrolyte fluid pump 18 by means of a fluid inlet device of the positive electrolyte fluid pump 181.

(DT-14) Fluid outlet device of the positive electrolyte fluid pump 182: a tube in which positive electrolyte fluid 9 can flow, referred to as the outlet end of the positive electrolyte fluid pump 18. One side is connected to the positive electrolyte fluid storage chamber 91, and its other side is connected to the positive electrolyte fluid pump 18. Under the action of the positive electrolyte fluid pump 18, positive electrolyte fluid 9 can be conducted into the positive

electrolyte fluid pump 18 by means of a fluid outlet device of the positive electrolyte fluid pump 182.

(DT-15) Second positive electrolyte fluid storage chamber 911

The second positive electrolyte fluid storage chamber 911 is used to store positive electrolyte fluid 9, and the stored positive electrode fluid 9 comes from the positive electrolyte fluid storage chamber 91, and after being adsorbed by the high temperature-resistant anti-freezing material for the siphon film 4 from the positive electrolyte fluid storage chamber 91, it flows at a certain speed into the second positive electrode fluid storage chamber 911.

The second positive electrolyte fluid storage chamber 911 is a hollow cavity in the shape of a cuboid, cube, cylinder, sphere, or other shape, with at least two openings, one of which is the inlet opening of the high temperature-resistant anti-freezing material 4, used for the positive electrolyte fluid 9 to flow into the second positive electrolyte fluid chamber 911; the other one is the opening for supplementing or discharging the positive electrolyte fluid 8.

The second positive electrolyte fluid storage chamber 911 can be connected to the battery, so that it can share the battery shell and supporting/fixing device 10 with the other components of the battery, and it can also be separated from the battery, or two or more cells can share the same second positive electrolyte fluid storage chamber 911.

In order to prevent leakage of positive electrode fluid 9 from the two openings in the second positive electrolyte fluid storage chamber 911, a plurality of adsorbing materials can be filled into the second positive electrolyte fluid storage chamber 911 in order to attach the positive electrode fluid 9 to the adsorbing materials, which can be chosen from: sponge, absorbent cotton, foam carbon nano-materials, glass fiber, etc.

(DT-16) Second positive electrolyte fluid isolation device 921

The second positive electrolyte fluid isolation device 921 is provided with an inlet for the high temperature-resistant anti-freezing material for the siphon film 4, and in order to prevent leakage of the electrolyte fluid from this opening and the high temperature-resistant anti-freezing material for the

siphon film 4, the second positive electrolyte fluid isolation device 921 is arranged, which will not affect the adsorption capacity of the high temperature-resistant anti-freezing material for the siphon film 4; and the second positive electrolyte fluid isolation device 921 is a sealing device which can be chosen from a rubber ring, PTFE sealing rubber ring, graphite sealing agent, etc.

(DT-17) Second positive electrolyte fluid storage chamber access channel 931: an opening on the second positive electrolyte fluid storage chamber 911, which is used for supplementing or discharging positive electrolyte fluid 9. A switch is arranged on the second positive electrolyte fluid storage chamber access channel 931, which can be turned on when supplementing positive electrolyte fluid 9 and turned off when finished. When positive electrolyte fluid 9 needs to be discharged, the switch on the positive electrolyte fluid storage chamber access channel 931 will also be turned on; when the discharge is completed, it will be turned off.

(2-2) Introduction to a metal-air fuel cell with a dynamic structure of movement in the negative electrolyte fluid 8 as shown in Figure 79.

A metal-air fuel cell with a dynamic structure of movement in the negative electrolyte fluid 9 consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode air inlet device 14, an air electrode carrier 15, a catalyst 16, a positive electrolyte fluid pump 18, a fluid inlet device of the positive electrolyte fluid pump 181, a fluid outlet device of the positive electrolyte fluid pump 182, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a membrane bag edge bonding part 32, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a core 6, a shockproof buffer layer 7, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a

second positive electrolyte fluid storage chamber 911, a second positive electrolyte fluid isolation device 921, a second positive electrolyte fluid storage chamber access channel 931, a battery shell and support/fixing device 10, etc.

Among the above items, the structure of the metal negative electrode 2, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the high temperature-resistant anti-freezing material for the siphon film 4, the electrolyte 5, the core 6 and the shock-proof buffer layer 7 is the same as in Example I.

For the air positive electrode 1, the “all around” and “surrounding” parts of the air positive electrode air inlet device 14 are fixed on the battery shell and supporting/fixing device 10. This attachment can be directly achieved with glue, adhesive agents, etc., or by a mechanical extrusion of sealing rings and sealing pads, or by a pressure device; alternatively, it can also be achieved by other methods.

For the air positive electrode 1, the air positive electrode current collector 11 is connected to the air electrode carrier 15; the air positive electrode lug 12 is connected to the air positive electrode current collector 11; the air positive electrode outlet circuit 13 is connected to the air positive electrode lug 12. The catalyst 16 can be applied to the air electrode carrier 15 using the chemical deposition method, vapor deposition method, ion plating method, electrolysis plating method, spraying method, hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black restoring potassium permanganate method, nitrate and cobalt decomposition method, vacuum ion plating method, high temperature vacuum ion plating method, ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria method, biological fermentation method, biological bonding method and other methods. The “all around” and “surrounding” parts of the air electrode carrier 15 are fixed on the battery shell and supporting/fixing device 10 for supplementary support, and then the above-mentioned secured air positive electrode air inlet device 14 is closely combined with the air electrode carrier 15 carrying catalyst. In the process of their close combination, the air in between is discharged; thus, the preparatory work for the installation of the air positive electrode 1 is completed. The

positive electrolyte fluid pump 18 is connected to the fluid inlet device of the positive electrolyte fluid pump 181 and the fluid outlet device of the positive electrolyte fluid pump 182; the fluid inlet device of the positive electrolyte fluid pump 181 is connected to the second positive electrolyte fluid storage chamber 911; the fluid outlet device of the positive electrolyte fluid pump 182 is connected to the positive electrolyte fluid storage chamber 91.

For the metal negative electrode 2, the metal Negative current collector 21 is connected to the metal fuel 24. The metal negative lug 22 is connected to the metal negative current collector 21; the metal negative outlet circuit 23 is connected to the metal negative lug 22. The preparation of the metal negative electrode 2 for installation is completed.

For the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3: The separation membrane 33 and the septum 34 are made into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 according to a required size; daub coating 35 and daub coating B 36 are applied to the corresponding parts of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 according to a certain method. At the same time, the membrane bag sealing device 31 should be prepared.

For the high temperature-resistant anti-freezing material for the siphon film 4: One end of the high temperature-resistant anti-freezing material for the siphon film 4 is put into the positive electrolyte fluid storage chamber 91, and the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91; and the other end is put into the second positive electrolyte fluid storage room 911, and the positive electrolyte fluid isolation device 821 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the second positive electrolyte fluid storage chamber 911.

For the positive electrolyte fluid 9, the positive electrolyte fluid 9 is added to the positive electrolyte fluid storage chamber 91 through the positive electrolyte fluid isolation device 92.

After the high temperature anti-freezing material for the siphon film 4 has been placed in the positive electrolyte fluid storage chamber 91, the positive

electrolyte fluid isolation device 92 is used to seal the junction between the high temperature anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

For the electrolyte 5 and core 6: The finished electrolyte 5 is applied to the metal fuel 24. After treatment, it is placed into the membrane bag together with the core 6, according to a certain order; and the electrolyte 5 can also be made into a sheet structure and placed into the membrane bag together with the core 6 and metal fuel 24 according to a certain order; after that, the negative electrolyte fluid 8 is added into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, and after the electrode fluid 8 is immersed in the electrolyte 5, the core 6 and the metal fuel 24, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is sealed by the membrane bag sealing device 31. The membrane bag with its enclosed negative electrolyte fluid 8, electrolyte 5, core 6 and metal fuel 24 is fixed on the battery shell and supporting/fixing device 10. The membrane bag with its enclosed negative electrolyte fluid 8, electrolyte 5, core 6 and metal fuel 24, the part of the ion terminal of the siphon film 42 and the air positive electrode 1 are closely combined, exhausting air at the junction of the three, which can be operated directly in a vacuum glove box.

In this way, the air electrode positive electrode 1, the metal negative electrode 2, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, the high temperature-resistant anti-freezing material for the siphon film 4, the electrolyte 5, the core 6, the shockproof buffer layer 7, the negative electrolyte fluid 8, the positive electrolyte fluid 9, the positive electrolyte fluid storage chamber 91, the battery shell and support/fixing device 10, which are ready to be installed, can be assembled into a battery in accordance with Figure 79 and the characteristics of each component, as well as the actual requirements. When the positive and negative poles of the battery are connected with the load, the current output can be obtained.

See above for specific materials and specific functions of each component of a metal-air fuel cell with a dynamic structure of movement in the negative electrolyte fluid 8.

III. Figure 80 features the movement of the negative electrolyte fluid 8 of this invention

A metal-air cell with a dynamic invention of positive electrolyte fluid 9 also in movement

Fig. 80 features an introduction to a metal-air fuel cell with a dynamic structure of movement both in the negative electrolyte fluid 8 and the positive electrolyte fluid 9:

A metal-air fuel cell of the dynamic structure of movement both in the negative electrolyte fluid 8 and the positive electrolyte fluid 9 consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode air inlet device 14, an air electrode carrier 15, a catalyst 16, a positive electrolyte fluid pump 18, a fluid inlet device of the positive electrolyte fluid pump 181, a fluid outlet device of the positive electrolyte fluid pump 182, a metal negative electrode 2, a metal negative current collector 1, a metal negative lug 22, a metal negative outlet circuit 23, a metal fuel 24, a negative electrolyte fluid pump 25, a fluid inlet device of the negative electrolyte fluid pump 251, a fluid outlet device of the negative electrolyte fluid pump 252, a daub coating 35, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, a high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43, a shockproof buffer layer 7, a negative electrolyte fluid 8, a negative electrolyte fluid storage chamber 81, a negative electrolyte fluid isolation device 82, a negative electrolyte fluid storage chamber access channel 83, a second negative electrolyte fluid storage chamber 811, a second negative electrolyte fluid isolation device 821, a second negative electrolyte fluid chamber access channel 831, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a second positive electrolyte fluid storage chamber 911, a second positive electrolyte fluid isolation device 921, a second positive electrolyte fluid storage chamber access channel 931, a battery shell and support/fixing device 10, etc.

For the air positive electrode 1, the “all around” and “surrounding” parts of the air positive electrode air inlet device 14 are fixed on the battery shell and

supporting/fixing device 10. This attachment can be directly achieved with glue, adhesive agents, etc., or by a mechanical extrusion of a sealing ring and a sealing pad, or by a pressure device; alternatively, it can also be achieved by other methods.

For the positive electrode 1: The air positive electrode current collector 11 is connected to the air electrode carrier 15. The air positive electrode lug 12 of the air electrode is connected to the air electrode positive electrode current collector 11. The air positive electrode output circuit 13 of the air electrode is connected to the air positive electrode lug 12. The catalyst 16 can be applied to the air electrode carrier 15 using the chemical deposition method, vapor deposition method, ion plating method, electrolysis plating method, spraying method, hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black restoring potassium permanganate method, manganese nitrate, and cobalt nitrate decomposition, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria method, biological fermentation method, biological bonding method and other methods. The “all around” and “surrounding” parts of the air electrode carrier 15 are fixed on the battery shell and supporting/fixing device 10 as supplementary support, and then the above fixed air electrode air positive inlet device 14 is closely combined with the air electrode carrier 15 that is filled with catalyst. In the process of this close combination, the air in between them is discharged; thus, the preparatory work for installing the air electrode positive 1 is completed. The positive electrolyte fluid pump 18 is connected to the fluid inlet device of the positive electrolyte fluid pump 181 and the fluid outlet device of the positive electrolyte fluid pump 182; the fluid inlet device of the positive electrolyte fluid pump 181 is connected to the second positive electrolyte fluid storage room 911; the fluid outlet device of the positive electrolyte fluid pump 182 is connected to the positive electrolyte fluid storage chamber 91.

For the metal negative electrode 2, the metal negative current collector 21 is connected to the metal fuel 24; the metal negative lug 22 is connected to the metal negative current collector 21; the metal negative outlet circuit is

connected to the metal negative lug 22. Thus, the preparatory work for installing the metal negative 2 is completed. The negative electrolyte fluid pump 25 is connected to the fluid inlet device of the negative electrolyte fluid pump 251 and the fluid discharging device of the negative electrolyte fluid pump 252; the fluid inlet device of the negative electrolyte fluid pump 251 is connected to the second negative electrolyte fluid storage chamber 811; the fluid discharging device of the negative electrolyte fluid pump 252 is connected to the negative electrolyte fluid storage chamber 81.

For the high temperature anti-freezing material for the siphon film 4, part of the ion terminal of the siphon film 42 of the high temperature-resistant anti-freezing material for the siphon film 4 is placed into the positive electrolyte fluid storage chamber 91 filled with positive electrolyte fluid 9, and the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91. The other part of the high temperature-resistant anti-freezing material for the siphon film 4 is placed into the second positive electrolyte fluid storage chamber 911; the second positive electrolyte fluid isolation device 921 is used to seal the junction between the high temperature anti-freezing material for the siphon film 4 and the second positive electrolyte fluid storage chamber 911. For the high temperature anti-freezing material for the negative electrolyte fluid siphon film 43, a daub coating 35 is applied to the high temperature anti-freezing material for the negative electrolyte fluid siphon film 43. One end of the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 is put into the negative electrolyte fluid storage chamber 81 filled with negative electrolyte fluid 8, and the negative electrolyte fluid isolation device 82 is used to seal the junction between the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 and the negative electrolyte storage chamber 81; its other end is put into the second negative electrolyte fluid storage room 811, and the second negative electrolyte fluid isolation device 821 is used to seal the junction between the high temperature-resistant anti-freezing material for the negative electrolyte fluid siphon film 43 and the second negative electrolyte fluid storage chamber 921.

For the positive electrode fluid 9: Positive electrode fluid 9 is added to the positive electrolyte fluid storage chamber 91 through the positive electrolyte fluid storage chamber access channel 93. After the high temperature-resistant anti-freezing material for the siphon film 4 is placed into the positive electrolyte fluid storage chamber 91, the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

In this way, the air positive electrode 1, the metal negative electrode 2, the high temperature-resistant anti-freezing material for the siphon film 4, the shockproof buffer layer 7, the negative electrolyte fluid 8, the negative electrolyte fluid storage chamber 81, the positive electrolyte fluid 9, the positive electrolyte fluid storage chamber 91, the battery shell and support/fixing device 10, which are ready to be installed, can be assembled into a battery in accordance with Figure 80 and the characteristics of each component, as well as the actual requirements. When the positive and negative poles of the battery are connected with the load, the current output can be obtained.

See above for specific materials and specific functions of each component of a metal-air fuel cell with a dynamic structure of movement both in the negative electrolyte fluid 8 and the positive electrolyte fluid 9.

IV. Figure 81 features a metal-air fuel cell of this invention with a dynamic structure of movement in the metal electrode 2.

(4-1) First, an introduction to several battery components:

A semi-solid metal fuel 26, a metal fuel chamber 261, a metal fuel recycle room 262, a metal fuel discharge area 263, a metal fuel pump 27, a metal fuel pump feeding device 271, a metal fuel pump discharge device 272, a metal fuel recycle pump 28, a metal fuel recycle pump feeding device 281, a metal fuel recycle pump discharge device 282.

(DT-18) Semi-solid metal fuel 26: a semi-solid metal with a certain degree of fluidity or a metal mixture.

The semi-solid metal fuel 26 is the storage section of the whole battery capacity, whose effective weight and effective volume are the key to the energy density of the battery.

The materials for the semi-solid metal fuel 26 can be chosen from metal elements in the periodic table of elements such as zinc (Zn), magnesium (Mg), aluminum (Al), iron (Fe), lead (Pb), sodium (Na), potassium (K), calcium (Ca) and more; or from alloys made from one or more of these metals, such as Mg Al alloy, Pb Ca Fe alloy, Mg Al Fe Ge Mn alloy, etc., as well as from alloys made from one or two or more of these metals with non-metallic elements, such as carbon zinc alloy, carbon iron tin alloy, silicon aluminum magnesium calcium alloy, etc.

The semi-solid metal fuel 26 is a semi-solid mixture of powders, particles, conductive agents, thickeners and others of the above materials with a certain degree of fluidity.

(DT-19) Metal fuel chamber 261:

A hollow box for the storage of semi-solid metal fuel 26. Its shape can be rectangular, square, round, oval, triangular, etc. Its materials can be chosen from ABS, polyethylene, polypropylene, PVC, plastic steel, alloys, metals, etc.

(DT-20) Metal fuel recycle room 262:

A hollow box for the storage of semi-solid metal fuel 26 after its discharge. Its shape can be rectangular, square, round, oval, triangular, etc. Its materials can be chosen from ABS, polyethylene, polypropylene, PVC, plastic steel, alloys, metals, etc.

(DT-21) Metal fuel discharge area 263: Located between the metal negative current collector 21 and the separation membrane 33. In Figure 81, the metal negative current collector 21 is in the shape of a block, consistent with the size of the separation membrane 33; and the “all around” parts of the negative electrode current collector 21 and the separation membrane 33 are secured on the battery shell and support/fixing device 10; the negative electrode current collector 21 has a certain distance from the membrane 33; this distance is referred to as the metal fuel discharge area 263, where the semi-solid metal fuel 26 is discharged.

(DT-22) Metal fuel pump 27: A device capable of pumping and running semi-solid metal fuel 26 and capable of withstanding the corrosion of semi-solid metal fuel 26, and capable of being in use for a long time. It can be a membrane pump, a peristaltic pump, a vacuum pump, and other devices. The power of the metal fuel pump 27 can be derived from the external power supply, but it can also be derived from the battery itself, as well as other equipment. Its operation and stop are controlled by the battery management system.

(DT-23) Metal fuel pump feeding device 271: A tube in which semi-solid metal fuel 26 can flow and a suction end of the metal fuel pump 27. One side is connected to the metal fuel chamber 261, and the other side is connected to the metal fuel pump 27. Semi-solid metal fuel 26 can be conducted into the metal fuel pump 27 by means of a metal fuel pump feeding device 271.

(DT-24) Metal fuel pump discharging device 272: A tube in which semi-solid metal fuel 26 can flow and an outlet end of the metal fuel pump 27. One side is connected to the metal fuel discharge area 263, and its other side is connected to the metal fuel pump 27. Under the action of the metal fuel pump 27, the semi-solid metal fuel 26 can be conducted into the metal fuel discharge area 263 by means of a metal fuel pump discharging device 272.

(DT-25) Metal fuel recycle pump 28: A device capable of pumping and running semi-solid metal fuel 26, capable of withstanding the corrosion of semi-solid metal fuel 26, and capable of being in use for a long time. It can be a membrane pump, a peristaltic pump, a vacuum pump, and other devices. The power of the metal fuel recycle pump 28 can be derived from the external power supply, but it can also be derived from the battery itself, as well as other equipment. Its operation and stop are controlled by the battery management system.

(DT-26) Metal fuel recycle pump feeding device 281: A tube in which semi-solid metal fuel 26 which has finished its discharge can flow, and a suction end of the metal fuel recycle pump 28. One side is connected to the metal fuel discharge area 263, and its other end is connected to the metal fuel recycle pump 28. Semi-solid metal fuel 26 which has finished its discharge can

be conducted into the metal fuel recycle pump 28 by means of a metal fuel recycle pump feeding device 281.

(DT-27) Metal fuel recycle pump discharging device 282: A tube in which semi-solid metal fuel 26 which has finished its discharge can flow, and an outlet end of the metal fuel recycle pump 28. One side is connected to the metal fuel recycle room 262, and its other side is connected to the metal fuel recycle pump 28. Under the action of the metal fuel recycle pump 28, semi-solid metal fuel 26 which has finished its discharge can be introduced into the metal fuel recycle room 262 by means of a metal fuel recycle pump discharging device 282.

(4-2) Introduction to a metal-air fuel cell with a dynamic structure of movement in the metal electrode 2 as shown in Figure 81

A metal-air fuel cell with a dynamic structure of movement in the metal electrode 2 consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode air inlet device 14, an air electrode carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative lug 22, a metal negative outlet circuit 23, a semi-solid metal fuel 26, a metal fuel chamber 261, a metal fuel recycle room 262, a metal fuel discharge area 263, a metal fuel pump 27, a metal fuel pump feeding device 271, a metal fuel pump discharging device 272, a metal fuel recycle pump 28, a metal fuel recycle pump feeding device 281, a metal fuel recycle pump discharging device 282, a separation membrane 33, a high temperature anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, a shockproof buffer layer 7, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and support/fixing device 10, etc.

For the air positive electrode 1, the “all around” and “surrounding” parts of the air positive electrode air inlet device 14 are fixed on the battery shell and supporting/fixing device 10. This attachment can be directly achieved by

means of glue, adhesive agents, etc., or by a mechanical extrusion of a sealing ring and a sealing pad, or by a pressure device, or by other methods.

For the air positive electrode 1, the air positive electrode current collector 11 is connected to the air electrode carrier 15; the air positive electrode lug 12 is connected to the air positive electrode current collector 11; the air positive electrode outlet circuit 13 is connected to the air positive electrode lug 12. The catalyst 16 can be applied to the air electrode carrier 15 using the chemical deposition method, vapor deposition, ion plating, electrolysis plating method, spraying method, hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black restoring potassium permanganate method, manganese nitrate and cobalt nitrate decomposition, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria method, biological fermentation method, biological bonding method and other methods. The “all around” and “surrounding” parts of the air electrode carrier 15 is fixed on the battery shell and supporting/fixing device 10, and then the air intake device 14, as already fixed earlier, is closely combined with the air electrode carrier 15, which is filled with catalyst. In the process of combination, the air is discharged in between them. Thus, the preparatory work of installing the air electrode positive 1 is completed.

For the metal negative electrode 2, the metal negative current collector 21, secured to the battery shell and support/fixing device 10, forms the metal fuel recycle room 262 together with the separation membrane 33; the metal negative lug 22 is connected to the metal negative current collector 21, and the metal negative outlet circuit 23 is connected to the metal negative lug 22. Semi-solid metal fuel 26 is added to the metal fuel chamber 261; the metal fuel pump 27 is connected to the metal fuel pump feeding device 271 and the metal fuel pump discharging device 272; the metal fuel pump feeding device 271 is connected to the metal fuel chamber 261; the metal fuel pump discharging device 272 is connected to the metal fuel discharge area 263; the metal fuel recycle pump 28 is connected to the metal fuel recycle pump feeding device 281 and the metal fuel recycle pump discharging device 282; the metal fuel recycle pump feeding device 281 is connected to the metal fuel

discharge area 263; the metal fuel recycle pump discharging device 282 is connected to the metal fuel recycle room 262. In this way, the preparatory work for the installation of the metal negative electrode 2 is completed.

The separation membrane 33 is fixed on the battery shell and support/fixing device 10, and is coated with daub coating 35.

For the high temperature-resistant anti-freezing material for the siphon film 4, part of the ion terminal of the siphon film 42 of the high temperature-resistant anti-freezing material for the siphon film 4 is placed into the positive electrolyte fluid storage chamber 91 filled with positive electrolyte fluid 9, and a positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

For the positive electrode fluid 9, the positive electrode fluid 9 is added to the positive electrolyte fluid storage chamber 91 through the positive electrolyte fluid storage chamber access channel 93. After the high temperature-resistant anti-freezing material for the siphon film 4 is placed into the positive electrolyte fluid storage chamber 91, the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

In this way, the air positive electrode 1, the metal negative electrode 2, the high temperature-resistant anti-freezing material for the siphon film 4, the shockproof buffer layer 7, the negative electrolyte fluid 8, the positive electrolyte fluid storage chamber 91, and the battery shell and support/fixing device 10, which are ready to be installed, can be assembled into a battery in accordance with Figure 81 and the characteristics of each component, as well as the actual requirements. When the positive and negative poles of the battery are connected with the load, the current output can be obtained.

See above for specific materials and specific functions of each component of a metal-air fuel cell with a dynamic structure of movement in the metal negative electrode 2.

V. Figure 82 features a metal-air fuel cell with a dynamic structure of rotation in the metal negative electrode 2.

(5-1) First, an introduction to several battery components:

Negative rotation motor 29, negative rotation axis 291, rotating seal 292

(DT-28) Negative rotation motor 29: a motor that drives the metal fuel 24 to rotate at a certain speed, which is fixed on the battery shell and support/fixing device 10. The power output end of the negative rotation motor 29, connected to the negative rotation axis 291, transmits power to the metal fuel 24, which is of a circular turntable type. The power of the negative rotation motor 29 can be derived from the external power supply, but can also be derived from the battery itself, as well as other equipment. Its operation and stop are controlled by the battery management system.

(DT-29) Negative rotation axis 291:

The only transmission device, one end of which is connected to the power output end of the negative rotation motor 29 and the other end of which is connected to the metal fuel 24, transmits the power of the negative rotation motor 29 to the metal fuel 24 and drives the metal fuel 24 to rotate at a certain speed.

(DT-30) Rotating seal 292: a sealing device; materials available: sealing rubber ring, PTFE sealing rubber ring, graphite sealing agent, etc. Without affecting the optional configuration of the metal fuel 24, it prevents leakage of electrolyte fluid from the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. It is located between the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 and the negative rotation axis 291.

(5-2) Introduction to a metal-air fuel cell with a dynamic structure of rotation in the metal negative electrode 2.

The metal-air fuel cell with a dynamic structure of rotation in the metal electrode 2 consists of an air positive electrode 1, an air positive electrode current collector 11, an air positive electrode lug 12, an air positive electrode outlet circuit 13, an air positive electrode air inlet device 14, an air electrode

carrier 15, a catalyst 16, a metal negative electrode 2, a metal negative current collector 21, a metal negative electrode lug 22, a metal negative outlet circuit 23, a metal fuel 24, a negative rotation motor 29, a negative rotation axis 291, a rotating seal 292, a membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, a membrane bag sealing device 31, a separation membrane 33, a septum 34, a daub coating 35, a daub coating B 36, a high temperature-resistant anti-freezing material for the siphon film 4, a siphon end of the siphon film 41, an ion terminal of the siphon film 42, an electrolyte 5, a negative electrolyte fluid 8, a positive electrolyte fluid 9, a positive electrolyte fluid storage chamber 91, a positive electrolyte fluid isolation device 92, a positive electrolyte fluid storage chamber access channel 93, a battery shell and support/fixing device 10, etc.

For the air positive electrode 1, the “all around” and “surrounding” parts of the air positive electrode inlet device 14 are fixed on the battery shell and the supporting/fixing device 10. This attachment can be directly achieved with glue, adhesive agents, etc., or by a mechanical extrusion of sealing rings and sealing pads, or by a pressure device; alternatively, it can also be achieved by other methods.

For the air positive electrode 1, the air positive electrode current collector 11 is connected to the air electrode carrier 15; the air positive electrode lug 12 is connected to the air positive electrode current collector 11; the air positive electrode outlet circuit 13 is connected to the air positive electrode lug 12. The catalyst 16 can be applied to the air electrode carrier 15 using the chemical deposition method, vapor deposition method, ion plating, electrolysis plating method, spraying method, hydrothermal method, normalization method, microwave method, normalization and microwave method, acetylene black restoring potassium permanganate method, permanganate nitrate and cobalt nitrate decomposition method, vacuum ion plating method, high temperature vacuum ion plating method, high temperature and high pressure ion plating method, high temperature and high pressure spraying ion plating method, biological bacteria method, biological fermentation method, biological bonding method and other methods. The “all around” and “surrounding” parts of the air electrode carrier 15 are fixed on the battery shell and supporting/fixing device 10 for supplementary support, and then the above fixed air intake

device 14 is closely combined with the air electrode carrier 15 filled with catalyst. In the process of this combination, the air is discharged from in between them. Thus, the preparatory work for installing the air electrode positive 1 is completed.

For the metal negative electrode 2, the metal negative current collector 21 is connected to the metal fuel 24, the metal negative lug 22 is connected to the metal negative current collector 21, and the metal negative outlet circuit 23 is connected to the metal negative lug 22; the negative rotation motor 29 is secured on the battery shell and support/fixing device 10 and the negative electrode electrolyte pump liquid outlet device 252; the negative rotation axis 291 is connected to the negative rotation motor 29; the negative rotation axis 291 is connected to the metal fuel 24. The rotation seal 292 is installed in between the negative rotation axis 291 and the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3. Thus, the preparatory work for installing the metal negative electrode 2 is completed.

For the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3, the separation membrane 33 and the septum 34 are made into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 according to the required size; a daub coating 35 and daub coating B 36 are applied to the corresponding parts of the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 according to a certain method. At the same time, the membrane bag sealing device 31 should be prepared.

For the high temperature-resistant anti-freezing material for the siphon film 4, part of the ion terminal of the siphon film 42 of the high temperature anti-freezing material for the siphon film 4 is placed into the positive electrolyte fluid storage chamber 91 filled with positive electrolyte fluid 9; and the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material 4 and the positive electrolyte fluid storage chamber 91.

For the positive electrolyte fluid 9, which is added to the positive electrolyte fluid storage chamber 91 through the positive electrolyte fluid isolation device 92, and after the high temperature-resistant anti-freezing material for the siphon film 4 is inserted into the positive electrolyte fluid storage chamber 91,

the positive electrolyte fluid isolation device 92 is used to seal the junction between the high temperature-resistant anti-freezing material for the siphon film 4 and the positive electrolyte fluid storage chamber 91.

For the electrolyte 5: The finished electrolyte 5 is applied to the metal fuel 24 and, after treatment, placed into the membrane bag in a certain order; and the electrolyte 5 can also be made into a sheet structure, and the metal fuel 24 is placed in the membrane bag according to a certain order. After the electrolyte 5 and the metal fuel 24 are placed into the membrane bag in a certain order, the negative electrolyte fluid 8 is added into the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3; after the electrolyte fluid is immersed in the electrolyte 5 and the metal fuel 24, the membrane, membrane bag, bioactive membrane bag, bioactive membrane 3 is sealed by the prepared membrane bag sealing device 31. A membrane bag with the negative electrolyte fluid 8, electrolyte 5, and metal fuel of 24 is fixed on the battery shell and the supporting/fixing device 10. The membrane bag with the negative electrode fluid 8, electrolyte and metal fuel 24, part of the ion terminal of the siphon film 42 and the air positive electrode 1 are closely combined, air is exhausted at the junction of the combination of these three, which can also be operated directly in a vacuum glove box.

In this way, the air positive electrode 1, the metal negative electrode 2, the high temperature-resistant anti-freezing material for the siphon film 4, the electrolyte 5, the negative electrolyte fluid 8, the positive electrolyte fluid 9, the positive electrolyte fluid storage chamber 91, the battery shell and support/fixing device 10, which are ready to be installed, can be assembled into a battery in accordance with Figure 82 and the characteristics of each component, as well as the actual requirements. When the positive and negative poles of the battery are connected with the load, the current output can be obtained.

See above for specific materials and specific functions of each component of a metal-air fuel cell with a dynamic structure of rotation in the metal negative electrode 2.

VI. Parallel-series structure of a metal-air fuel cell:

This invented cell can be connected in parallel and in series to form a battery pack; or at least two single cells are connected in series and in parallel into a battery pack according to different requirements and conditions, as is shown in Figure 83.

Recovery and reduction of metal oxides and metal hydroxides

After the discharge of a metal-air fuel cell, a metal is converted into metal oxide and metal hydroxide; the metal-converted metal oxides and metal hydroxides are recovered and reduced in the factory to regenerate the metal fuel.

After the recovery of the metal oxides and metal hydroxide as the discharged products of the metal fuels, the following methods can be used for reduction:

1) Electrolysis, using the power of a power plant: the electric energy of water power, thermal power, nuclear power, solar energy, wind power, etc., restores metal oxides and metal hydroxides to metal fuels by electrolysis; the metal fuel is then placed into a metal-air fuel cell to continue discharging so that a cycle of metal fuel in the battery is formed; and using the excess electric energy of a power plant: water power, thermal power, nuclear power, solar energy, wind power and more can be used to restore the metal oxide and metal hydroxide into metal fuel by electrolysis, thus achieving the regulation of the electric peak ratio of the electric power plant.

2) Direct reduction with fossil material: Coke is used to restore metal oxides and metal hydroxides to metal fuels. The metal fuel is then placed into a metal-air fuel cell to continue discharging so that a cycle of metal fuel in the battery is formed.

3) Thermal decomposition using solar thermal energy: The solar energy is focused, and the focused temperature restores metal oxides and metal hydroxides to metal fuels. The metal fuel is then placed into a metal-air fuel cell to continue discharging so that a cycle of metal fuel in the battery is formed.

In the process of cycle power generation through the reduction of aluminum hydroxide to aluminum with energy supplied by wind or solar energy (including hydropower), the conversion of the solar energy used can reach 40%-50% or even more, because the direct use of solar energy heat suffices to achieve the goal instead of first converting solar energy to electricity and then restoring aluminum hydroxide into aluminum in the process of using solar energy to reduce the aluminum hydroxide into aluminum. This direct use will increase the utilization of solar energy to 40%-50% with no need for silicon wafers and, as a result, it will reduce the cost of producing a large number of silicon wafers and completely eliminate the pollution caused by the production of silicon wafers.

4) Other methods.

Example XIII: Experimental data 1 of aluminum battery

The following, although specific parameters are given, are only intended to illustrate the present invention and should not be understood as limitations to the present invention.

1. Composition of the battery

The structure of the battery is the same as in Example 1. Herein, the separation membrane is made of a polypropylene film; the daub coating consists of butter; the high temperature-resistant anti-freezing material for the siphon film is a polyethylene separator; the electrolyte is a semi-solid electrolyte (starch: butter: 8% sodium hydroxide methanol solution: glass fiber powder, = 1: 5: 22: 0.5); the negative electrolyte fluid is an 8% sodium hydroxide methanol solution; the positive electrolyte fluid is a 10% sodium hydroxide water solution; the metal fuel is pure aluminum; the air electrode carrier is a carbon cloth, to which the catalyst is applied according to the method as shown in the above example. According to Example 1, a battery is fabricated and assembled.

2. Discharge test

1) Discharge test 1

Aluminum sheet size: 12 m X 12 cm X 0.03 cm

Mass of aluminum sheet: 17.56 g

Duration of discharge: 600 minutes (10 hours)

Mass of aluminum sheet 600 minutes later: 16.98 g

Aluminum consumption 600 minutes later: 0.58 g

Aluminum consumption per hour: 0.058 g

Average current: 340 mA

Average voltage: 1.22 V

Energy density: 7152 Wh/kg

The discharge curve is shown in Figure 98.

2) Discharge test 2

Aluminum sheet size: 5.5 m X 5.5 cm X 0.03 cm

Mass of aluminum sheet: 3.37 g

Duration of discharge: 600 minutes (10 hours)

Mass of aluminum sheet 600 minutes later: 3.24 g

Aluminum consumption 600 minutes later: 0.13 g

Aluminum consumption per hour: 0.013 g

Average current: 76 mA

Average voltage: 1.20 V

Energy density: 7015 Wh/Kg

The discharge curve is shown in Figure 99.

2) Early long term test

Aluminum sheet size: 5.5 m X 5.5 cm X 0.03 cm

Mass of aluminum sheet: 5.40 g

Duration of discharge: 14,230 minutes (273.16 hours)

Mass of aluminum sheet 14,230 minutes later: 3.43 g

Aluminum consumption 14,230 minutes later: 1.97 g

Aluminum consumption per hour: 0.0083066 g

Average current: 30mA

Average voltage: 1.25V

Energy density: 4514Wh/Kg

3. Negative corrosion test

3.1 Experimental grouping

Experimental group: The battery composition is the same as in test 1.

Aluminum sheet size: 12 m X 12 cm X 0.03 cm

Mass of aluminum sheet: 18.23 g

Control group: The battery structure is the same as in the experimental group, but there is no septum and no daub coating.

3.2 Test method

Control group: 10 cells; experimental group: 10 cells

Battery in room temperature environment

The air humidity is 45%.

Placed for 100 days

Take the aluminum sheet as an example to investigate the degree of corrosion.

3.3 Test result

Average corrosion rate 0.015% for the experimental group; average corrosion rate 15.76% for the control group.

4. Collision test

4.1 Experimental grouping:

Experimental group: The composition of a cell is the same as the above.

Aluminum sheet size: 12 m X 12 cm X 0.03 cm

Mass of aluminum sheet: 18.23 g

Control group: The battery structure is the same as in the experimental group, but there is no siphon material and no positive electrolyte storage chamber, and the positive electrolyte fluid is in direct contact with the air positive electrode.

4.2 Test method:

Control group: 10 cells; experimental group: 10 cells. Impact force: 300 kg, impact: three times for each cell.

4.3 Test result:

There was no explosion in the experimental group, and an explosion occurred in 3 cases in the control group.

Example XIV: Experimental data 2 of aluminum battery

The following, although specific parameters are given, are only intended to illustrate the present invention and should not be understood as limitations to the present invention.

1. Composition of the battery

The structure of the battery is the same as in Example 1. Herein, the separation membrane is made of a glass fiber membrane; tin, manganese, silicon and indium elements are added to the separation membrane and doped to the glass fiber film (thickness 50nm) by electroplating and sputtering. The molar ratio of tin, manganese, silicon and indium is 1.5: 1.5: 0.7: 1; no daub coating; the high temperature-resistant antifreeze material for the siphon film is a polyethylene separator; the electrolyte is a semi-solid electrolyte (the mass fraction ratio of ethyl cellulose, sheep's fat, 18% potassium hydroxide methyl sulfoxide solution and glass fiber powder is 1: 4:20: 3); the negative electrolyte

fluid is an 18% potassium hydroxide methyl sulfoxide solution; the positive electrolyte fluid is an 18% potassium hydroxide aqueous solution; the metal fuel is pure aluminum; % is mass percent. The air electrode carrier is a carbon cloth, and the manganese-based catalyst is applied onto the carrier using the decomposition method. According to Example 1, a battery is fabricated and assembled.

2. Discharge test

Aluminum sheet size: 5.5 m X 5.5 cm X 0.03 cm

Mass of aluminum sheet: 3.35 g

Duration of discharge: 600 minutes (10 hours)

Mass of aluminum sheet 600 minutes later: 3.22 g

Aluminum consumption 600 minutes later: 0.13 g

Aluminum consumption 600 minutes later: 0.013 g

Average current: 75 mA

Average voltage: 1.20 V

Energy density: 6923 Wh/Kg

3. Negative electrode corrosion test

3.1 Experimental grouping

Test group: The battery composition is the same as in Test 1.

Aluminum sheet size: 5.5 m X 5.5 cm X 0.03 cm

Mass of aluminum sheet: 3.53 g

Control group: The battery structure is the same as in the experimental group, but with no separation membrane material.

3.2 Test method

Control group: 10 cells; experimental group: 10 cells

Battery in room temperature environment

The air humidity is 45%.

Placed for 100 days

Take the aluminum sheet as an example to investigate the degree of corrosion.

3.3 Test result

The average corrosion rate of the experimental group was 0.017%, and the average corrosion rate of the control group was 16.87%.

Industrial applicability

The metal-air fuel cell of the invention has the advantages of large energy density, low cost and high safety, and it can be widely used in mobile phone batteries, power batteries and energy storage power plants.

CLAIMS

1. A metal air fuel cell comprising at least one positive unit and at least one negative unit,

wherein the positive unit comprises a positive air electrode comprising an air electrode carrier containing a catalyst, a positive electrolyte, and a wicking material, wherein the catalyst catalyzes oxygen and creates anions,

wherein the negative unit comprises a metal negative electrode containing metal fuel and a first negative electrolyte, wherein the metal fuel provides cations for a fuel cell's discharge,

wherein the wicking material conveys the positive electrolyte to the air electrode carrier, and connects the positive electrolyte to the air electrode carrier, wherein the metal negative electrode connects to the first negative electrolyte, wherein an ion path exists between the positive air electrode and the metal negative electrode,

wherein the metal air fuel cell comprises a hydrophobic structure layer between the positive air electrode and the metal negative electrode, wherein the hydrophobic structure layer is able to let an ion pass through, and has hydrophobicity,

wherein the negative unit further comprises a membrane which has one or more layer(s), wherein at least one of said one or more layers possesses a hydrophobic coating and forms the hydrophobic structure layer, wherein a material for the hydrophobic coating is selected from the group consisting of PTFE (polytetrafluoroethylene), polyethylene, microcrystalline wax, liquid paraffin, polyethylene wax, cream, butter, mutton fat, lard, fish oil, avian oil, bean oil, sunflower oil, colza oil, castor oil, peanut oil, and synthetic ester based compounds,

wherein the metal fuel is semisolid,

wherein the metal air fuel cell further comprises a metal fuel storage room and a metal fuel recycle room, wherein the metal fuel enters the metal fuel recycle

room from the metal fuel storage room after discharging via a negative discharge area of the fuel cell.

2. The metal air fuel cell of claim 1, wherein the negative unit contains the metal negative electrode, the first negative electrolyte and a second negative electrolyte.

3. The metal air fuel cell of claim 1, wherein the positive air electrode further comprises an air electrode positive collector, an air electrode positive lug and a positive output circuit, wherein the positive output circuit, the air electrode positive lug, the air electrode positive collector and the air electrode carrier sequentially connects to each other.

4. The metal air fuel cell of claim 1, wherein the positive unit further comprises an air electrode positive air inlet device, wherein the oxygen gets into the positive unit through the air electrode positive air inlet device, and touches the catalyst of the air electrode carrier.

5. The metal air fuel cell of claim 4, wherein the air electrode positive air inlet device has a breathable material layer, wherein the breathable material layer contains at least one of a waterproof breathable membrane and a carbon dioxide isolation membrane.

6. The metal air fuel cell of claim 1, wherein the catalyst is positioned inside and/or on the surface of the air electrode carrier.

7. The metal air fuel cell of claim 1, further comprising an air electrode catalyst coating that contains the catalyst on the surface of the air electrode carrier.

8. The metal air fuel cell of claim 7, wherein the air electrode catalyst coating is made of the catalyst, an adsorbent, a conductive agent, a dispersing agent and an adhesion agent.

9. The metal air fuel cell of claim 8, wherein the adsorbent is selected from the group consisting of an active carbon, an activated aluminum oxide, a molecular sieve, and a silica gel, wherein the conductive agent is selected from the group

consisting of acetylene black, graphene, graphite powder, carbon black, super carbon black, polyaniline, polyacetylene, polypyrrole, polythiophene, and metal powder, wherein the adhesion agent is selected from the group consisting of PTFE emulsion, fatty acid metal salt, polyvinyl acetate, polyvinyl alcohol, polyoxyethylene, PVP (poly vinyl pyrrolidone), polyvinylether, polymethyl methacrylate, polyvinylidene fluoride, PVC (polyvinyl chloride), polyacrylonitrile, polyvinyl pyridine, polystyrene, and their derivatives and copolymers.

10. The metal air fuel cell of claim 1, wherein the catalyst is selected from the group consisting of silver catalyst, perovskite-type catalyst, platinum catalyst, palladium catalyst, manganese catalyst, metal complex oxide catalyst, metallic oxide catalyst, organic metal catalyst, and metal complex catalyst.

11. The metal air fuel cell of claim 1, wherein the air electrode carrier is selected from the group consisting of: 1) a membrane structure, a chain structure, a fabric structure, a grain structure, a powder structure, nanometer materials made of carbon materials or carbon based materials, 2) a net structure, a foaming structure, a membrane structure, a fabric structure, a grain structure, a powder structure made of carbon nanomaterials, and 3) a net structure, a foaming structure, a membrane structure, a fabric structure, a grain structure, a powder structure made of metal and metal nanomaterials.

12. The metal air fuel cell of claim 11, wherein the air electrode carrier is selected from the group consisting of: 1) a carbon cloth, a carbon paper, a carbon fiber cloth, carbon nanofibers, a carbon nano paper, 2) a nickel wire mesh, a nickel plated steel wire mesh, a copper wire mesh, a nickel plated copper wire mesh, a copper coated wire mesh, and 3) a nickel foam, copper foam, a copper fiber, silver foam particles.

13. The metal air fuel cell of claim 1, wherein the metal negative electrode further comprises a metal negative collector, a metal negative lug, and a metal negative output circuit, wherein the negative output circuit, the metal negative lug, the metal negative collector, and the metal fuel sequentially connects to each other.

14. The metal air fuel cell of claim 1, wherein the metal fuel is selected from the group consisting of Lithium, Zinc, Magnesium, Aluminum, Iron, Lead, Sodium,

Potassium, Calcium, an alloy of metals thereof, and an alloy of one or more metals thereof and nonmetals.

15. The metal air fuel cell of claim 14, wherein the metal fuel is Aluminum.

16. The metal air fuel cell of claim 1, wherein the metal fuel pumps into the negative discharge area of the fuel cell via a metal fuel pump, and pumps into the metal fuel recycle room via a metal fuel recycle pump.

17. The metal air fuel cell of claim 1, wherein the semisolid metal fuel is selected from the group consisting of a fluid semisolid mixture made of powder or particles, a conductive agent, and a thickening agent, the fluid semisolid mixture being formed of one or more of materials selected from the group consisting of Zinc, Magnesium, Aluminum, Iron, Lead, Sodium, Potassium, and Calcium.

18. The metal air fuel cell of claim 1, wherein the hydrophobic structure layer exists at least between one group of two layers of the one or more layer(s).

19. The metal air fuel cell of claim 1, wherein the membrane is polyethylene film, polypropylene film, glass fiber separator, PVC diaphragm, or bacterial microbial biofilm.

20. The metal air fuel cell of claim 1, wherein the negative unit further comprises a second negative electrolyte, which fits with the membrane.

21. The metal air fuel cell of claim 1, wherein the membrane forms a membrane bag by itself or with supplementary materials.

22. The metal air fuel cell of claim 21, wherein at least one of the metal negative electrode, the first negative electrolyte and a second negative electrolyte are located inside the membrane bag.

23. The metal air fuel cell of claim 21, wherein the membrane bag has a membrane bag sealing device, which is located at an opening of the bag and is used for sealing up the opening of the bag.

24. The metal air fuel cell of claim 21, wherein the membrane bag contains the membrane and a septum, which form a bag shape together.
25. The metal air fuel cell of claim 24, wherein a material for the septum is PTFE, polyethylene, polyethylene, polypropylene, PVC (Polyvinyl Chloride) or ABS (Acrylonitrile Butadiene Styrene).
26. The metal air fuel cell of claim 1, further comprising a positive electrolyte first storage chamber, wherein part of the wicking material inserts into the positive electrolyte first storage chamber, while part of the wicking material touches the air electrode carrier.
27. The metal air fuel cell of claim 26, further comprising a positive electrolyte second storage chamber, wherein both ends of the wicking material insert into the positive electrolyte first storage chamber and the positive electrolyte second storage chamber, while middle part of the wicking material touches the air electrode carrier.
28. The metal air fuel cell of claim 27, wherein the positive electrolyte first storage chamber is connected to the positive electrolyte second storage chamber via piping, which is equipped with a positive electrolyte pump, wherein the positive electrolyte is achievable to circulate between the first storage chamber and the second storage chamber by driving the positive electrolyte pump.
29. The metal air fuel cell of claim 27, further comprising a positive electrolyte isolation device respectively at an entrance of where the wicking material is inserted into the positive electrolyte first and second storage chambers, wherein the positive electrolyte isolation device seals a junction between the wicking material and the positive electrolyte first and second storage chambers.
30. The metal air fuel cell of claim 1, wherein the air electrode carrier further comprises the wicking material, wherein the metal air fuel cell further comprises a positive electrolyte storage chamber, wherein part of the wicking material is inserted into the positive electrolyte storage chamber.

31. The metal air fuel cell of claim 1, wherein the negative unit contains the first negative electrolyte, as well as a mandrel, which has adsorbability so that it can absorb and store the first negative electrolyte, wherein the mandrel and the metal fuel touch each other.

32. The metal air fuel cell of claim 31, wherein the cell contains the first negative electrolyte, the mandrel and a third electrolyte, wherein the metal fuel is located in between the mandrel and the third electrolyte, and fits up with the mandrel and the third electrolyte respectively.

33. The metal air fuel cell of claim 1, wherein the negative unit contains a negative wicking material, wherein part of the negative wicking material fits up with the metal fuel, and conveys the first negative electrolyte to the metal fuel via the negative wicking material.

34. The metal air fuel cell of claim 33, wherein a face of the negative wicking material that faces the positive unit has the hydrophobic coating, which forms the hydrophobic structure layer.

35. The metal air fuel cell of claim 34, further comprising a negative electrolyte first storage chamber and a negative electrolyte second storage chamber, wherein both ends of the negative wicking material insert into the negative electrolyte first storage chamber and the second storage chamber respectively, while middle part of the negative wicking material touches the metal fuel.

36. The metal air fuel cell of claim 35, wherein the negative electrolyte first storage chamber is connected to the negative electrolyte second storage chamber via piping, which is equipped with a negative electrolyte pump, wherein the first negative electrolyte is achievable to circulate between the first storage chamber and the second storage chamber by driving the negative electrolyte pump.

37. The metal air fuel cell of claim 1, further comprising a third electrolyte wherein the electrolyte is solid or semisolid electrolyte that provides ion channel for the positive and negative electrodes, and provides ion moving for the negative electrode.

38. The metal air fuel cell of claim 37, wherein the third electrolyte is selected from the group consisting of: 1) Solid electrolyte: β -Al₂O₃, zirconium dioxide and ceramic material, 2) Polymer electrolyte: PEO series, Polyvinylidene fluoride series, Polymethyl methacrylate series and Polyacrylonitrile, and 3) Semi-solid electrolyte: which is made via reaction by taking at least one from oligosaccharide, polysaccharide, amylum, dextrin and ethyl cellulose, and at least one from lipid, higher order alkanes and esters, and at least one from carbon material, magnetic material and glass fiber, then mixing with at least one alkaline organic solution from caustic soda, caustic potash and lithium hydroxide under waterless environment.

39. The metal air fuel cell of claim 1, wherein the first negative electrolyte is an electrolyte that provides an ion moving for the negative electrode, wherein the first negative electrolyte is selected from the group consisting of:

an alkaline electrolyte: selected from the group consisting of one or more from caustic soda, caustic potash, lithium hydroxide, sodium Bicarbonate, calcium hydroxide, aluminum hydroxide, zinc hydroxide, sodium methoxide, and potassium methoxide and one or more organic solutions from ethanol, methanol, acetonitrile, dimethyl sulfoxide, and carbonic ester;

an acid electrolyte: selected from the group consisting of organic weak acid, inorganic weak acid and one or more organic solutions from ethanol, methanol, acetonitrile, dimethyl sulfoxide, and carbonic ester; and

a neutral electrolyte: selected from the group consisting of

(i) one or more salts selected from the group consisting of sodium chloride, sodium fluoride, sodium iodide, potassium chloride, potassium fluoride, and potassium iodide,

(ii) one or more organic selected from the group consisting of ethanol, methanol, acetonitrile, acetone, tetrahydrofuran, isopropanol, dimethyl sulfoxide, and carbonic ester; and

(iii) a metal halide ionic liquid made by a metal halide and one from hyamine or phosphonium salts and season sulfur salt.

40. The metal air fuel cell of claim 1, wherein the positive electrolyte is an electrolyte that provides an ion channel for the positive and negative electrodes, and provides ion running for the positive air electrode, wherein the positive electrolyte is selected from the group consisting of:

an alkaline electrolyte: selected from the group consisting of one or more from caustic soda, caustic potash, lithium hydroxide, sodium Bicarbonate, calcium hydroxide, aluminum hydroxide, sodium methoxide and potassium methoxide, and one or more organic solutions from ethanol, methanol, acetonitrile, dimethyl sulfoxide, and carbonic ester;

an acid electrolyte: selected from the group consisting of organic weak acid, inorganic weak acid and one or more organic solutions from ethanol, methanol, acetonitrile, dimethyl sulfoxide, and carbonic ester; and

a neutral electrolyte: selected from the group consisting of one or more salts selected from the group consisting of sodium chloride, sodium fluoride, sodium iodide, potassium chloride, potassium fluoride and potassium iodide, and one or more organic solvents selected from the group consisting of ethanol, methanol, acetonitrile, dimethyl sulfoxide, and carbonic ester.

41. The metal air fuel cell of claim 1, further comprising a rotation device, connected with the metal fuel, wherein the rotation device drives a rotation of the metal fuel.

42. The metal air fuel cell of claim 41, wherein the rotation device contains an electrical motor and a connector that connects the electrical motor and the metal fuel.

43. The metal air fuel cell of claim 1, further comprising a shockproof buffer structure, which has resilience, wherein the resilience from the shockproof buffer structure strongly and closely connects components in the cell.

44. The metal air fuel cell of any one of claims 1-43, wherein the metal air fuel cell contains two or more than two positive units.

45. The metal air fuel cell of any one of claims 1-43, wherein the metal air fuel cell contains two or more than two negative units.
46. The metal air fuel cell of any one of claims 1-43, further comprising a fuel cell shell and a stationary support unit, wherein the fuel cell shell and the stationary support unit firmly secure components in the cell.
47. The metal air fuel cell of claim 46, wherein the metal air fuel cell is of tubular shape, wherein both of the positive unit and the negative unit are of tubular shape and fit each other tightly and closely.
48. The metal air fuel cell of claim 46, wherein the metal air fuel cell is in cylinder shape, negative unit centered, wherein the negative unit is surrounded by the positive unit, and their composition and structure closely fit each other.
49. The metal air fuel cell of any one of claims 1-45, wherein a fuel cell shell is equipped with a ventilation device that is closed.
50. The metal air fuel cell of any one of claims 46-48, where the fuel cell shell is equipped with a ventilation device that is closed.
51. The metal air fuel cell of any one of claims 1-48, wherein the metal air fuel cell is included in a fuel cell pack.
52. The metal air fuel cell of any one of claims 1-45, further comprising an oxygen supply device, wherein the oxygen supply device is connected with a fuel cell shell and provides oxygen to the metal air fuel cell.
53. The metal air fuel cell of any one of claims 46-48, further comprising an oxygen supply device, wherein the oxygen supply device is connected with the fuel cell shell and provides oxygen to the metal air fuel cell.
54. The metal air fuel cell of any one of claims 52 and 53, further comprising an oxygen concentration sensor equipped inside the fuel cell shell, wherein the oxygen supply device adjusts oxygen density inside the fuel cell shell according to data from the oxygen concentration sensor.

55. The metal air fuel cell of any one of claims 1-45, wherein a fuel cell shell is equipped with an oxygen selective passing-through membrane, which allows oxygen to pass selectively.

56. The metal air fuel cell of any one of claims 46-48, wherein the fuel cell shell is equipped with an oxygen selective passing-through membrane, which allows oxygen to pass selectively.

57. The metal air fuel cell of any one of claims 1-45, wherein a fuel cell shell is equipped with a prevention membrane for preventing carbon dioxide from passing through.

58. The metal air fuel cell of any one of claims 46-48, wherein the fuel cell shell is equipped with a prevention membrane for preventing carbon dioxide from passing through.

59. The metal air fuel cell of any one of claims 1-45, wherein a fuel cell shell is equipped with an air filter device.

60. The metal air fuel cell of any one of claims 46-58, wherein the fuel cell shell is equipped with an air filter device.

1/65

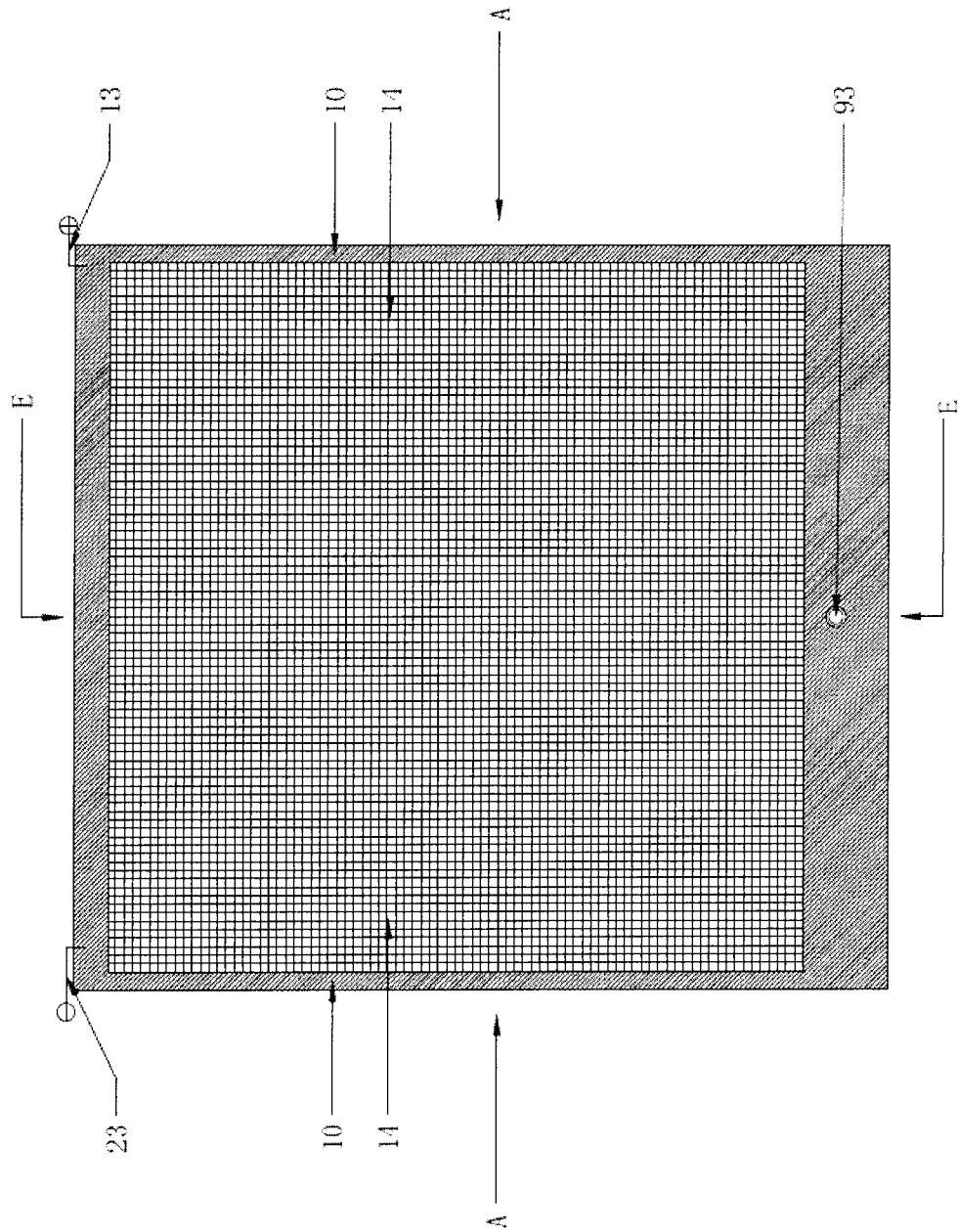


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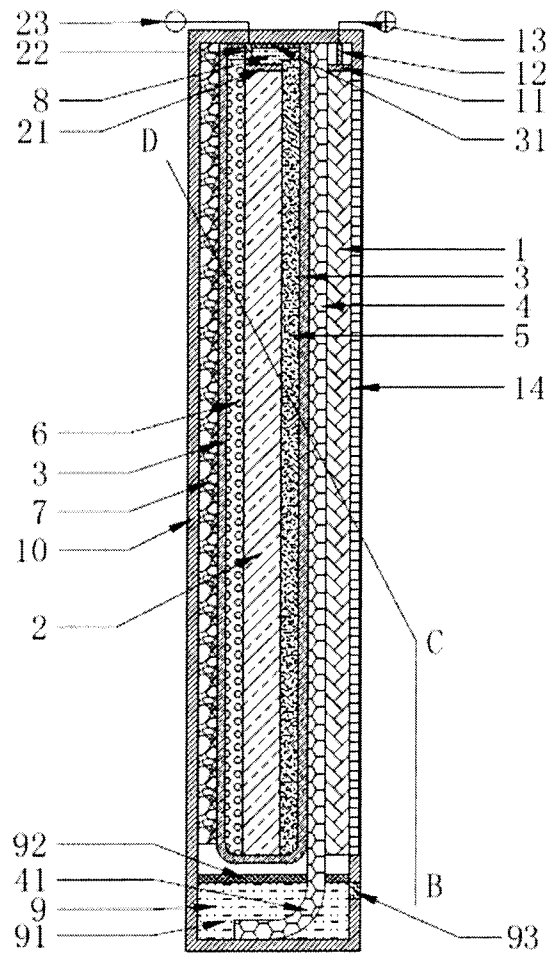


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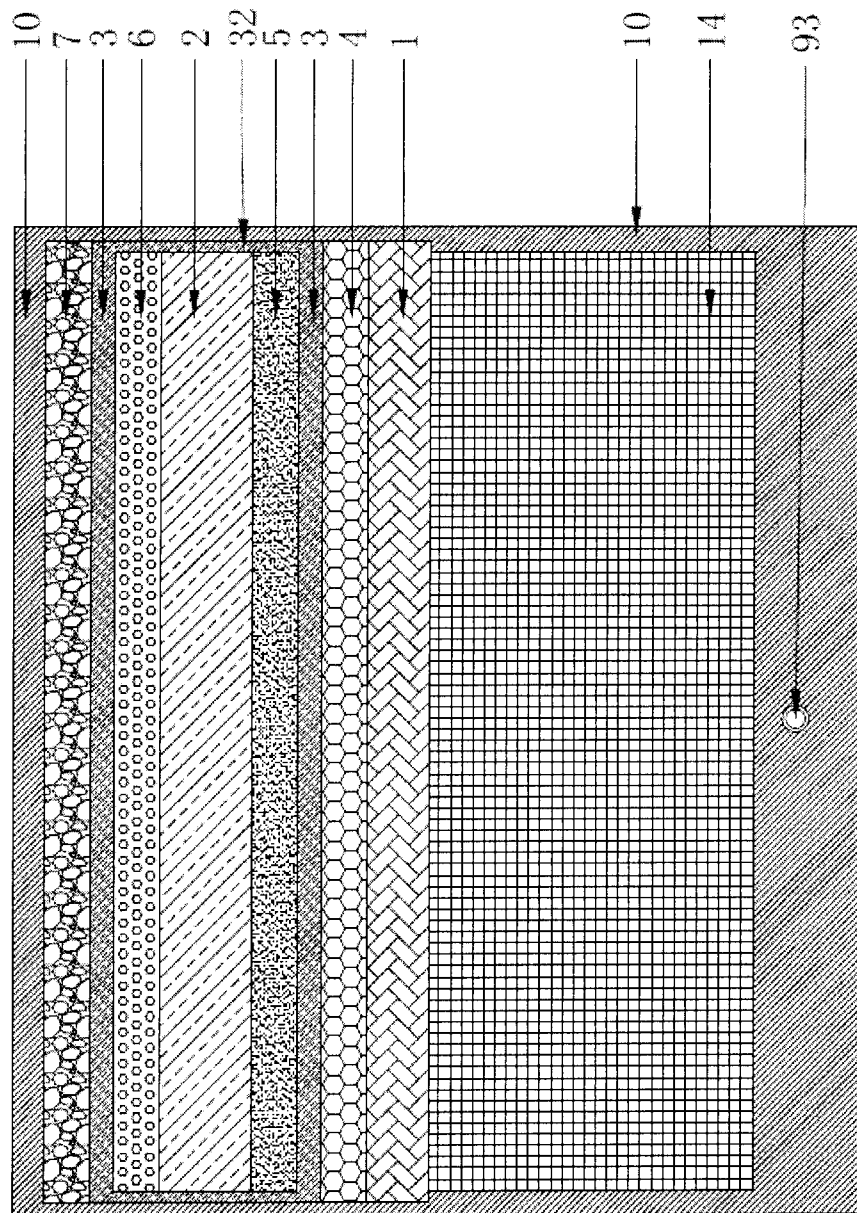


Figure 3

4/65

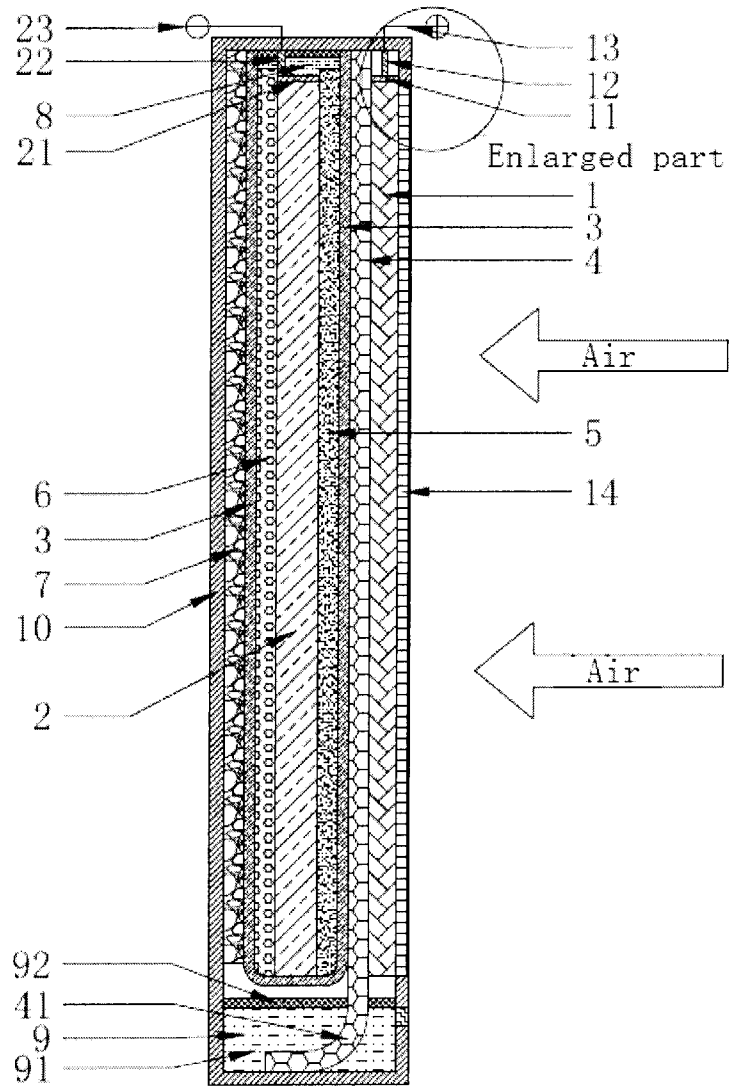


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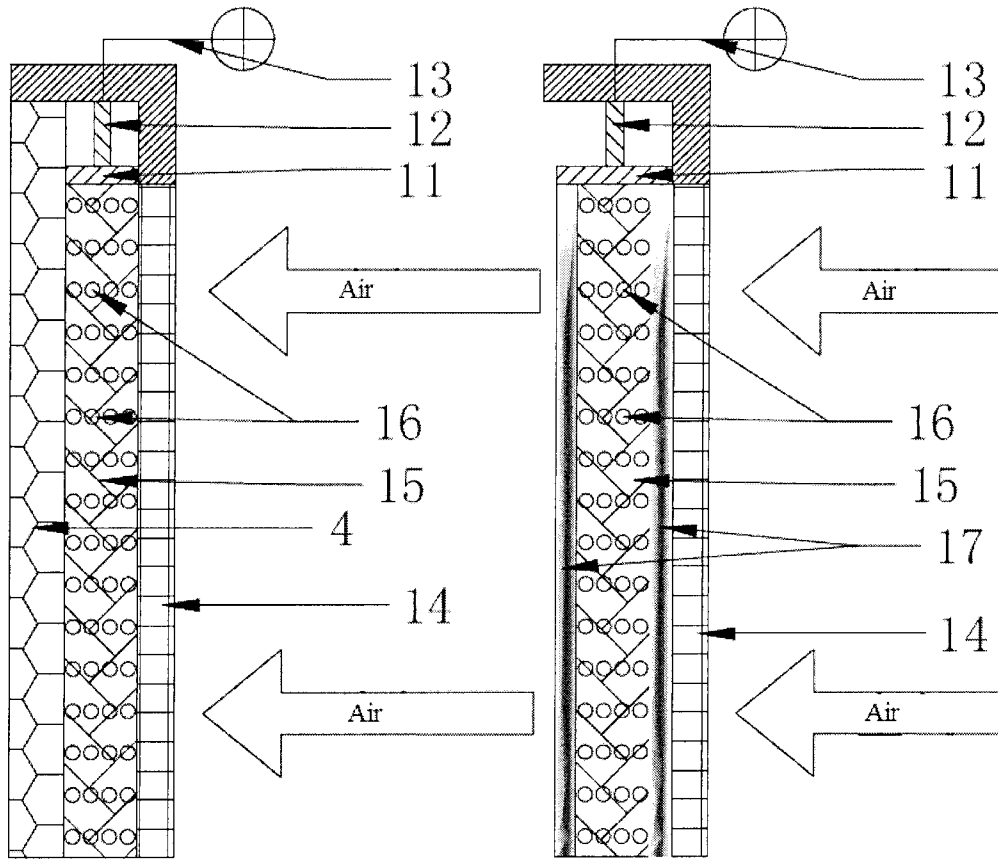


Figure 5

Figure 6

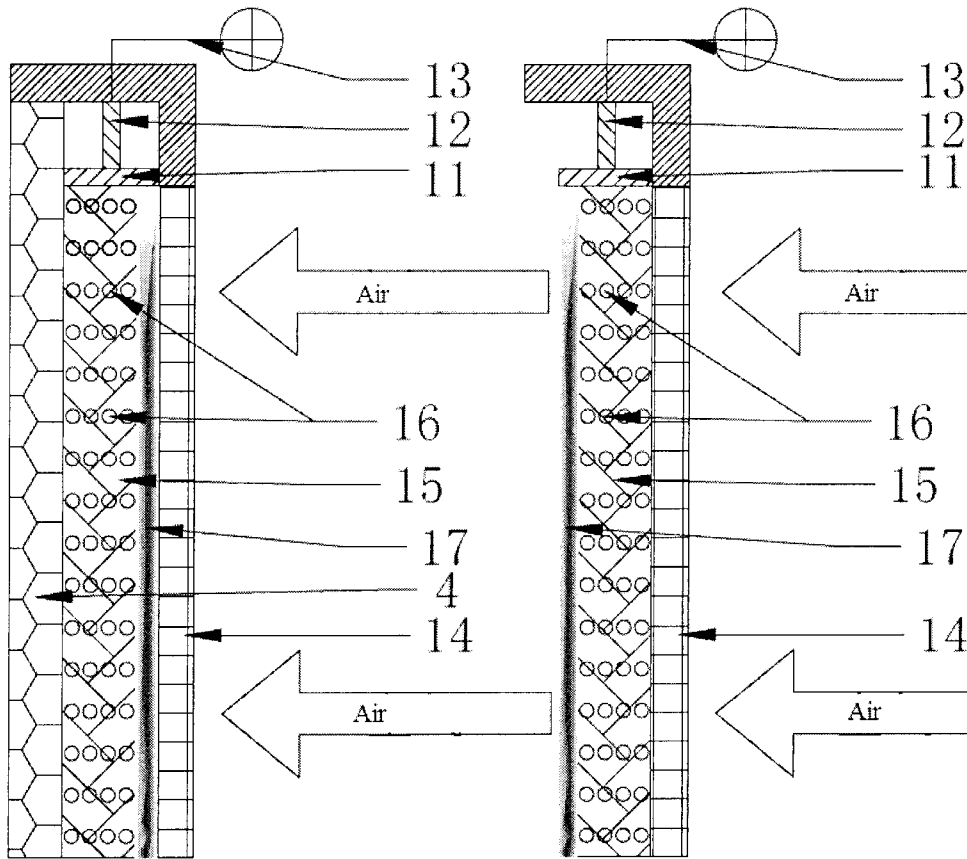


Figure 7

Figure 8

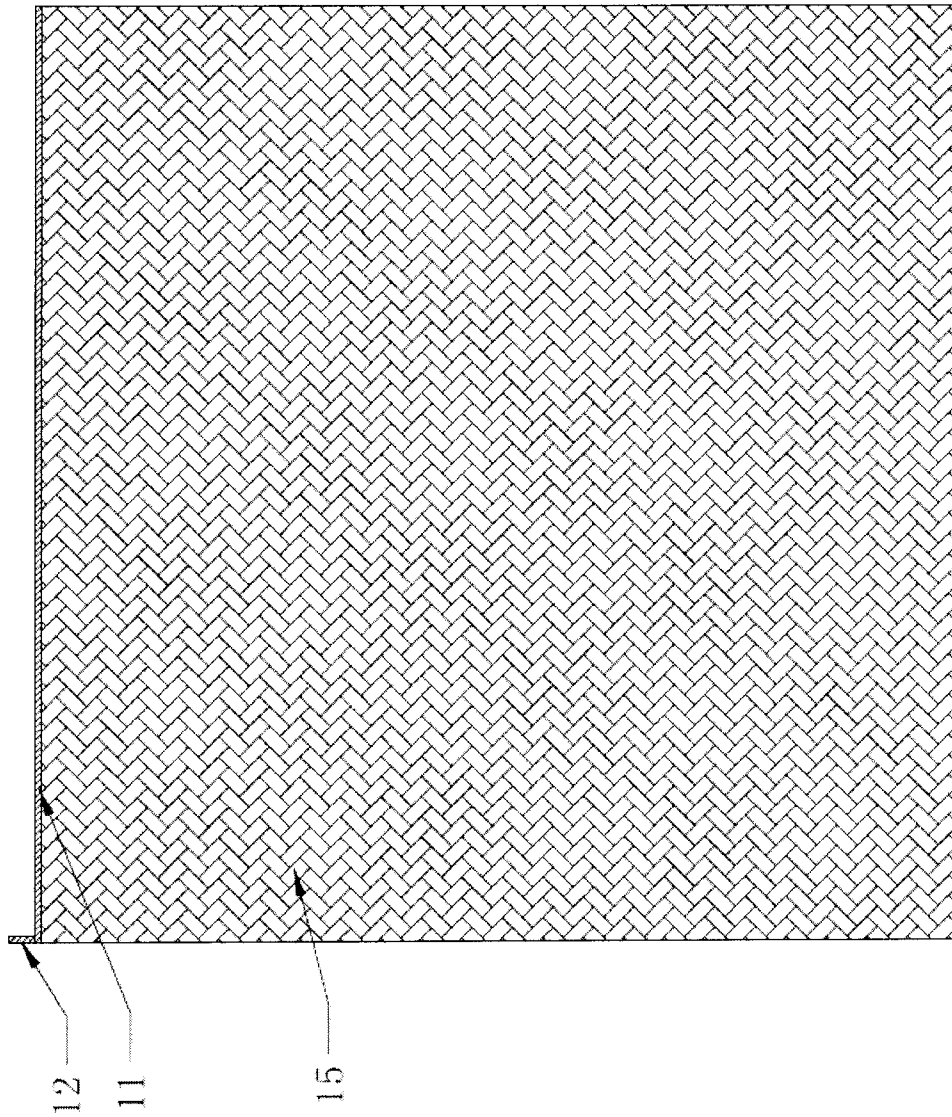


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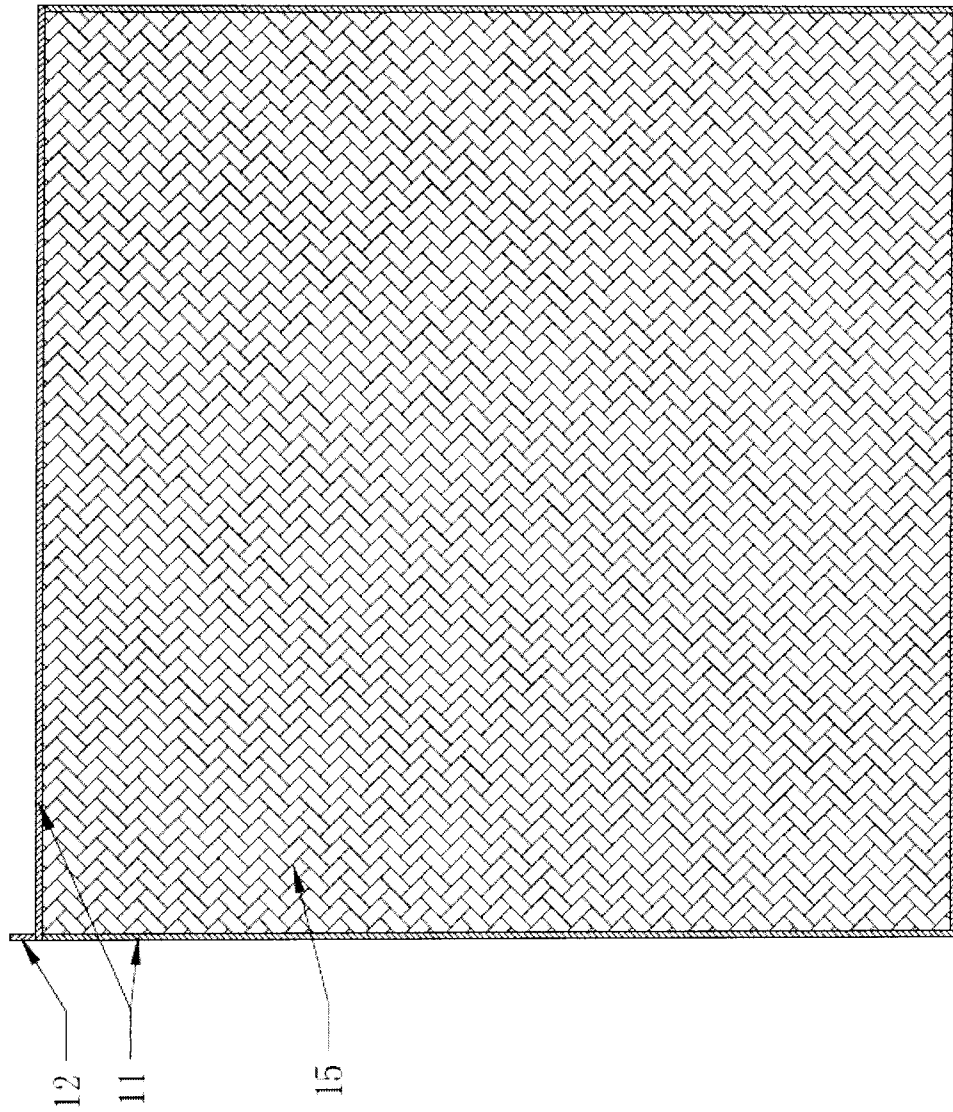


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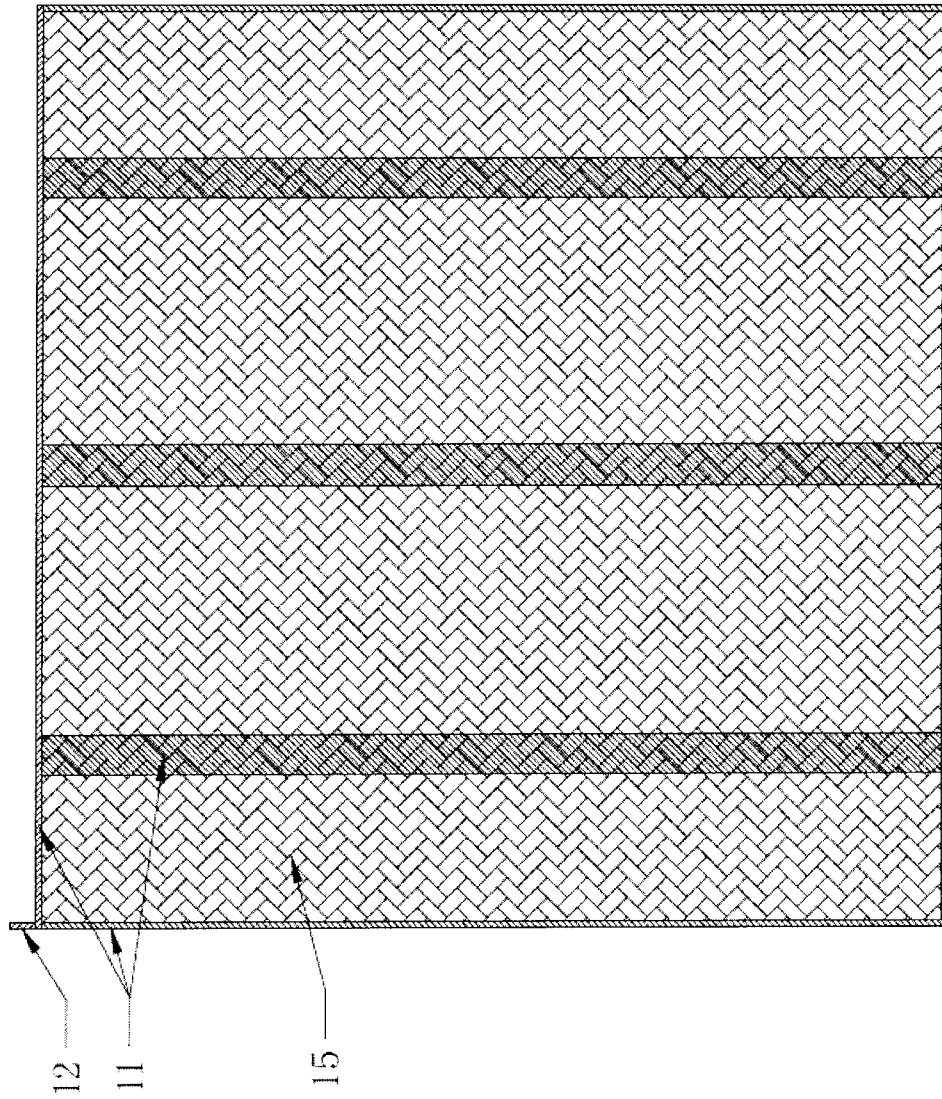


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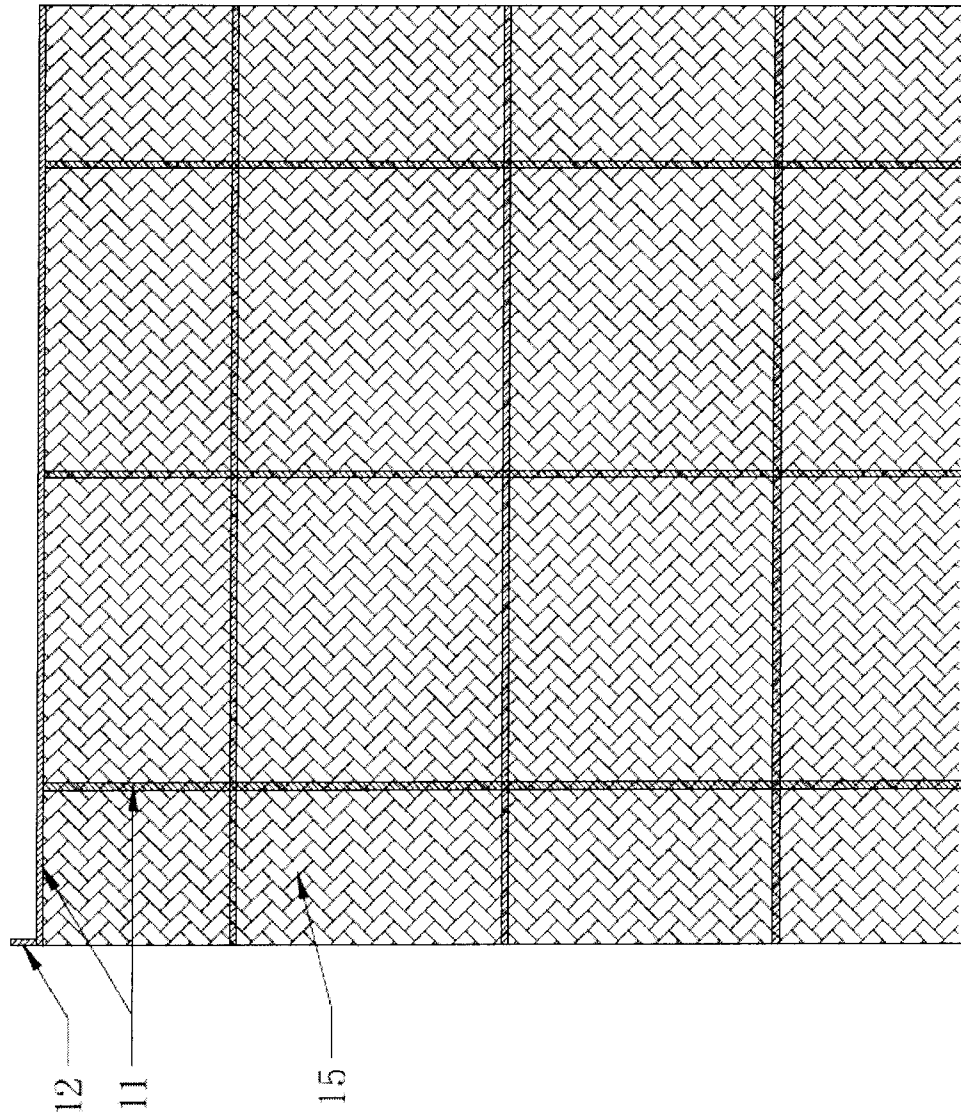


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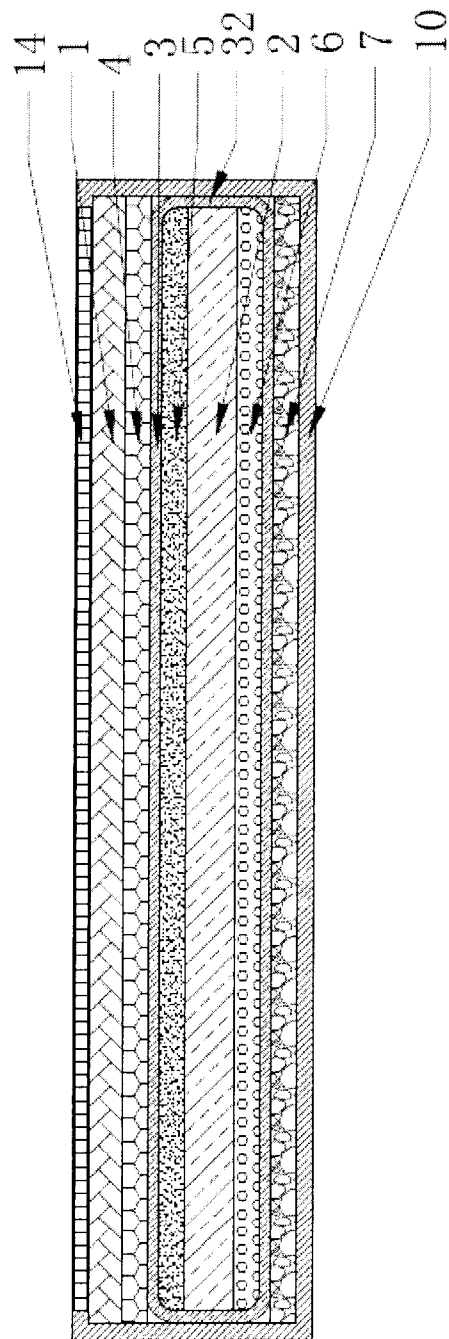


Figure 13

12/65

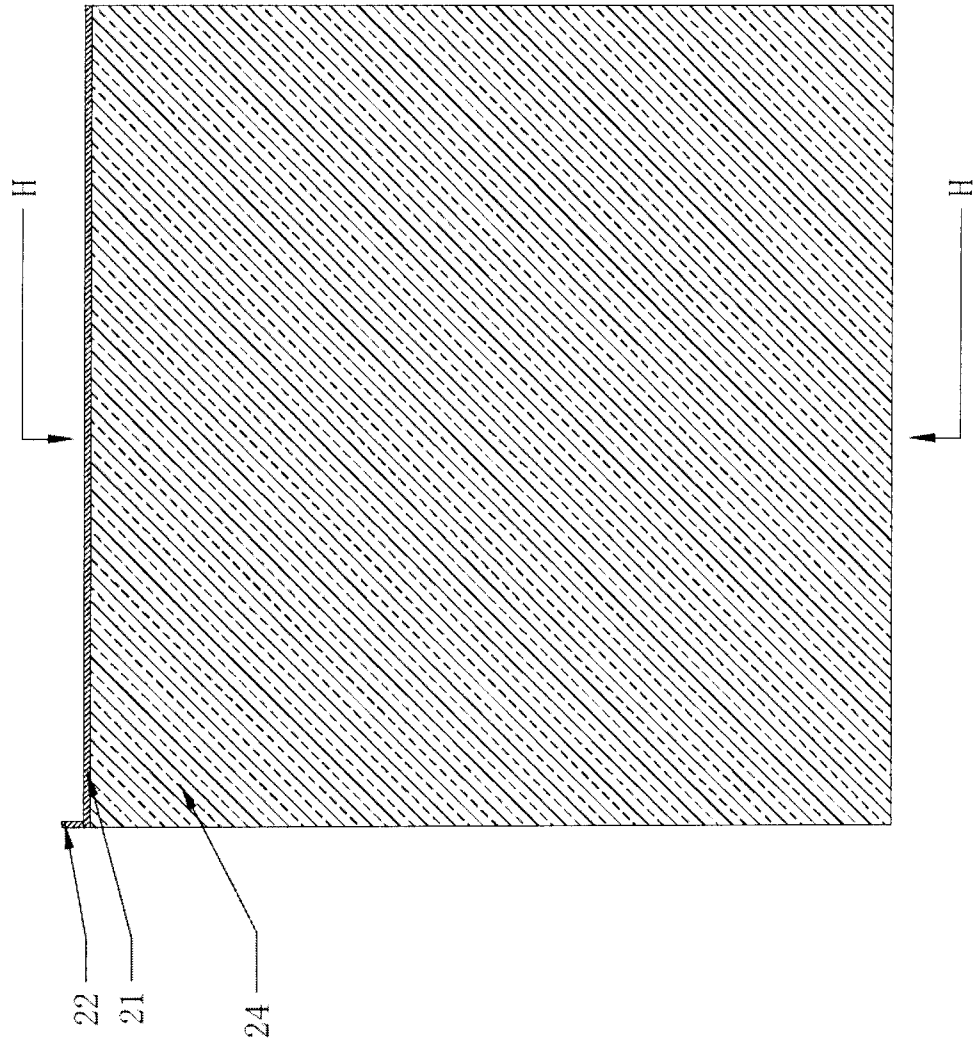


Figure 14



Figure 15

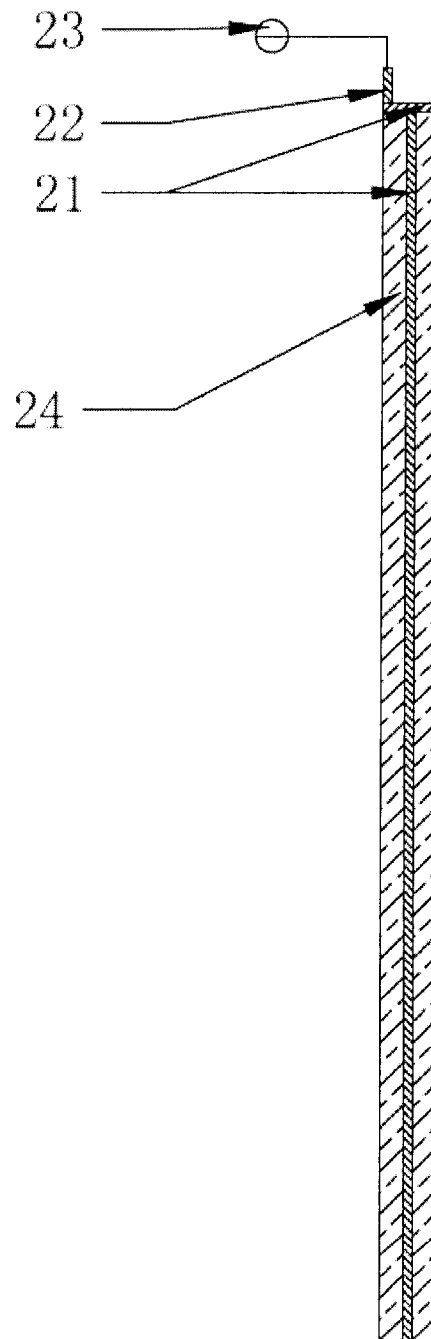


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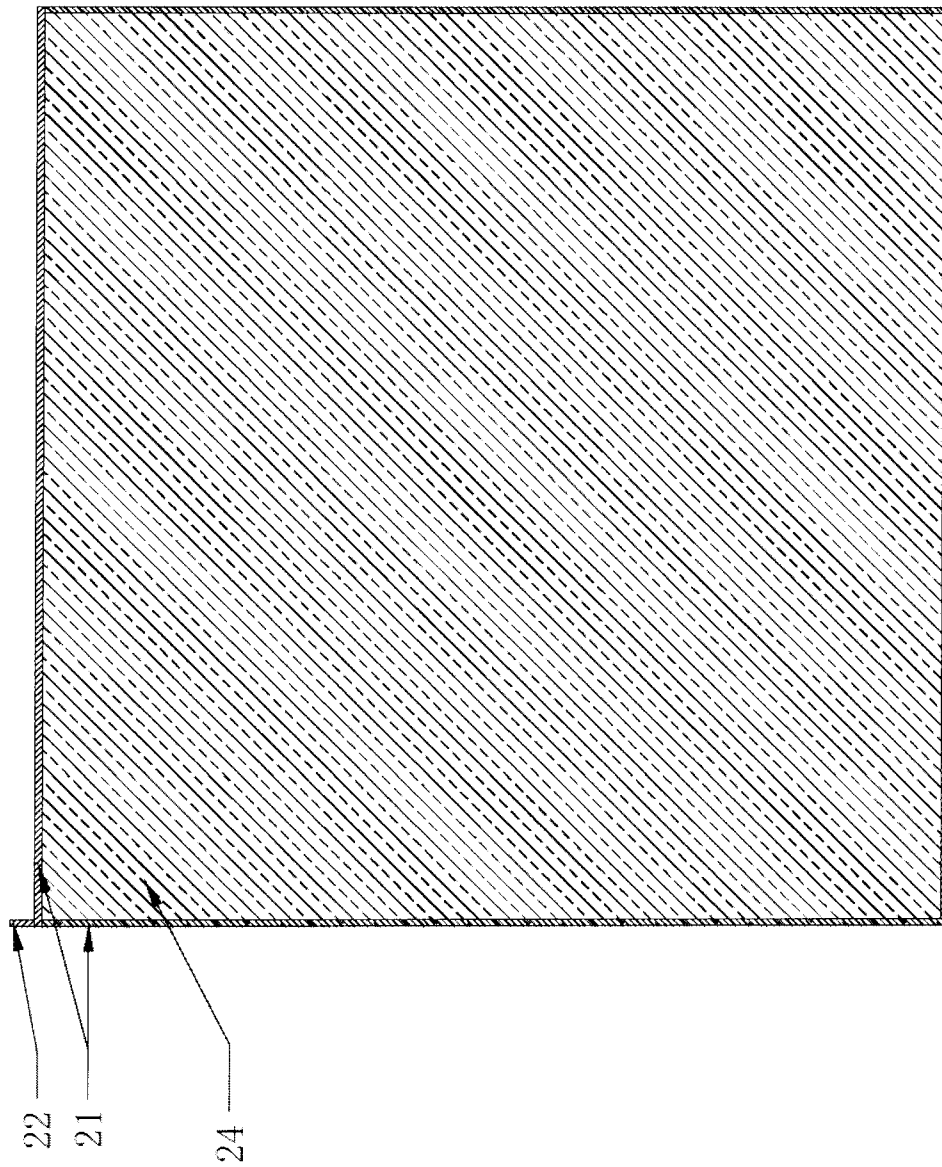


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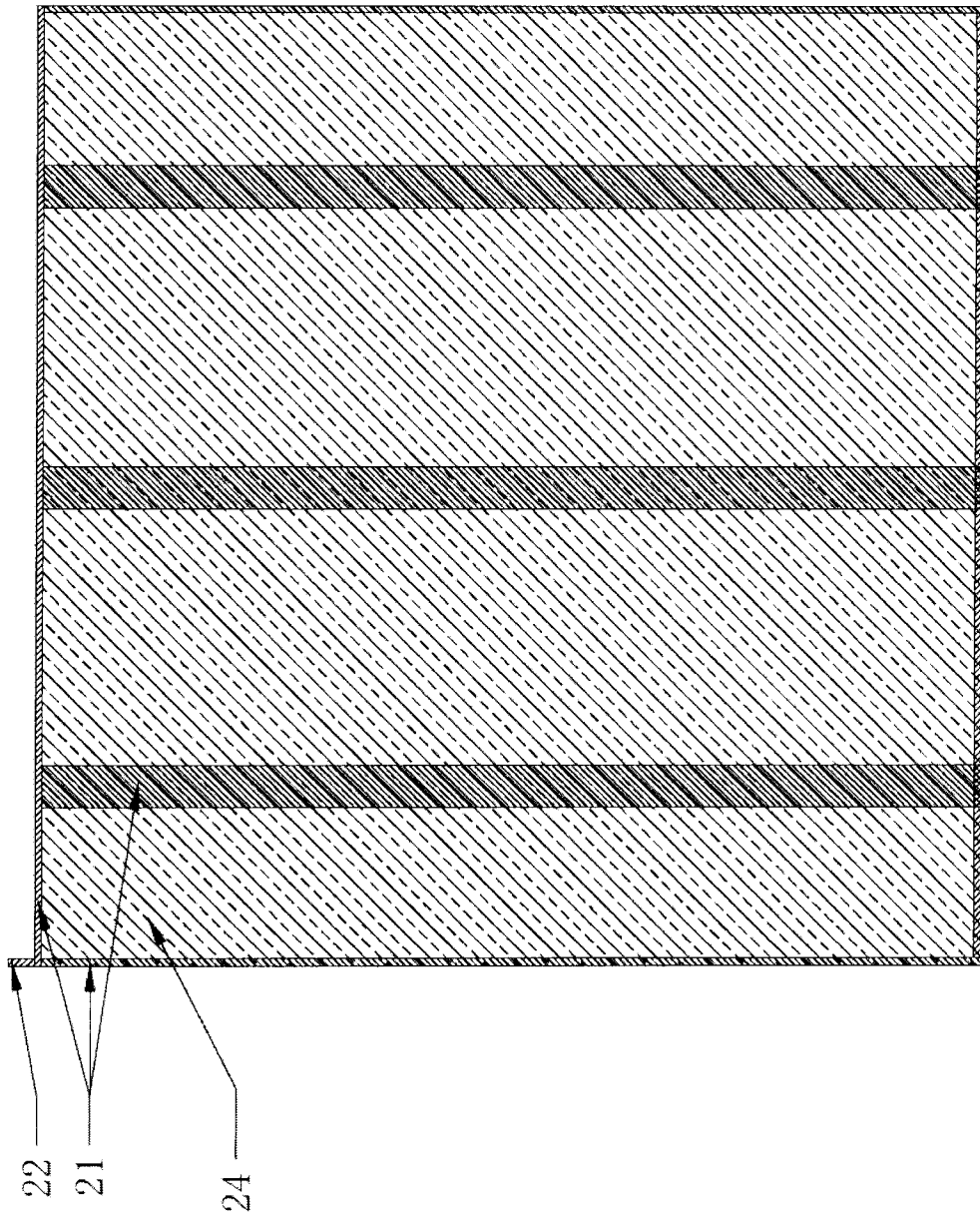


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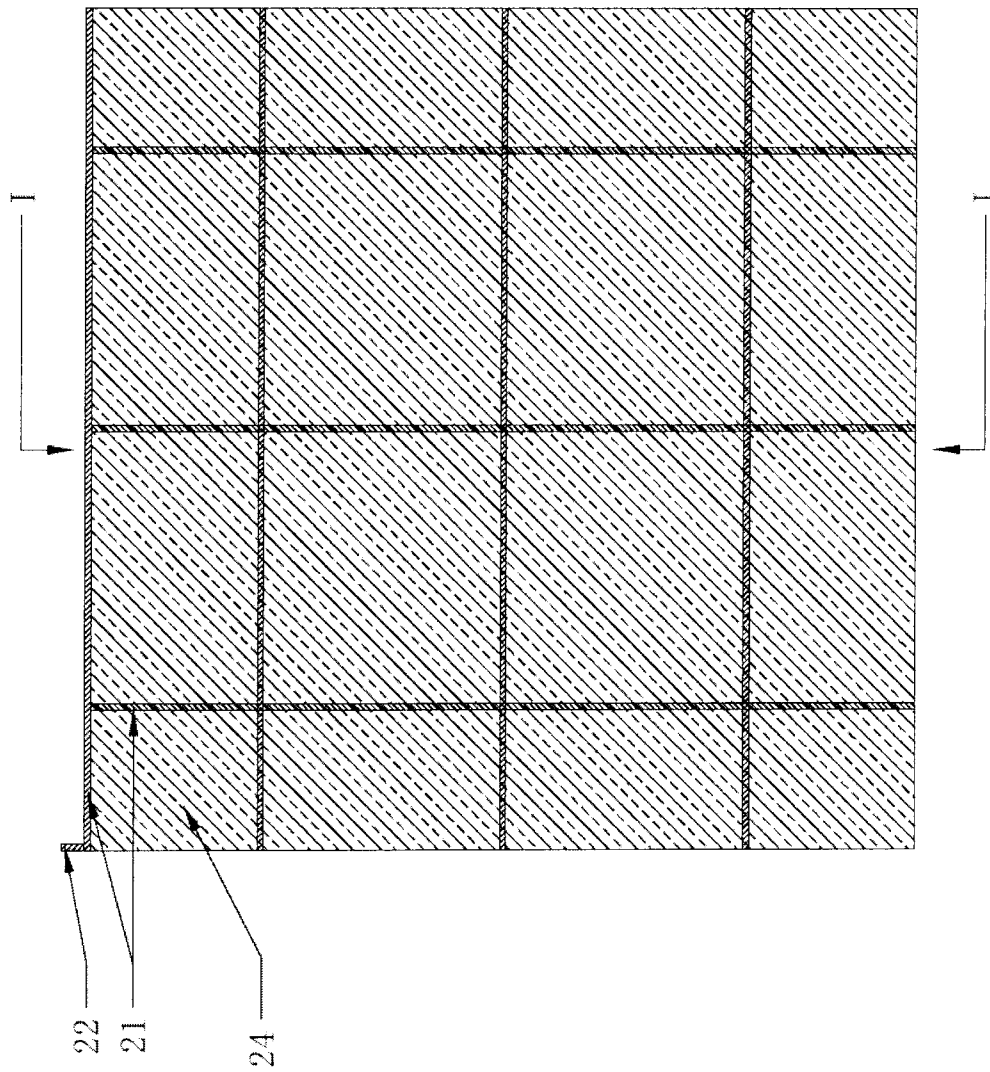


Figure 19



Figure 20



Figure 21

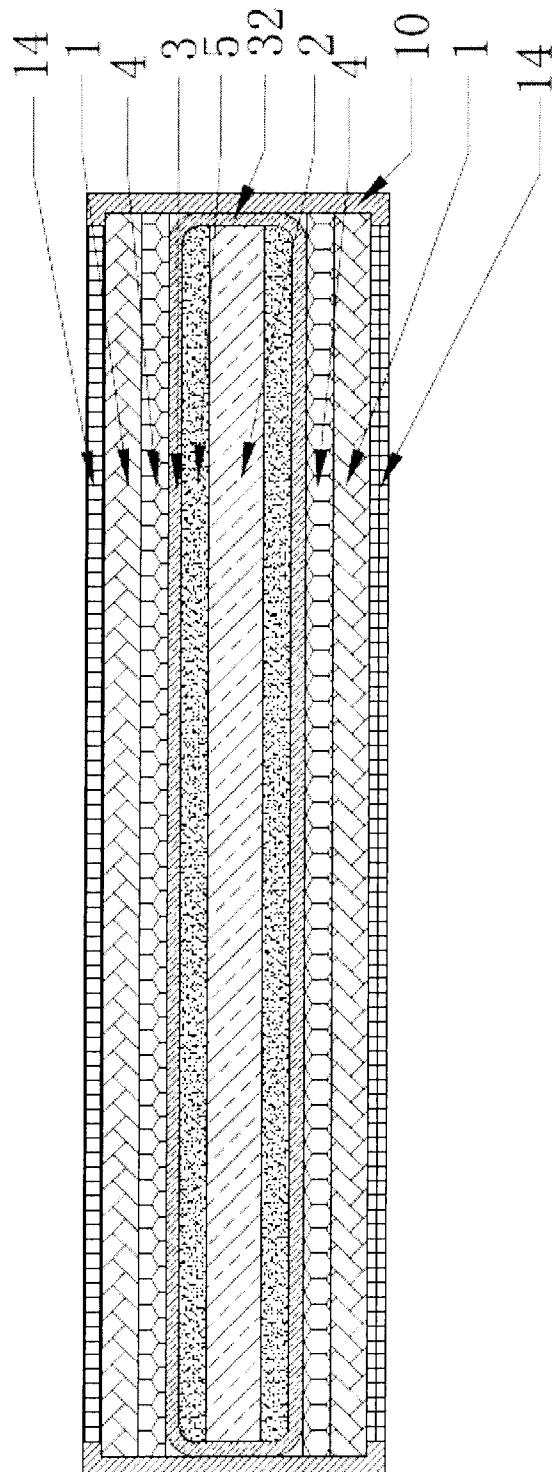


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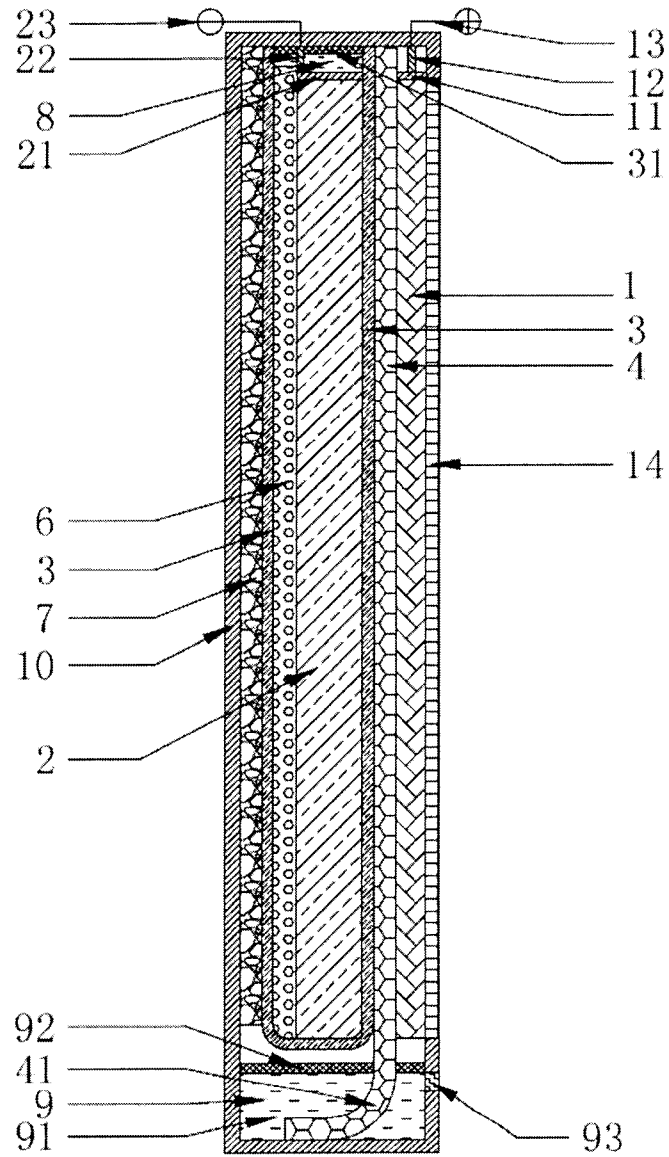


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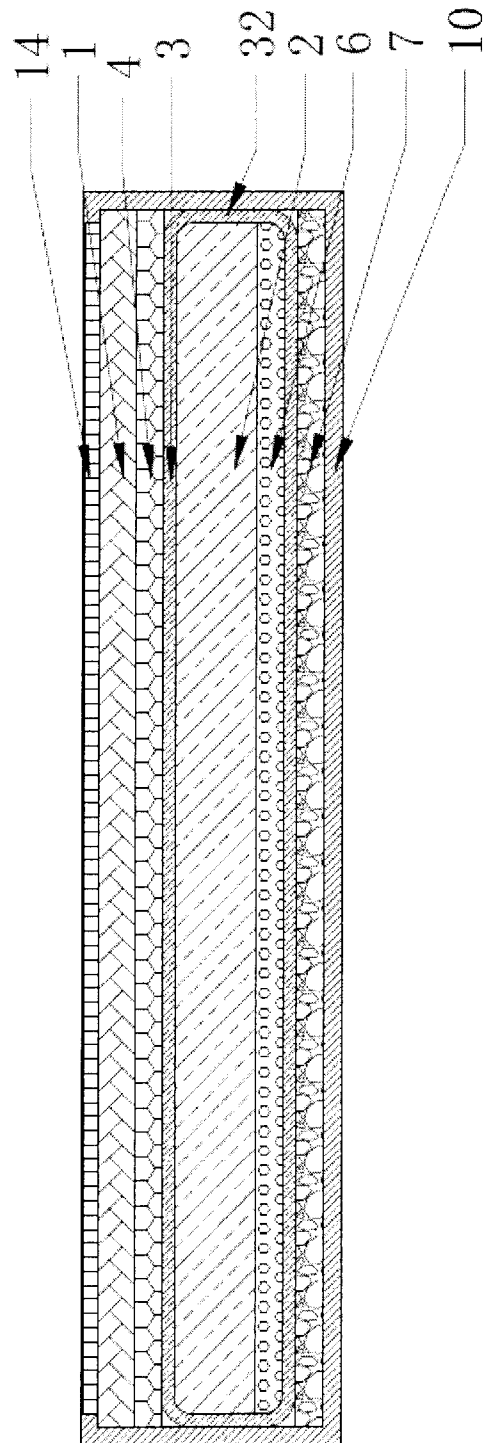


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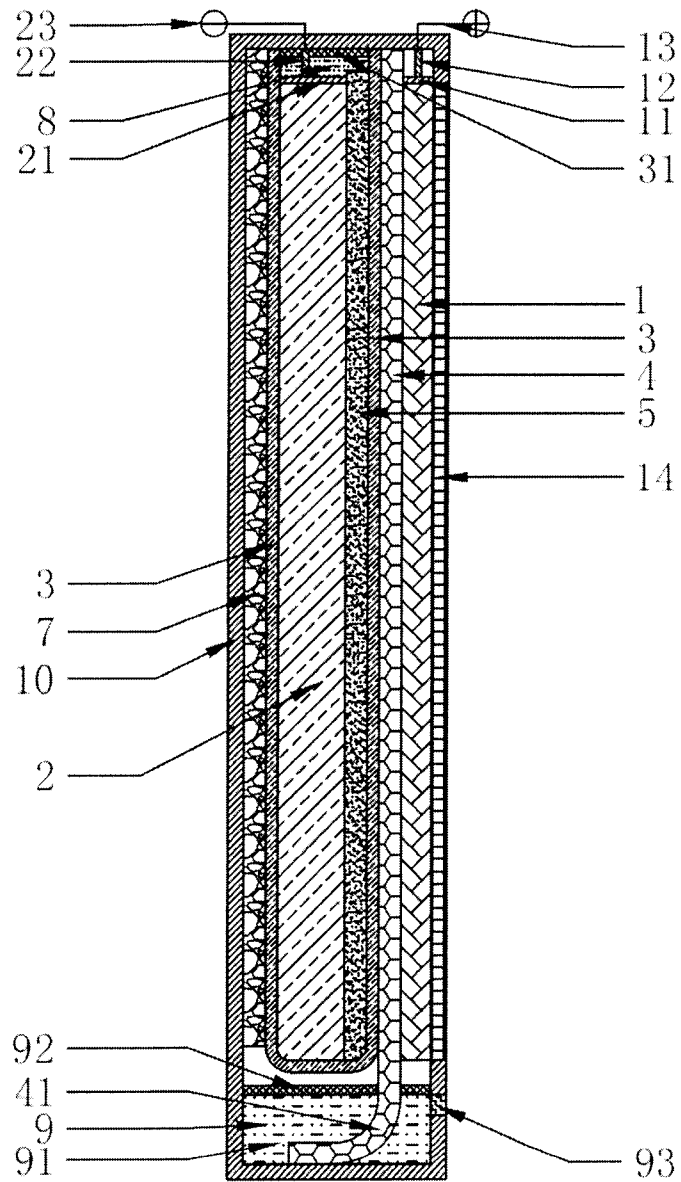


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23/65

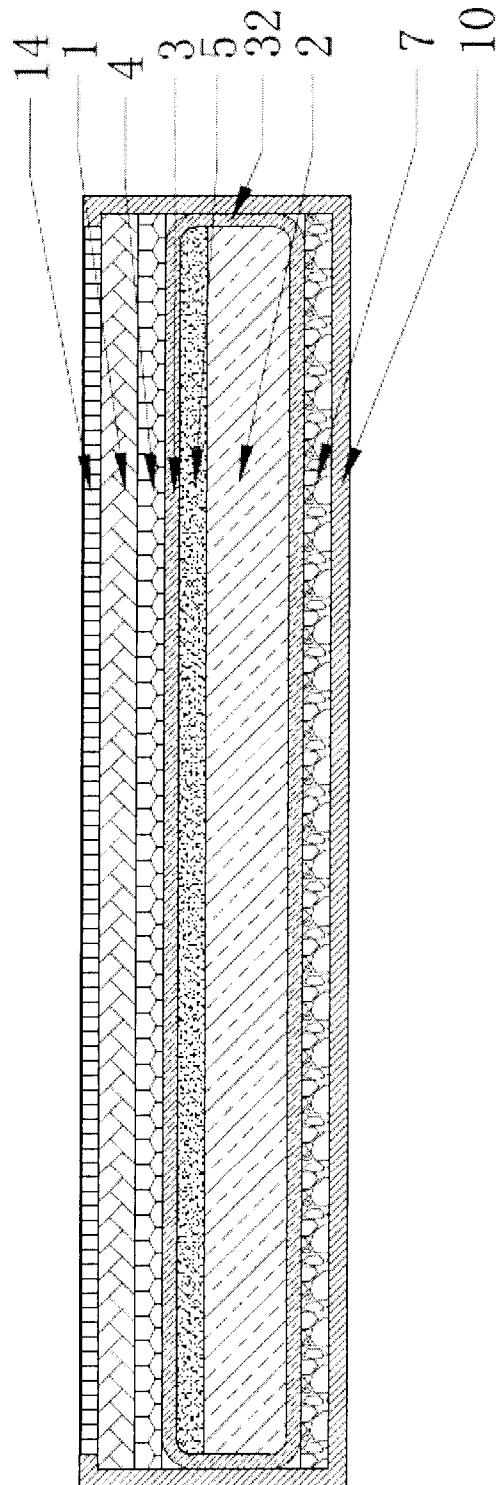


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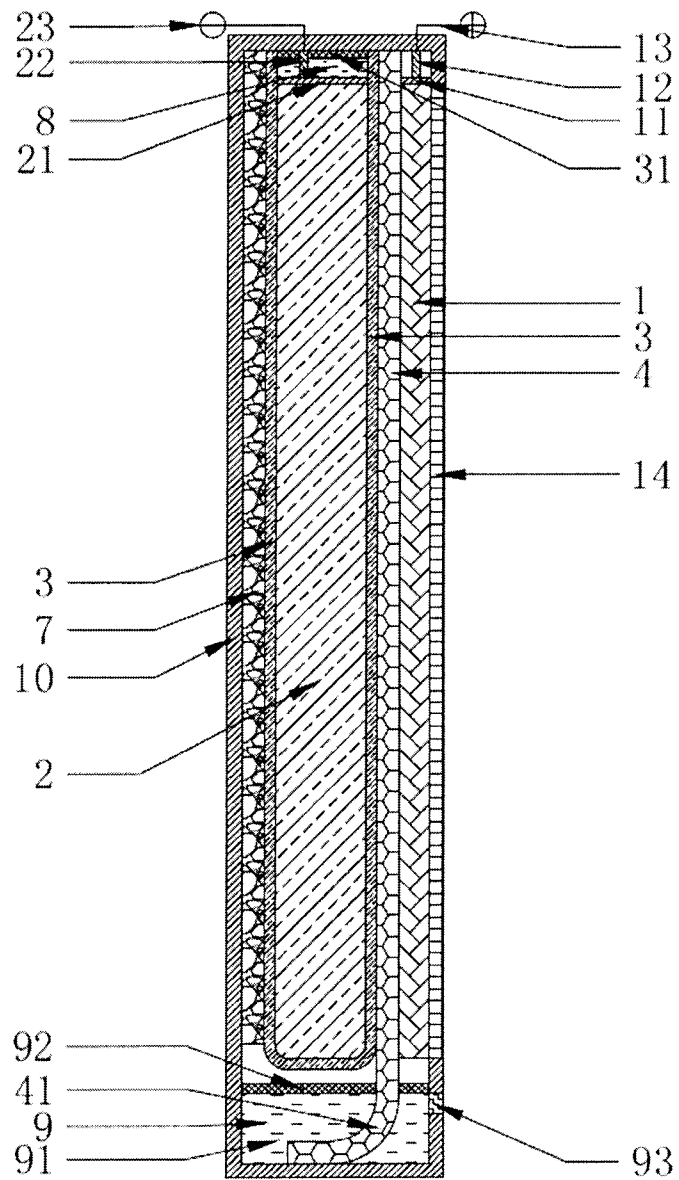


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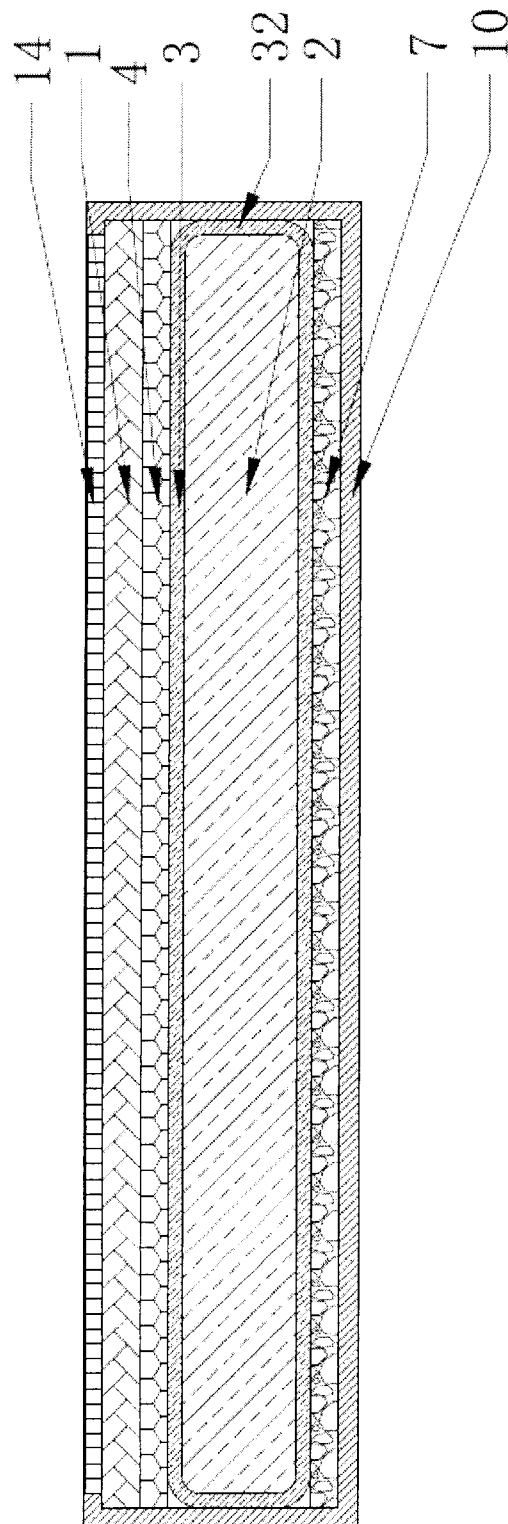


Figure 29

26/65

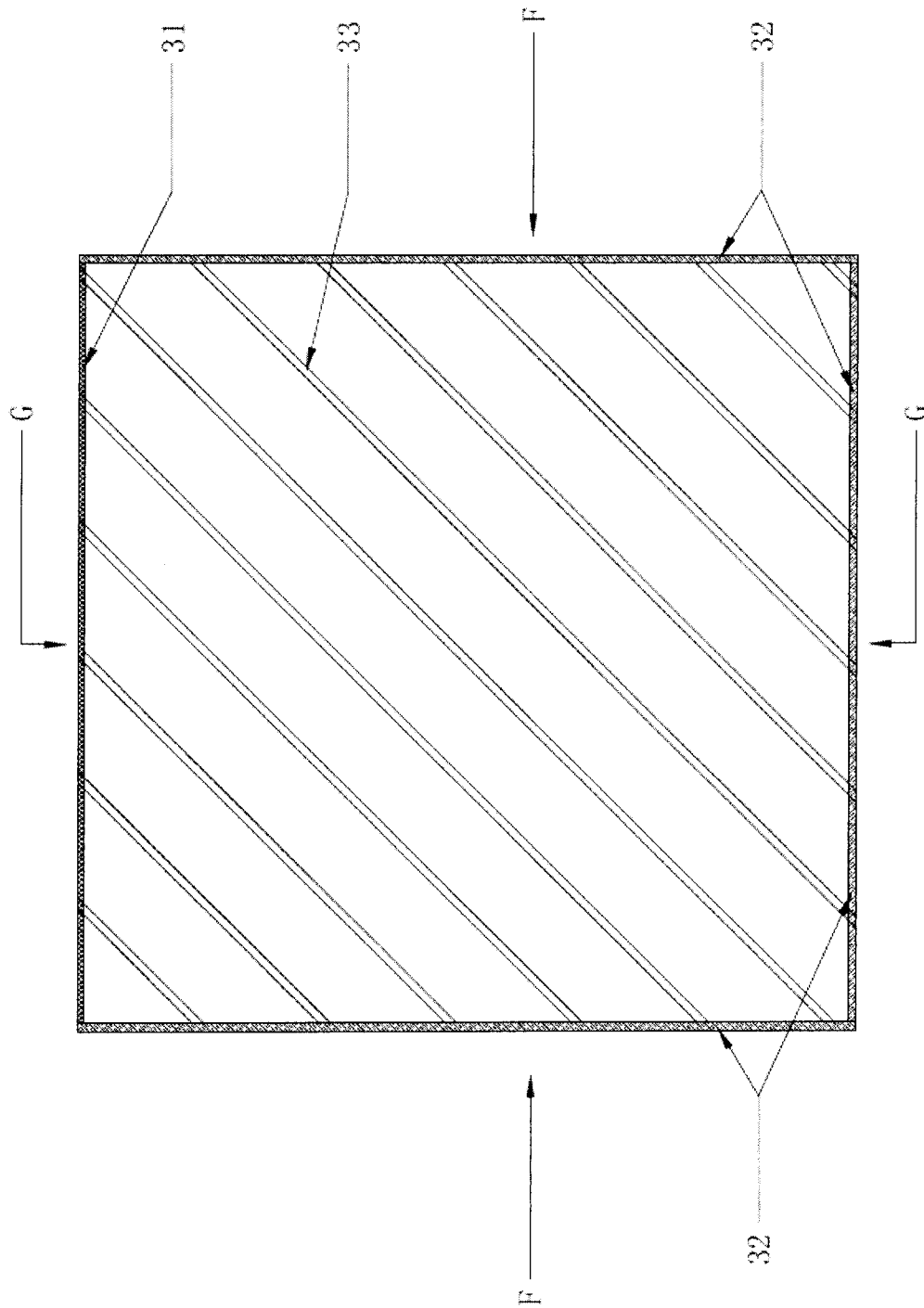
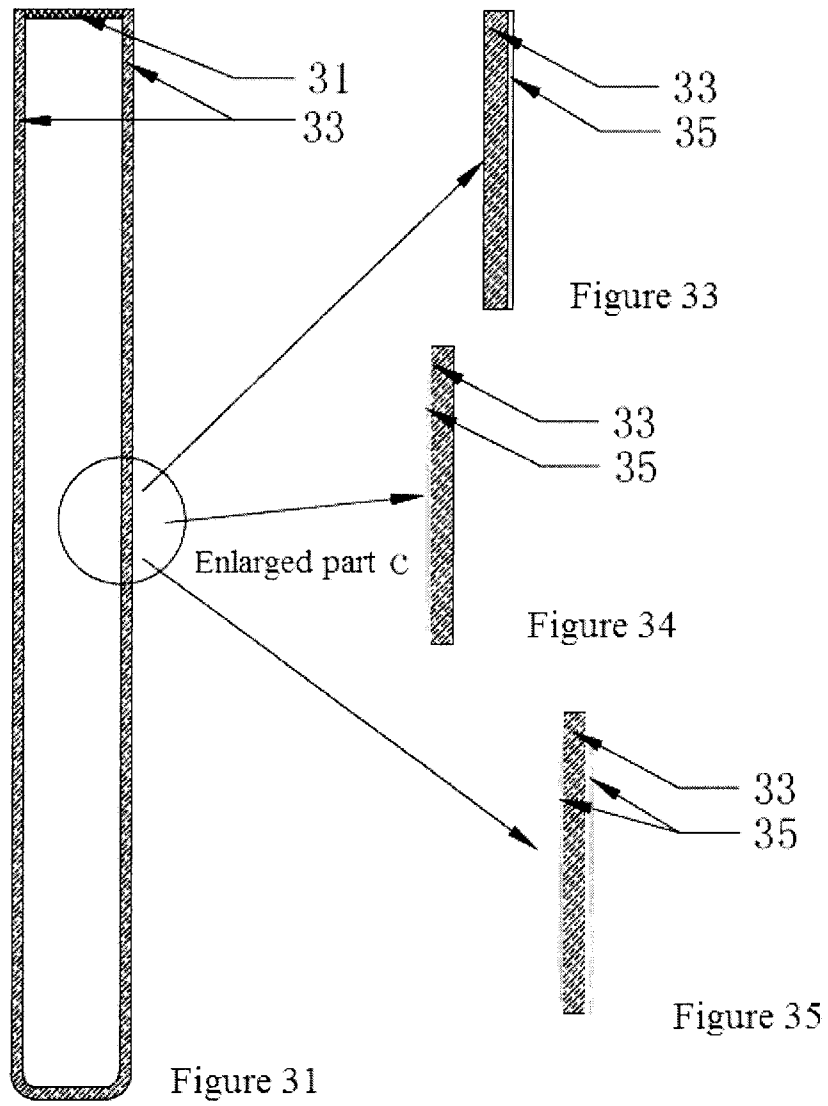


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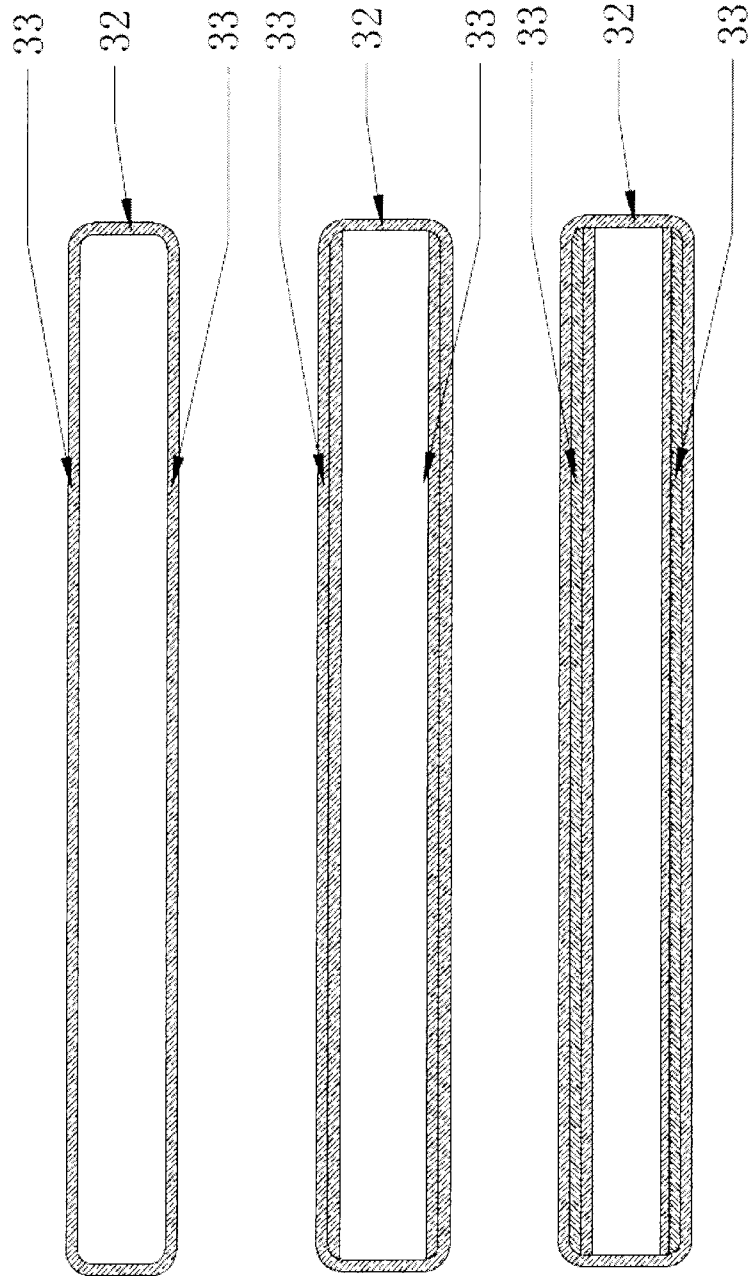
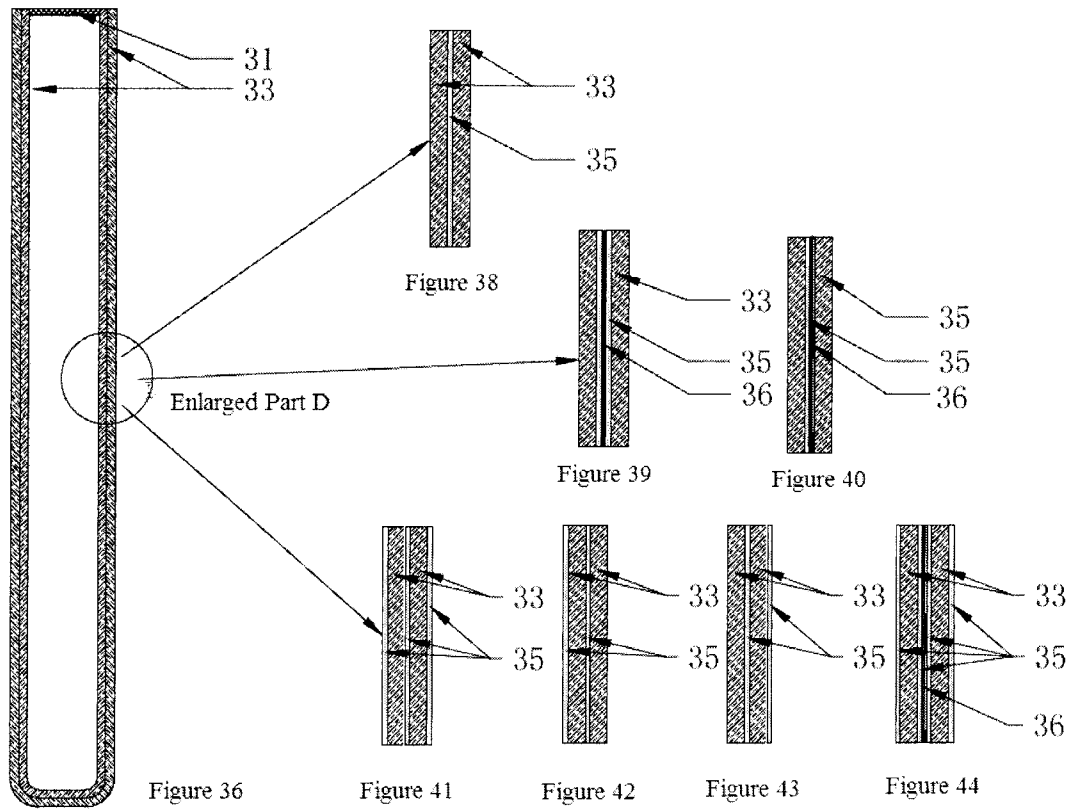


Figure 32

Figure 37

Figure 46



30/65

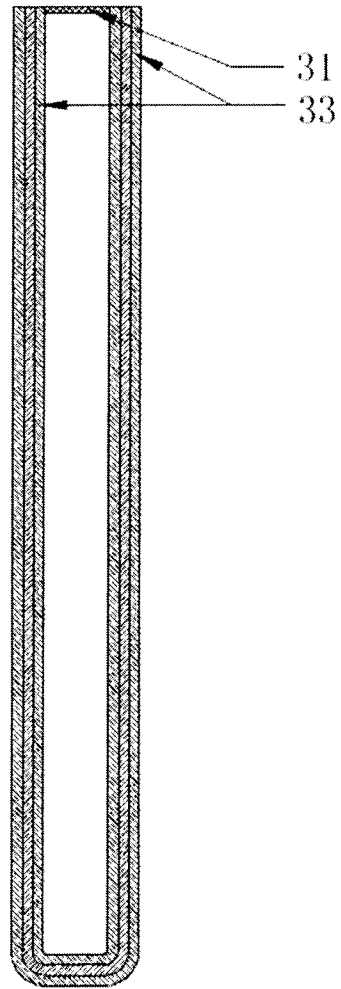


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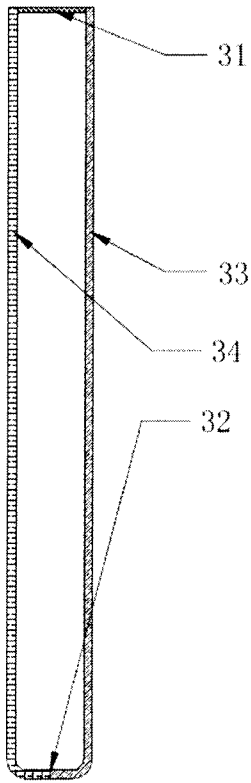


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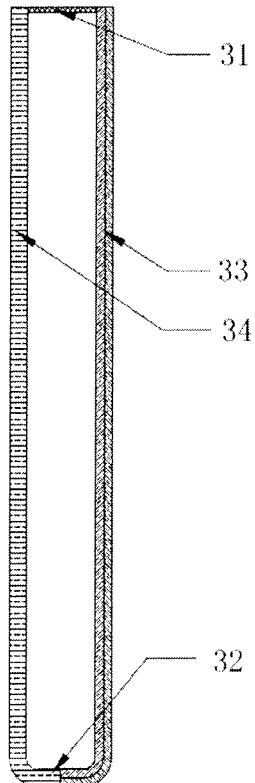


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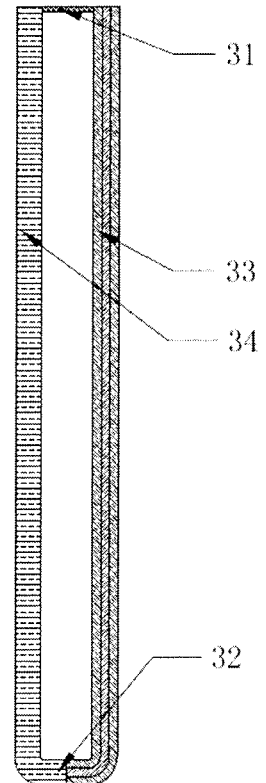


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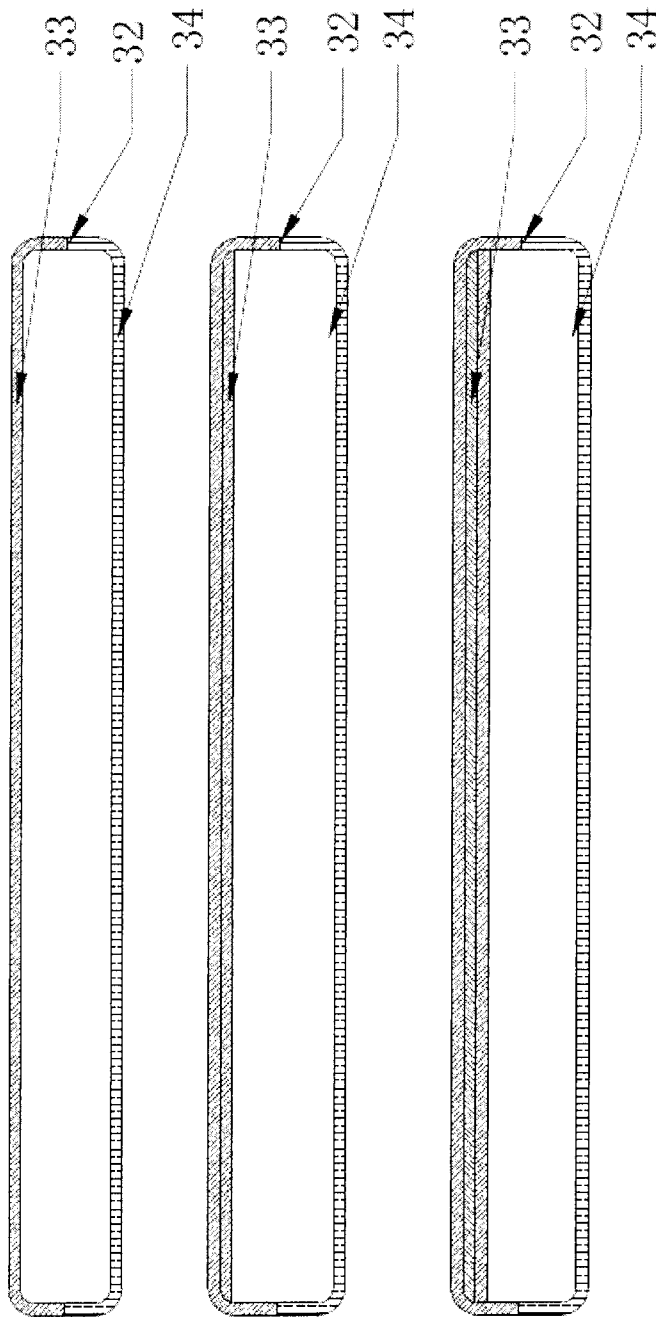
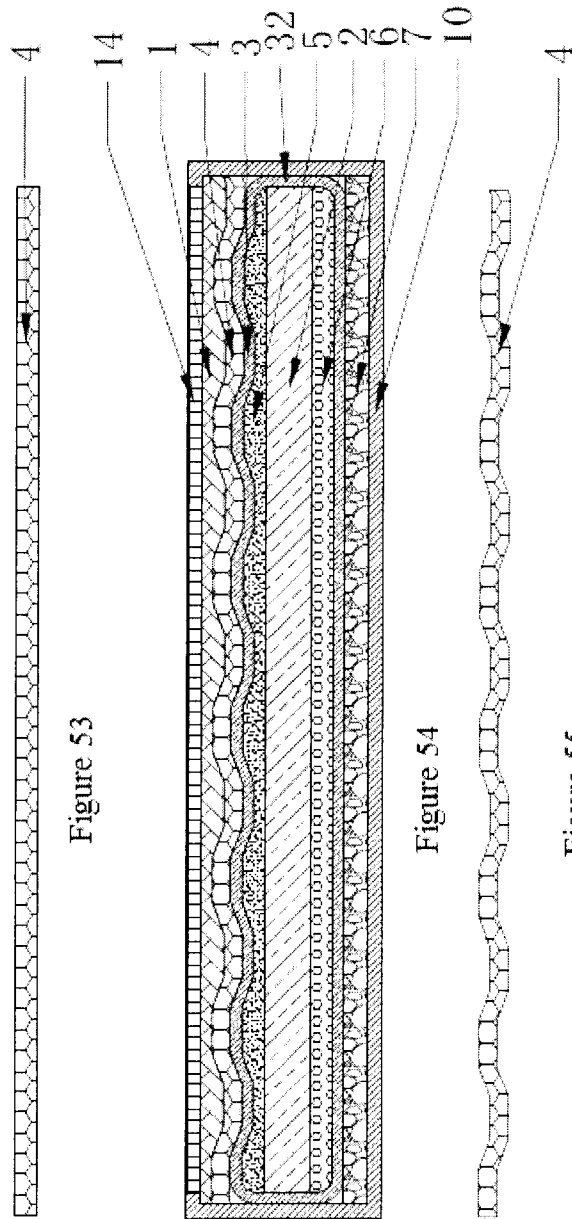


Figure 48

Figure 50

Figure 52



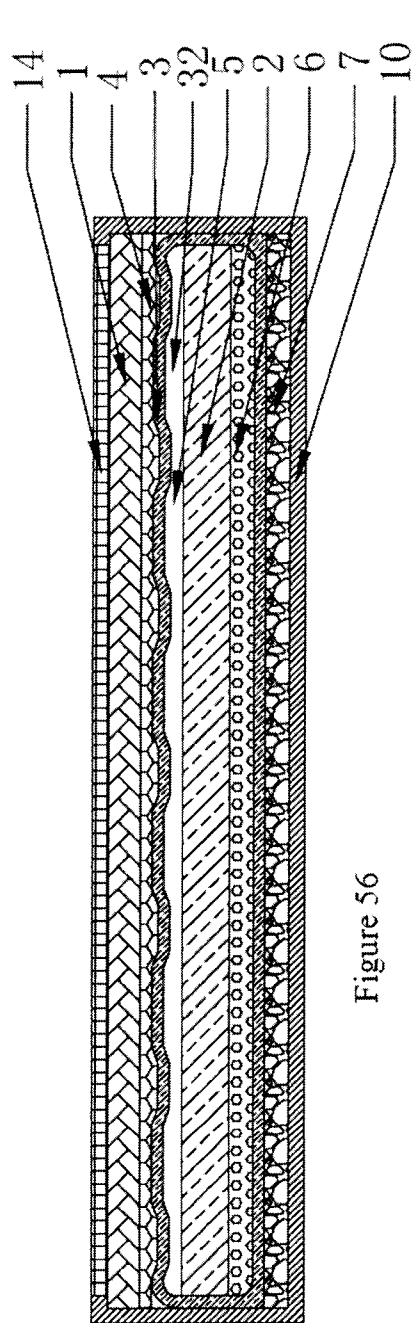


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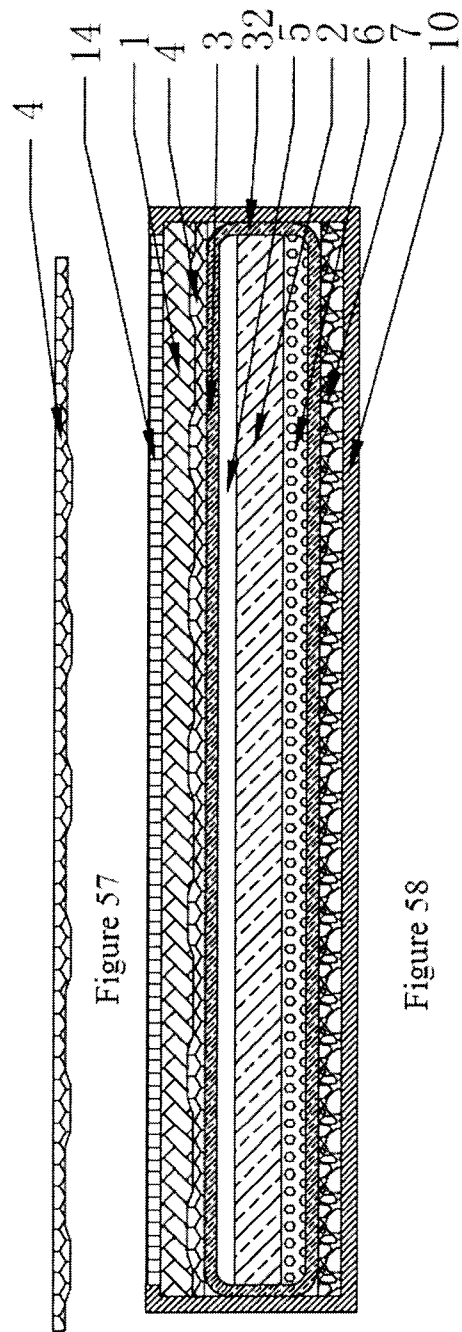


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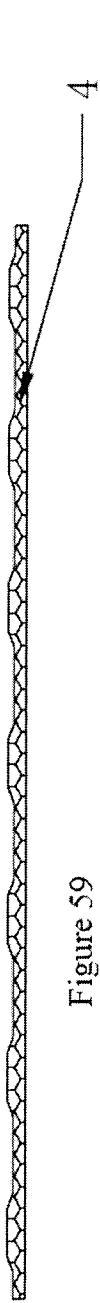


Figure 58



Figure 59

35/65

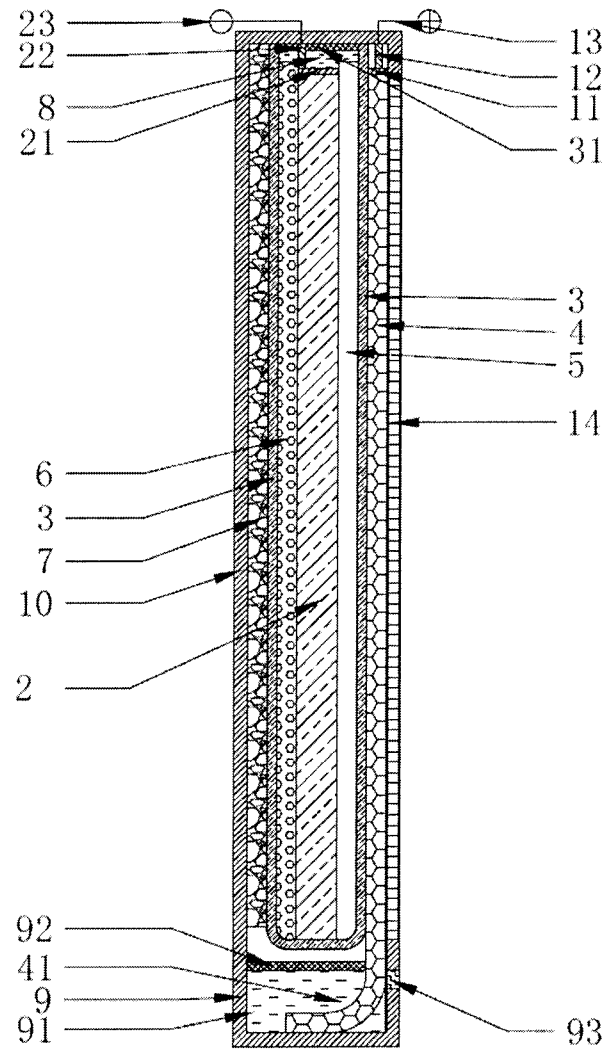


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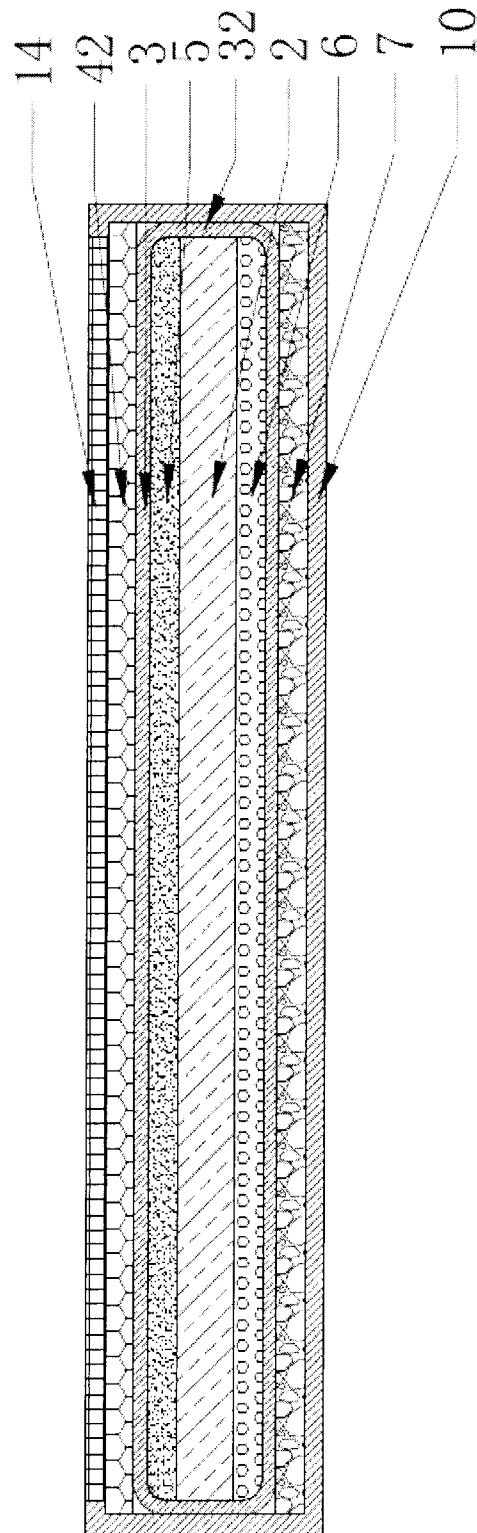
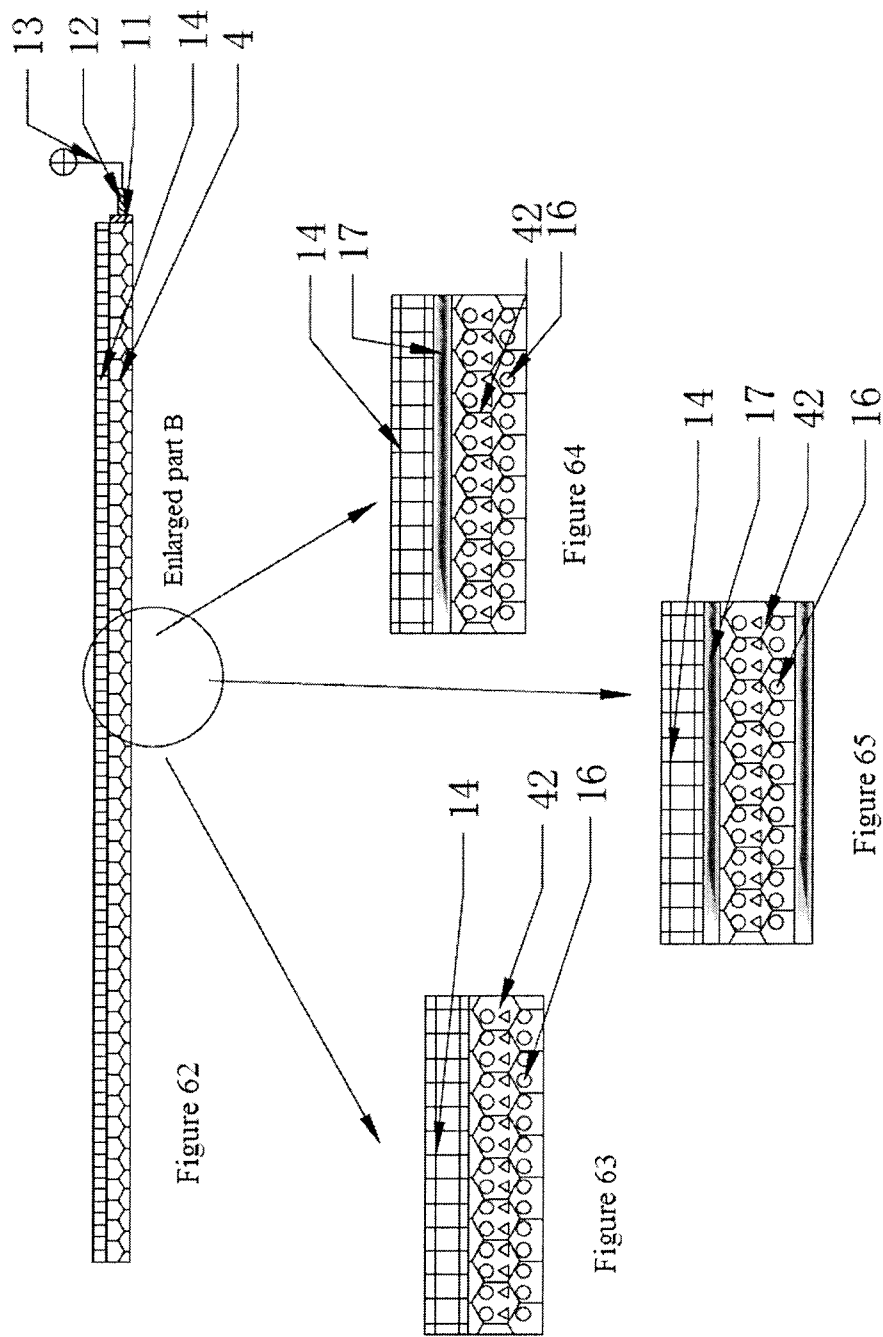


Figure 61



38/65

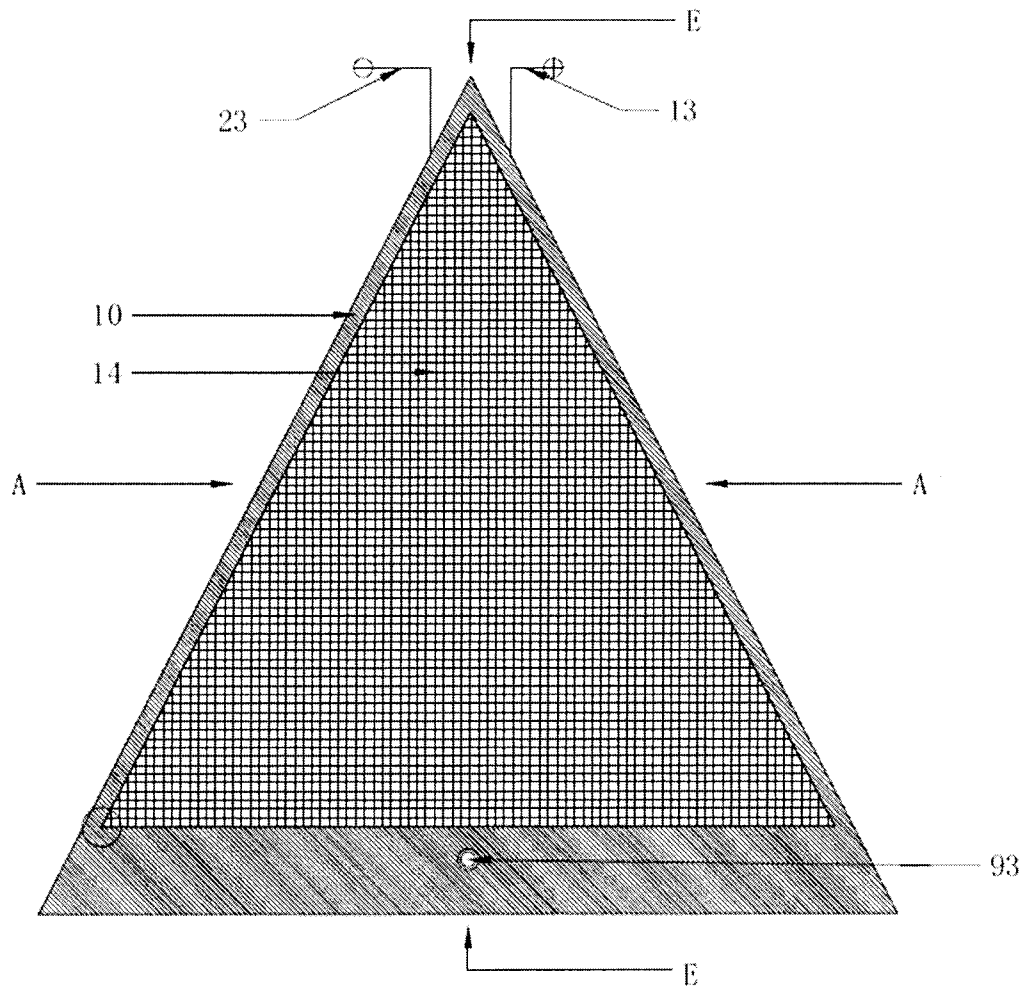


Figure 66

39/65

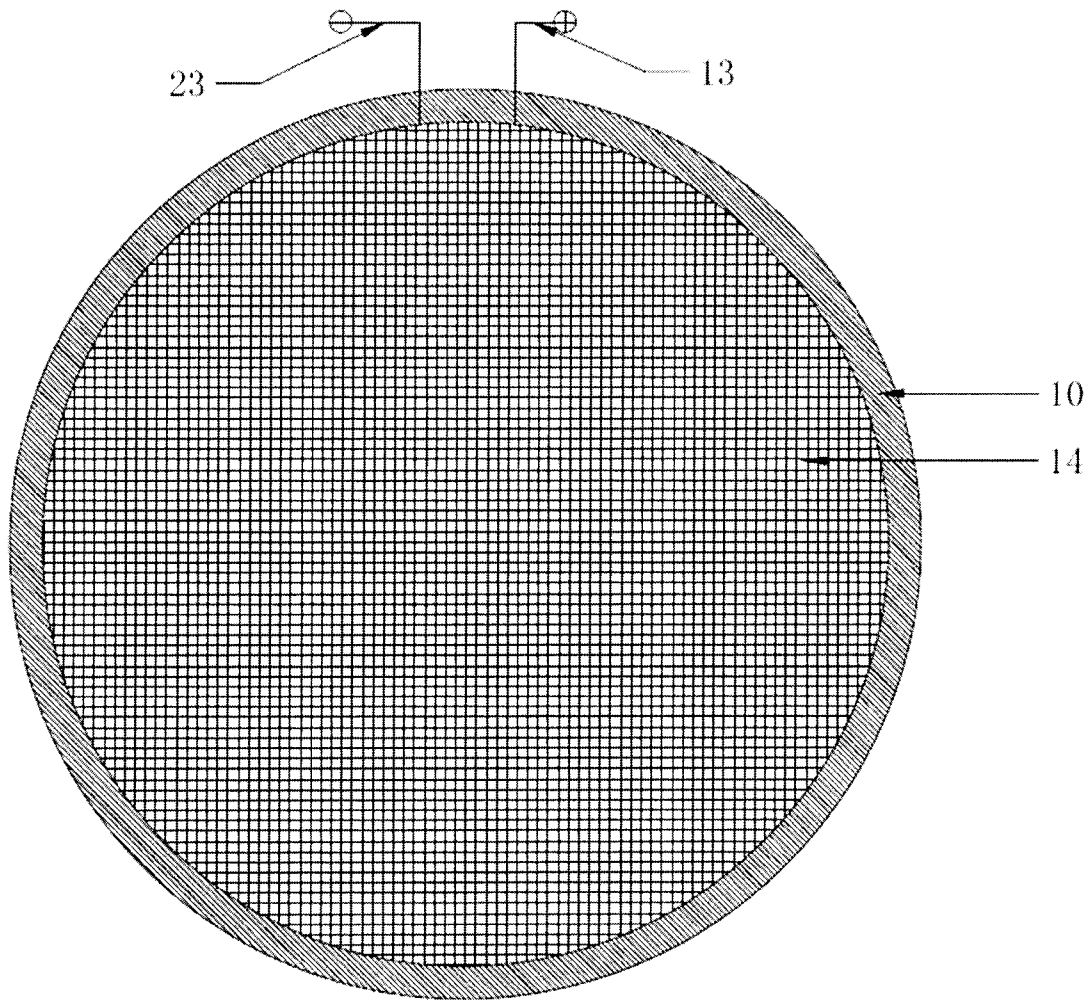


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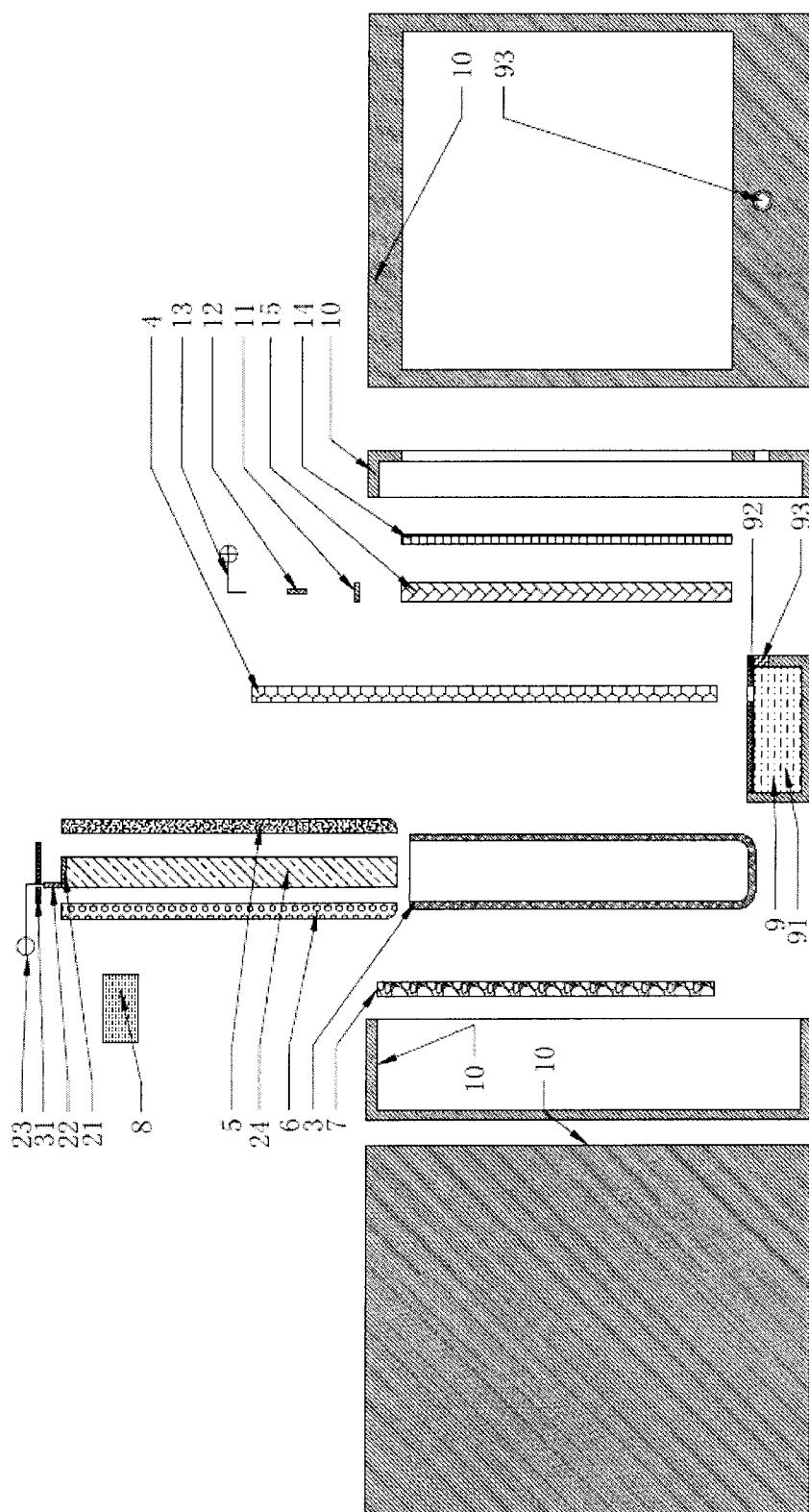


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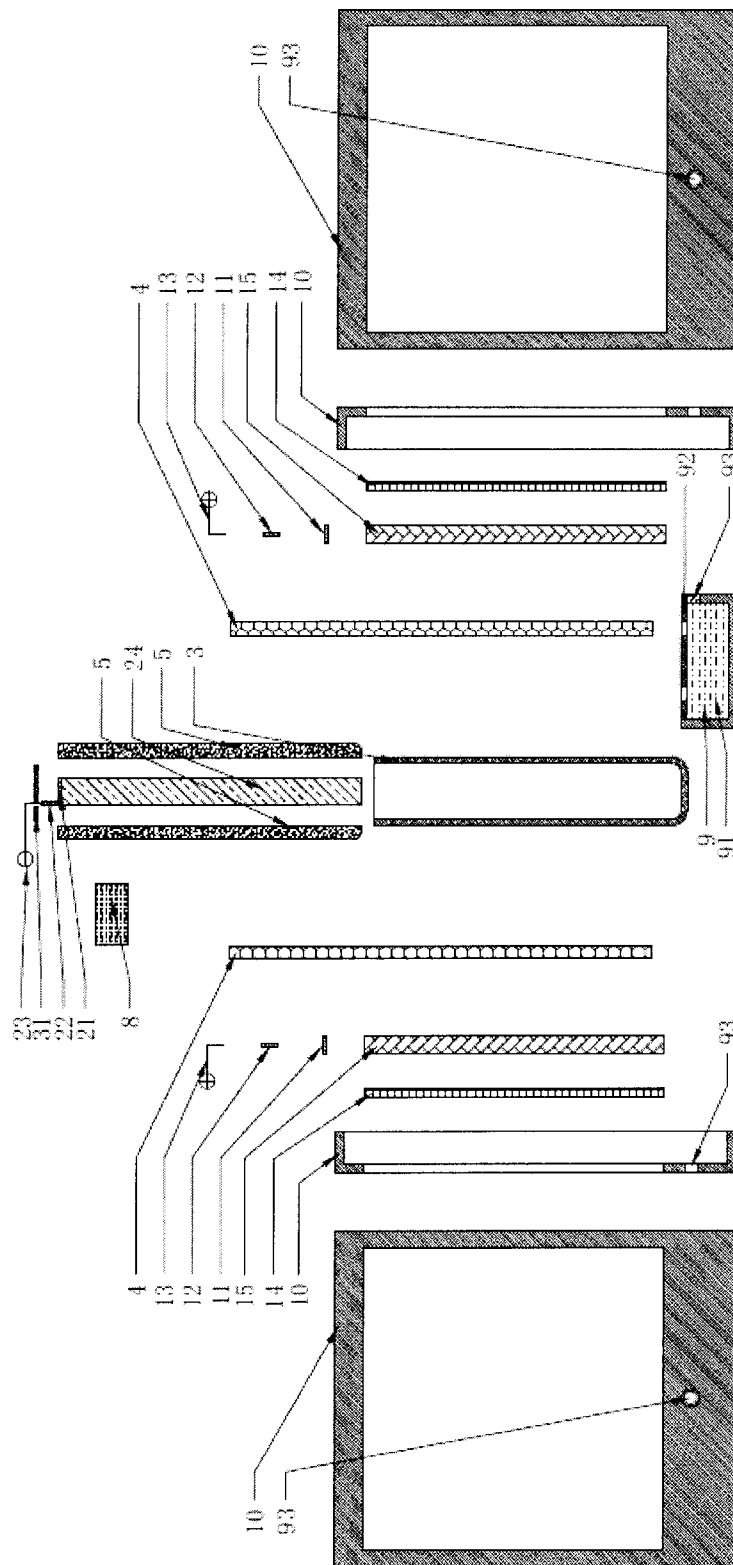


Figure 69

42/65

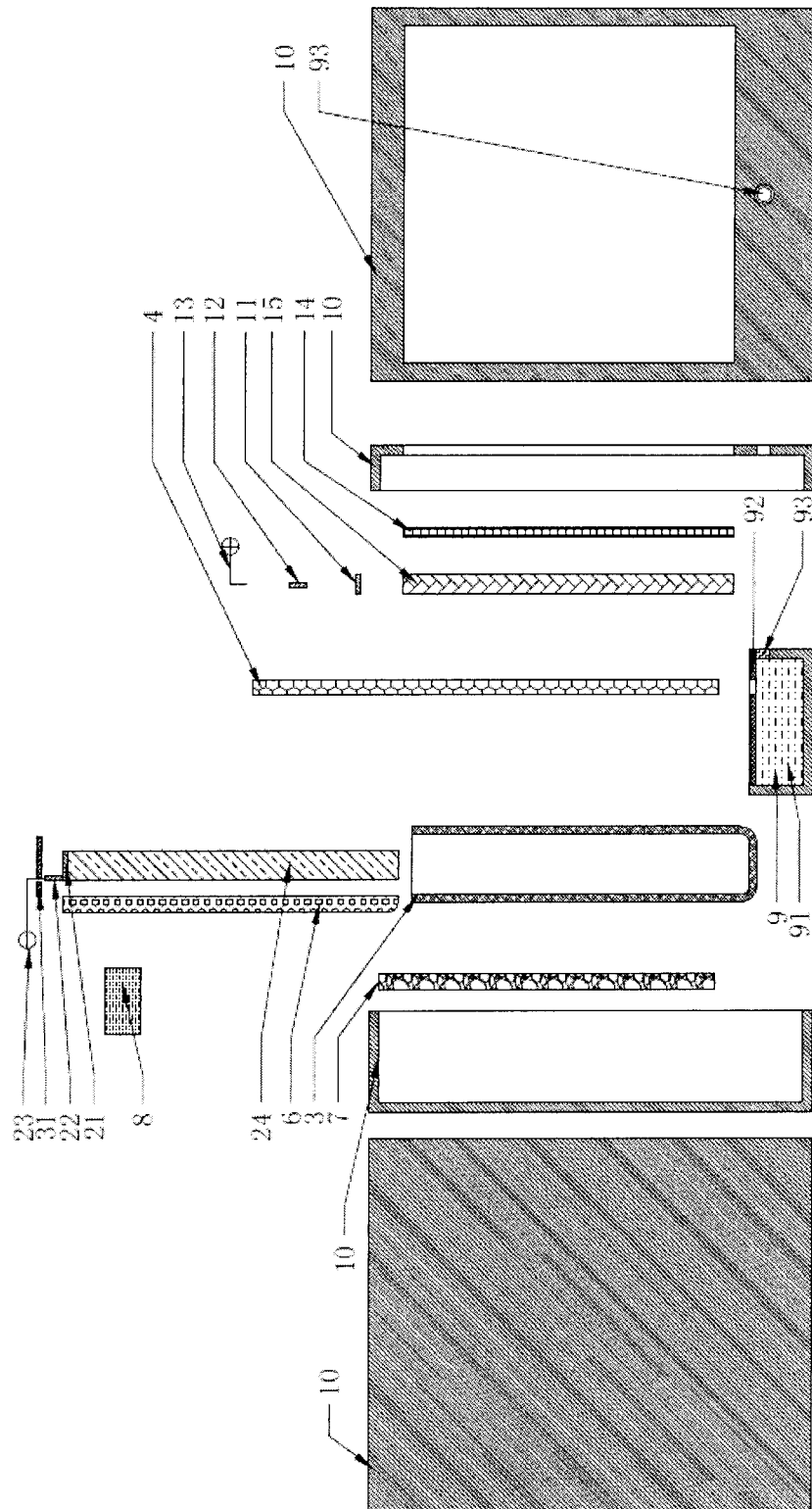


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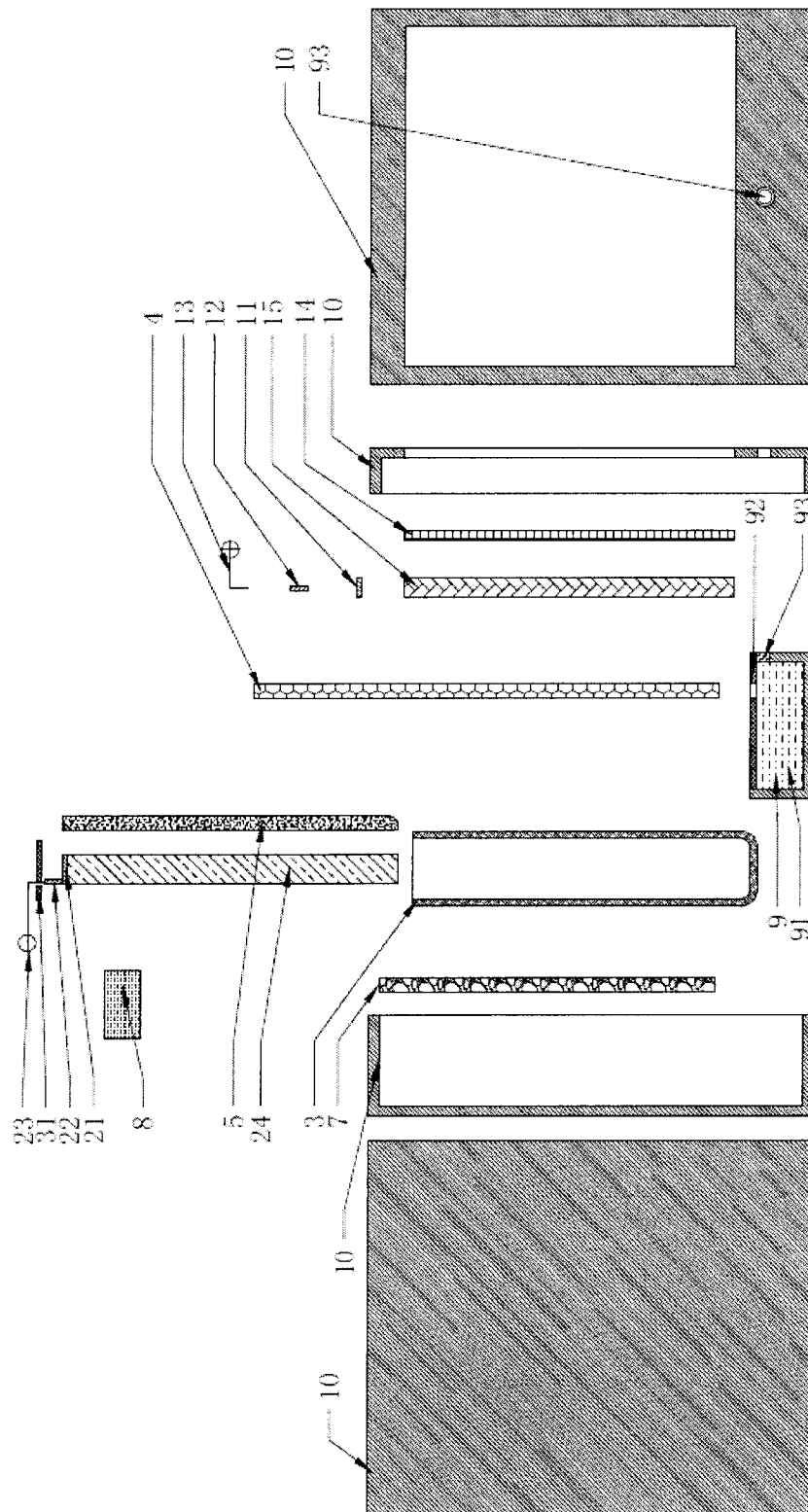


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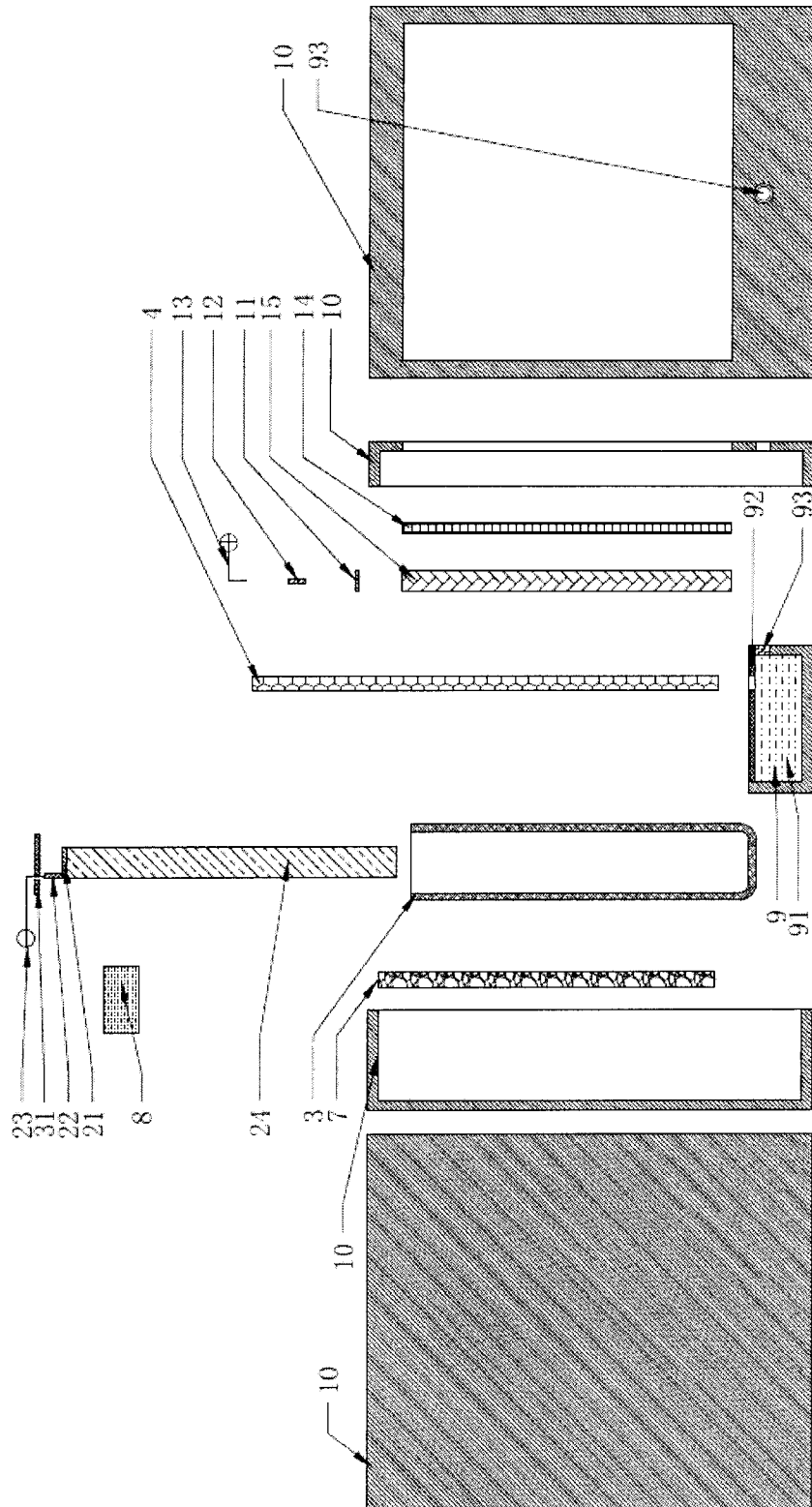


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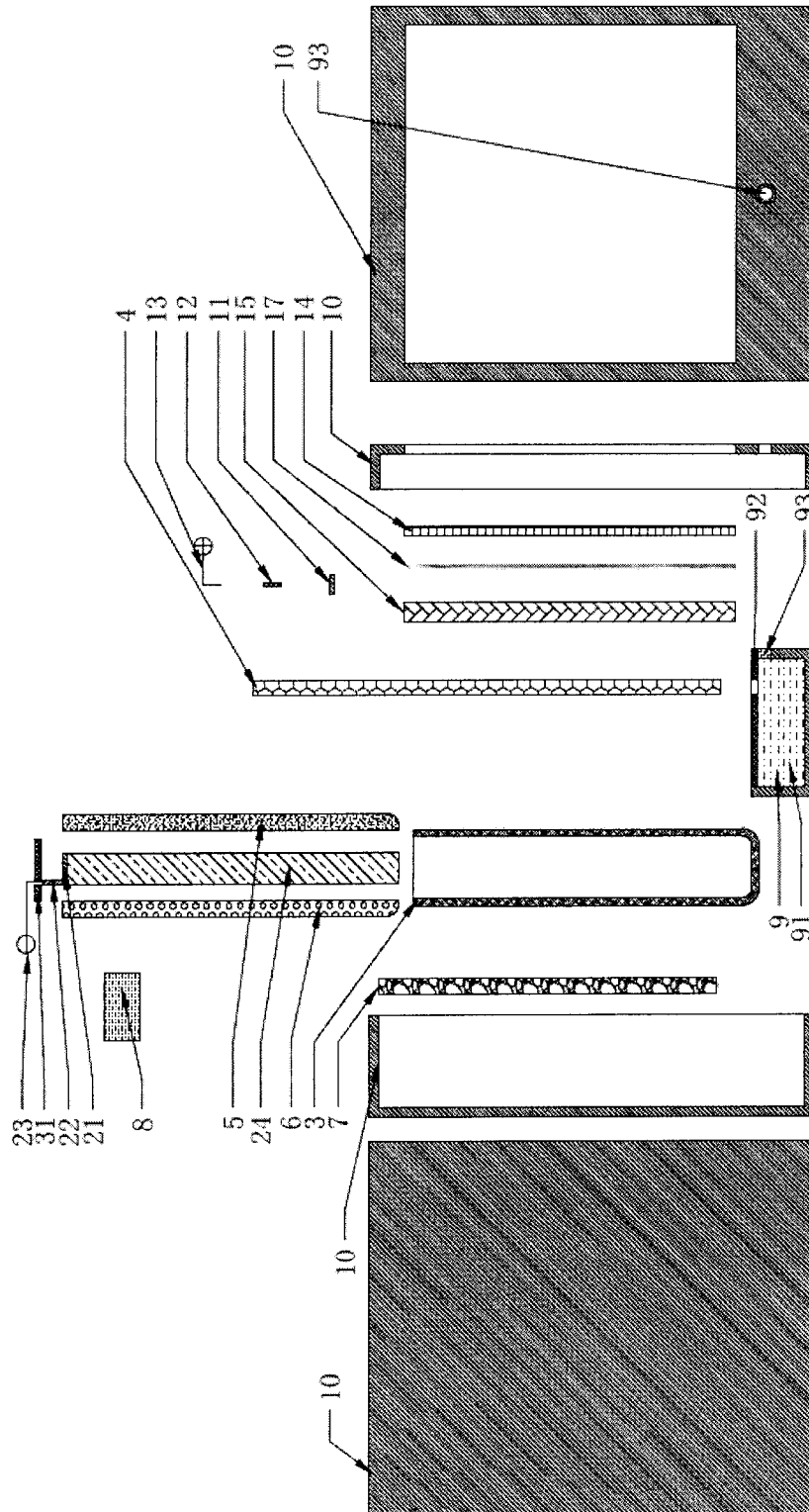


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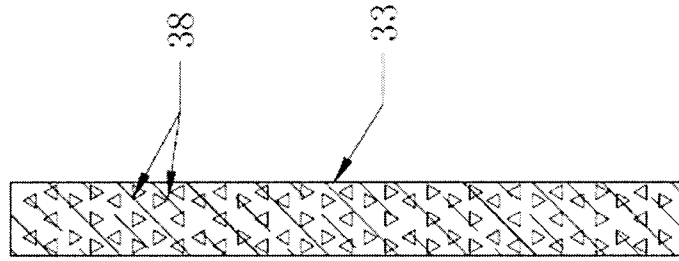


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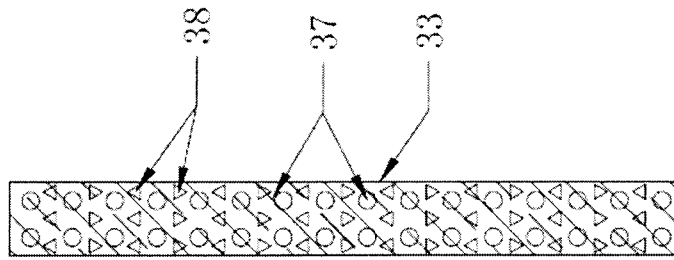


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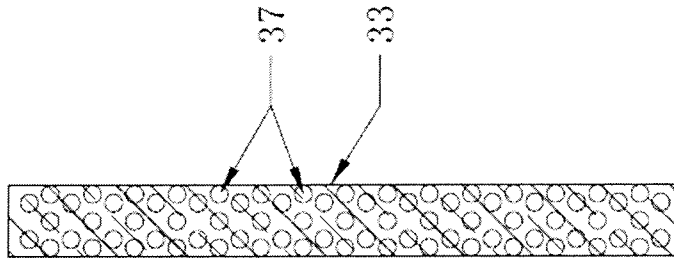


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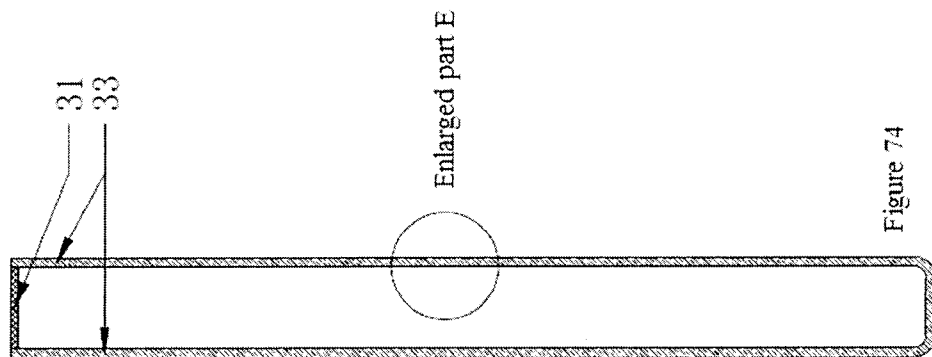


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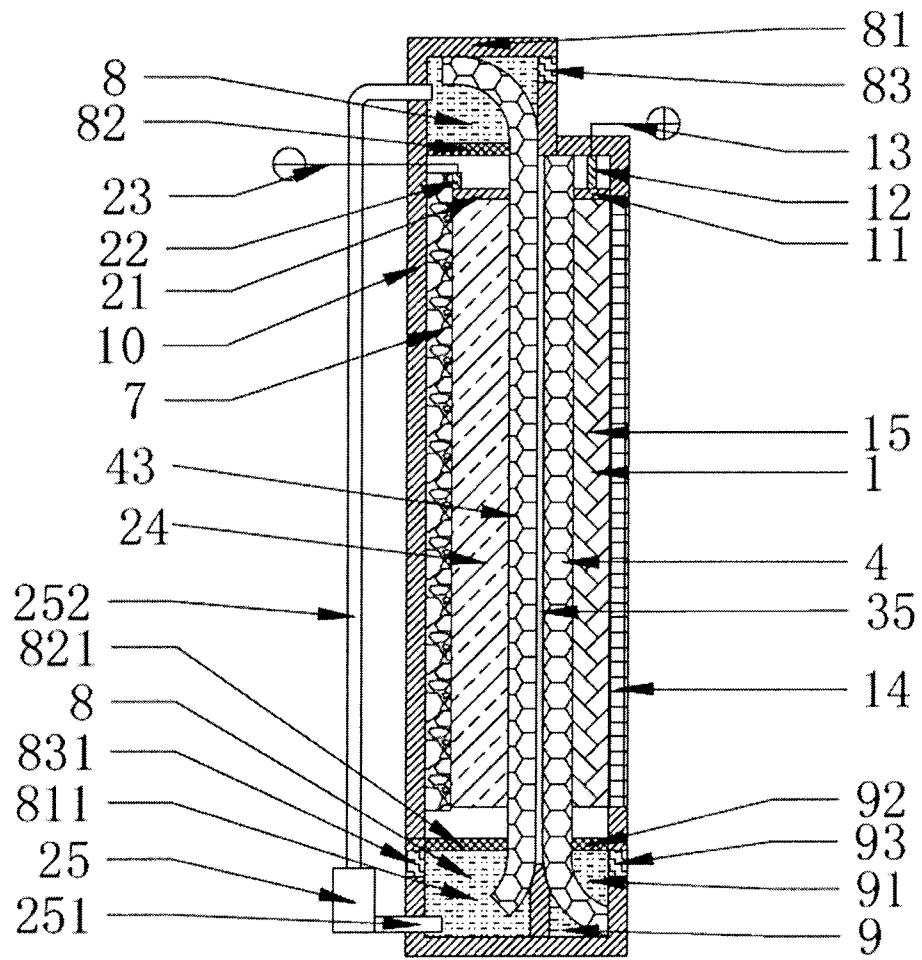


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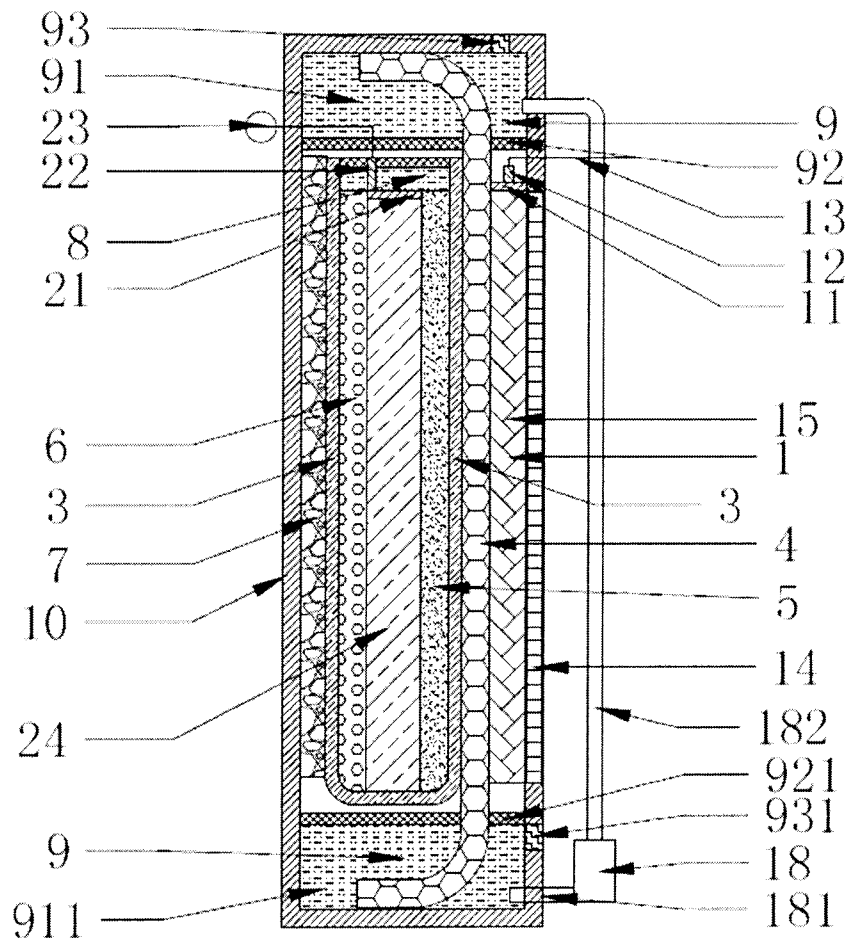


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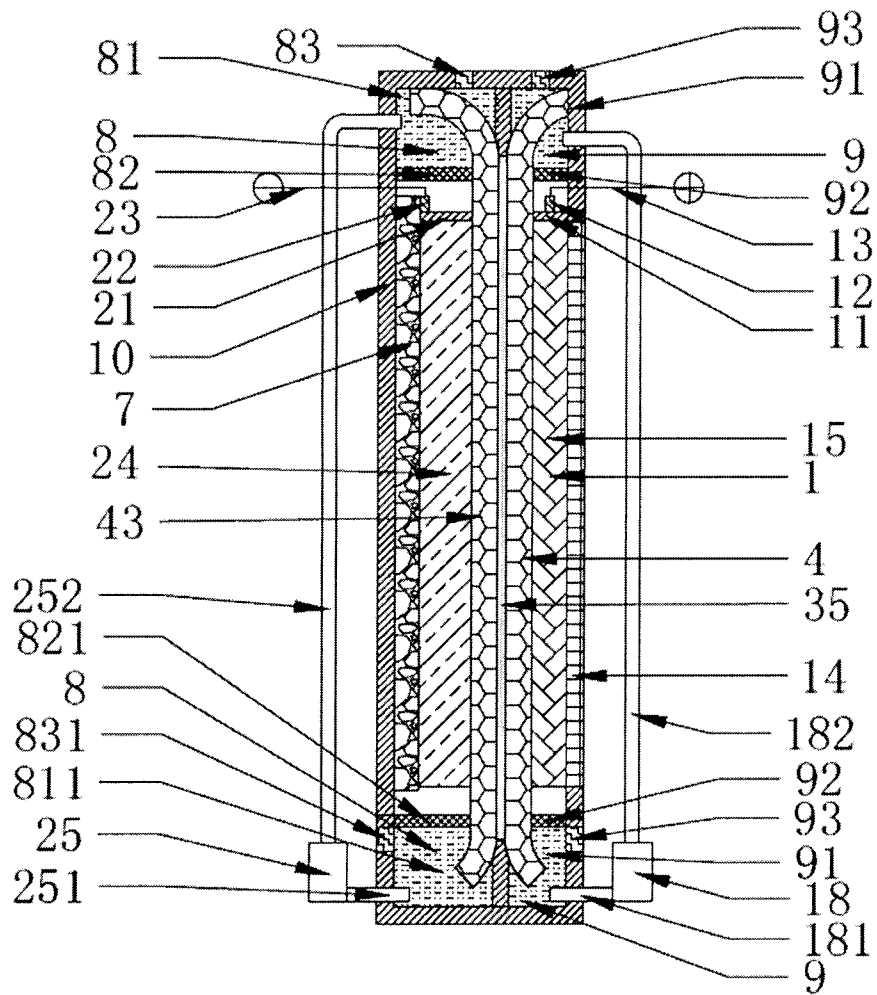


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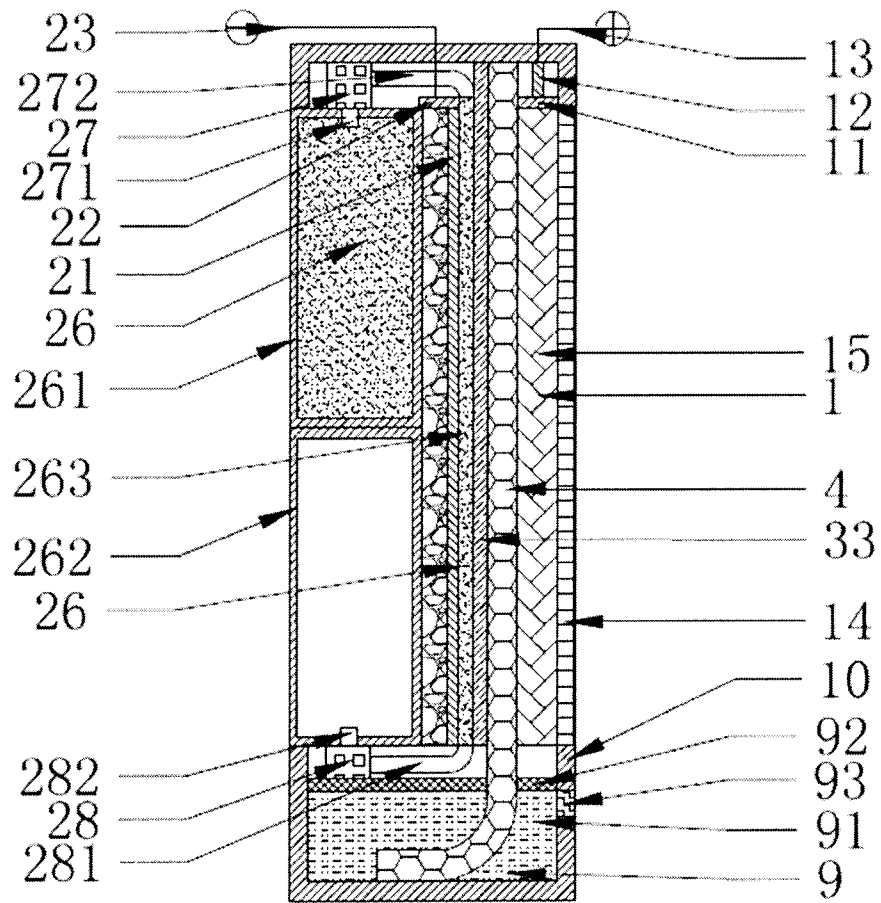


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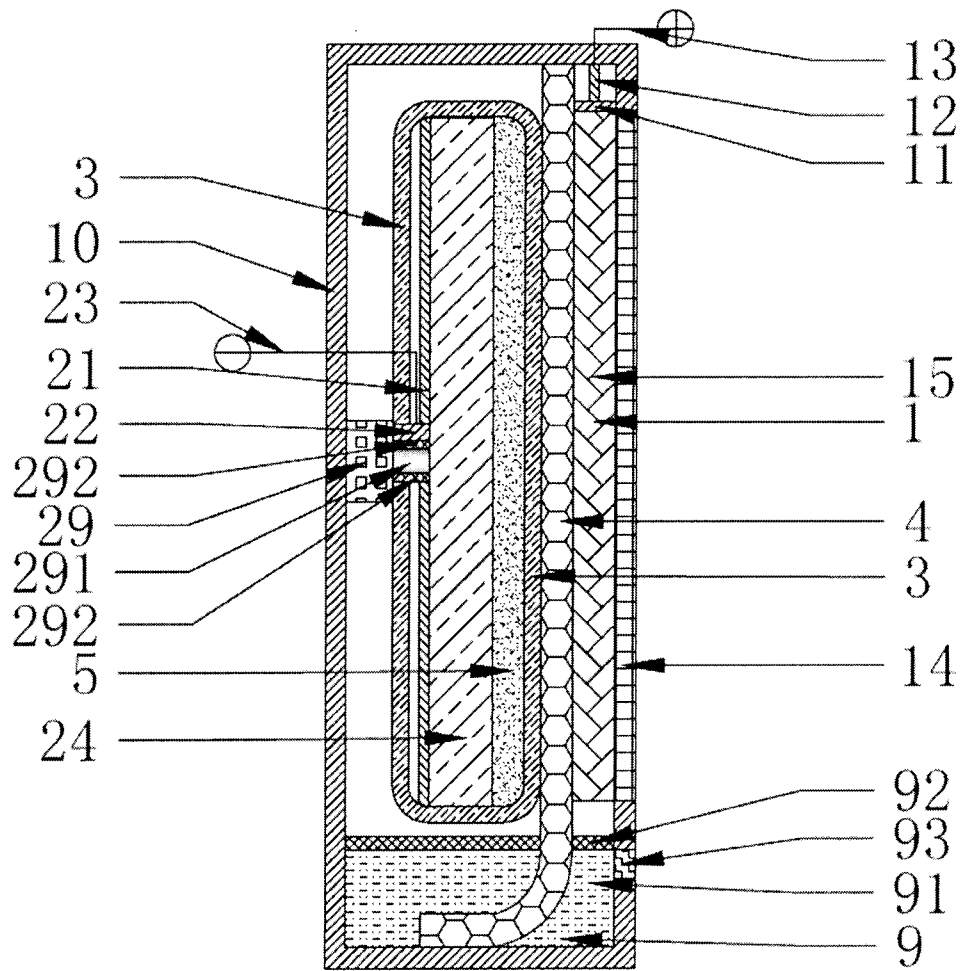


Figure 82

52/65

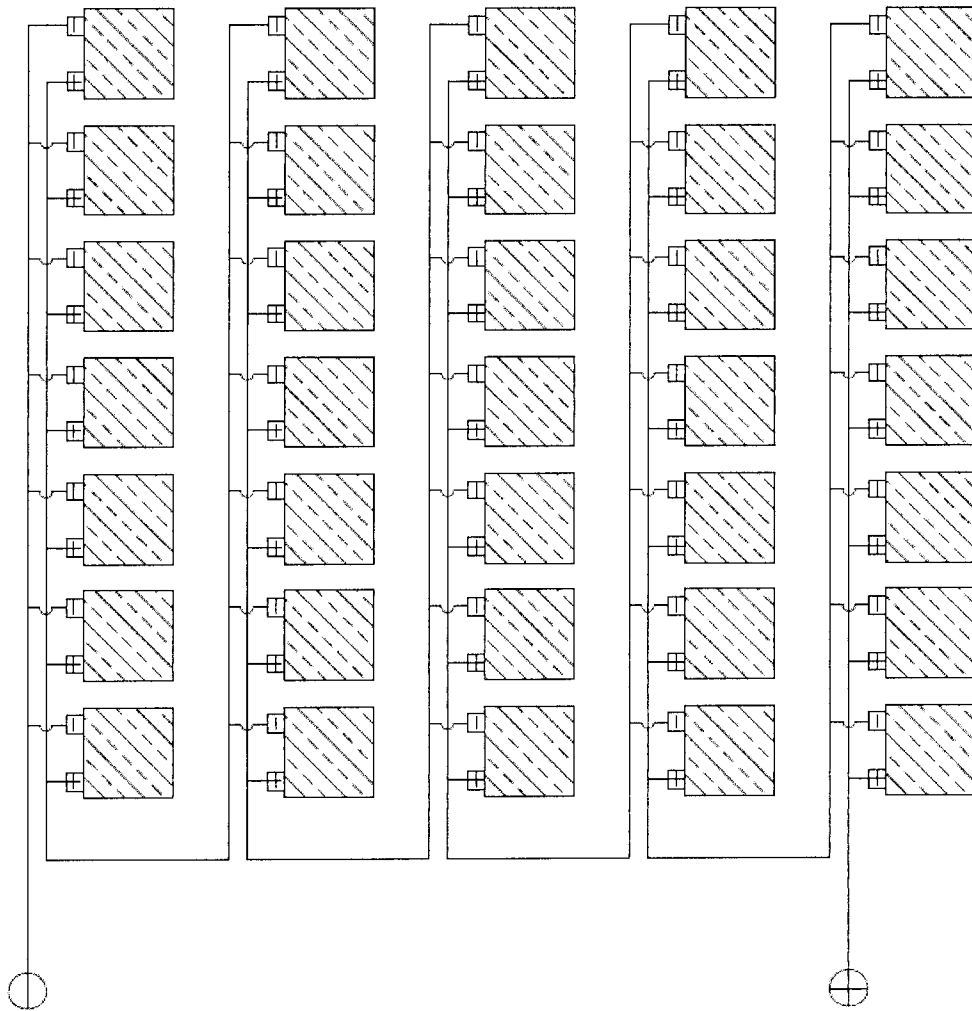


Figure 83

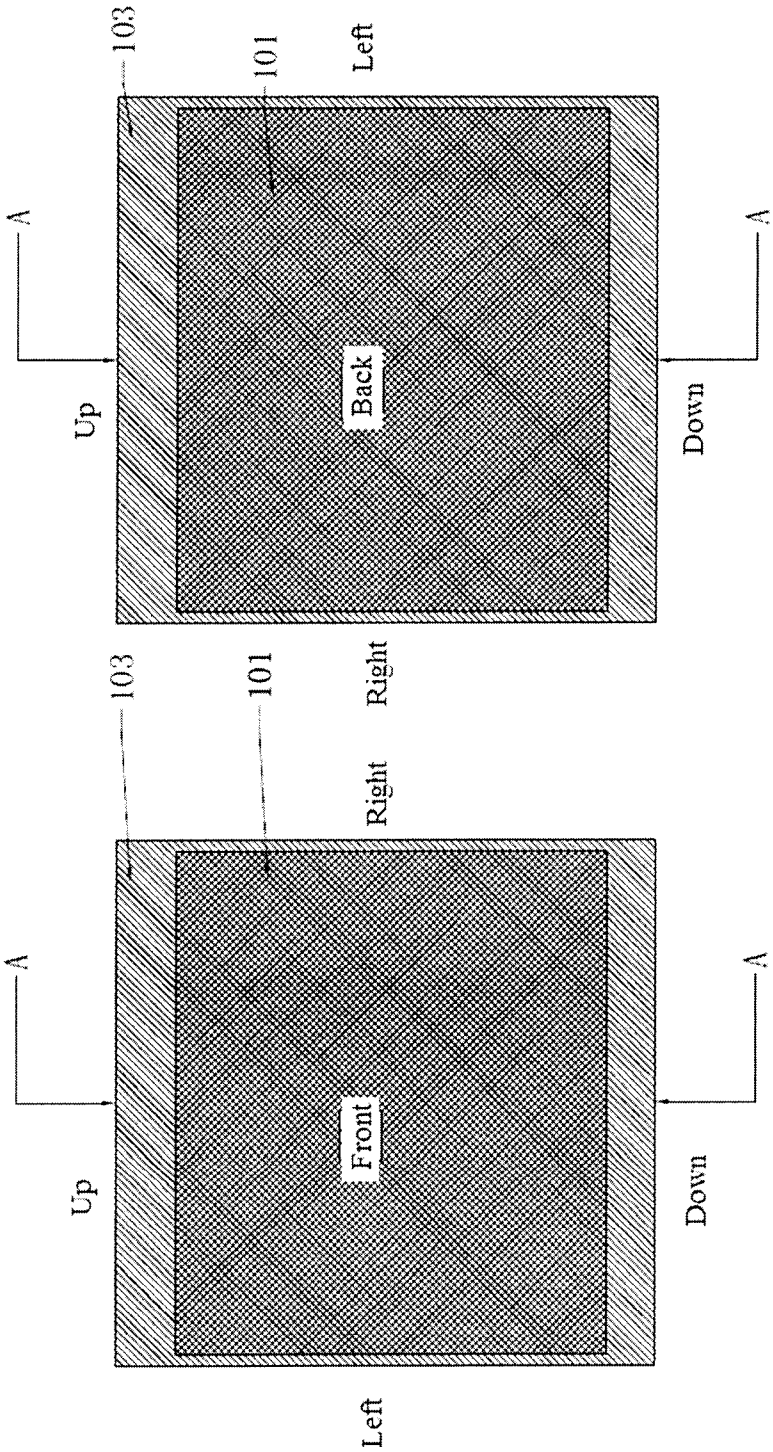


Figure 84

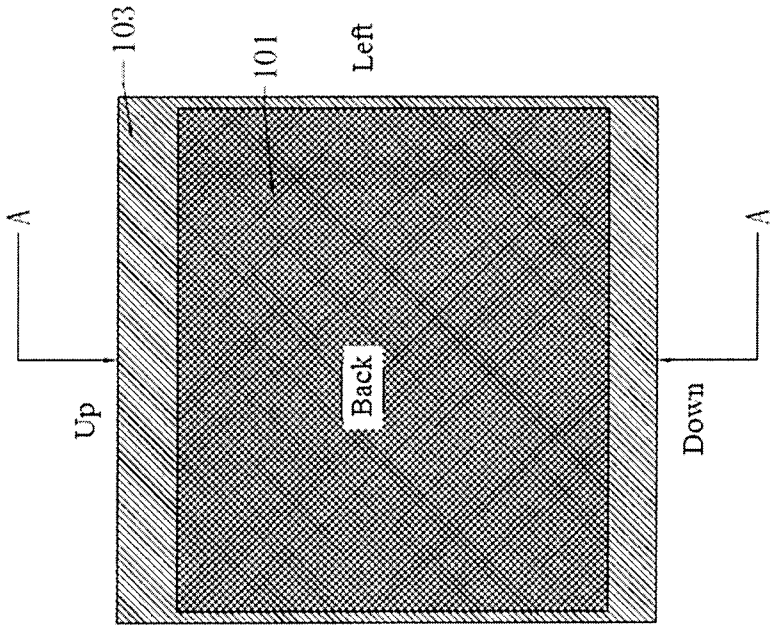


Figure 85

54/65

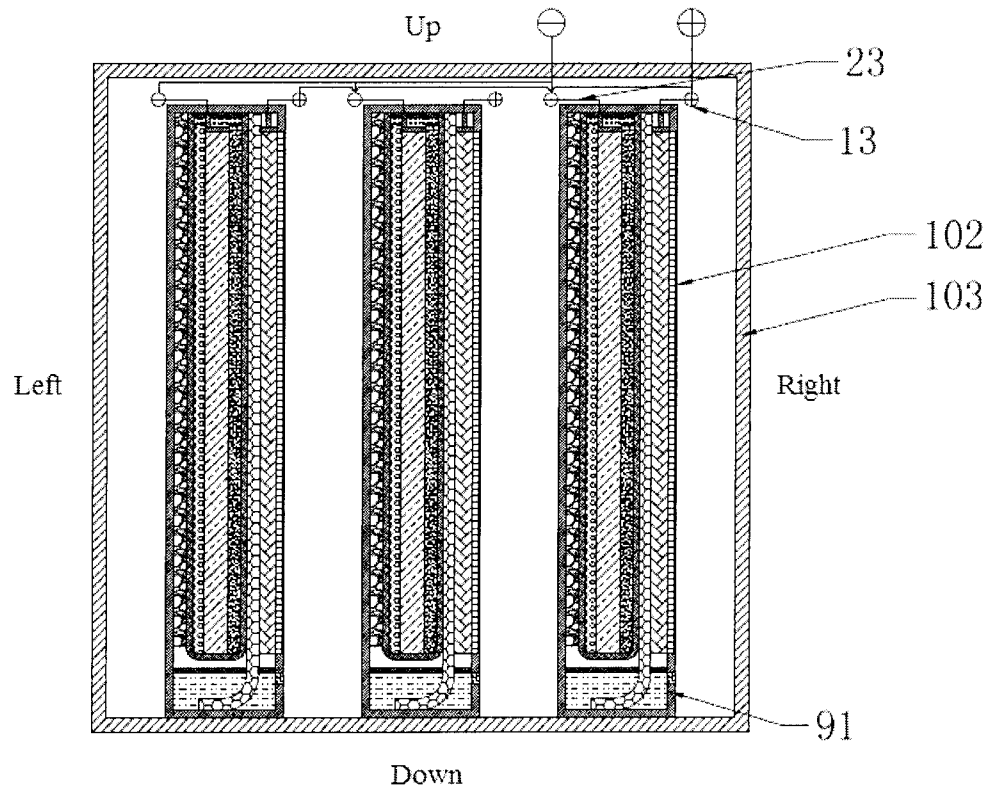


Figure 86

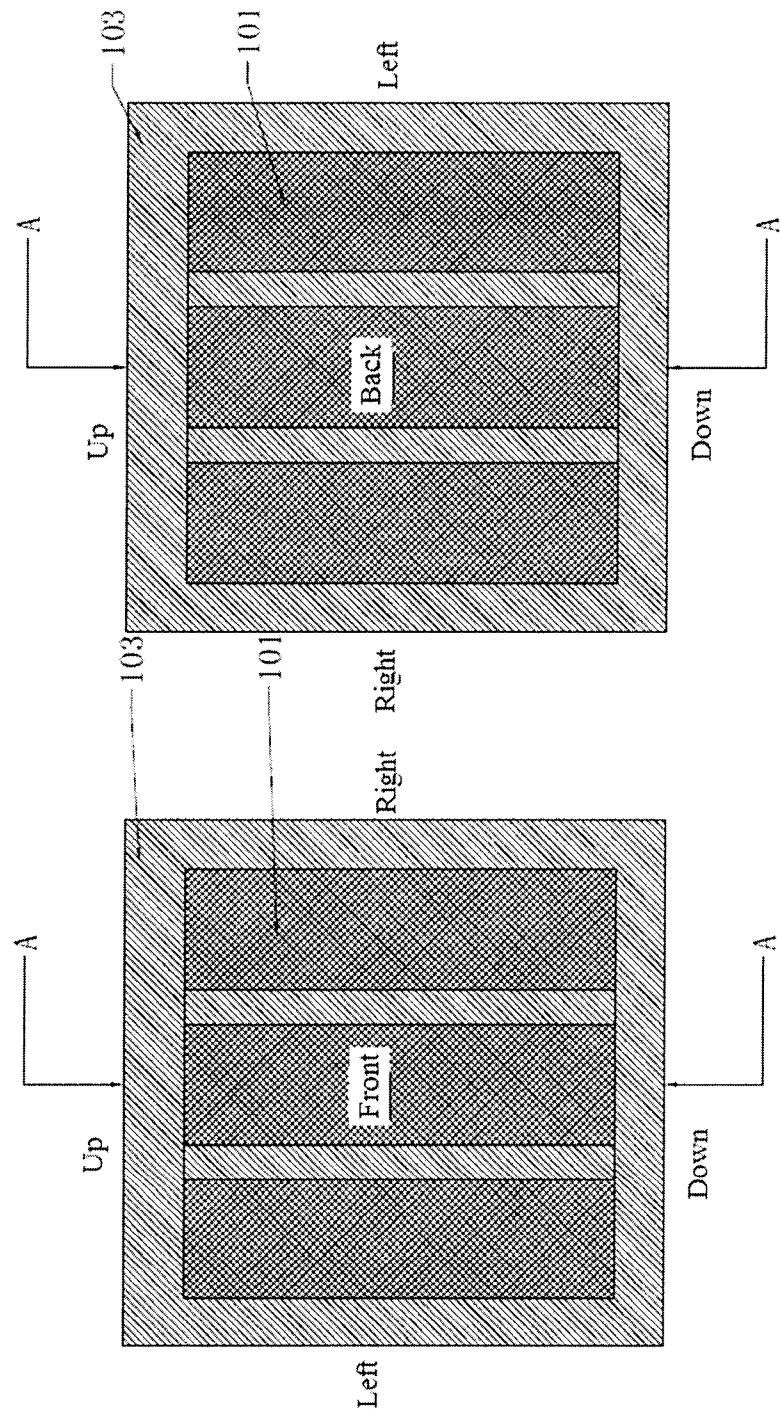


Figure 88

Figure 87

56/65

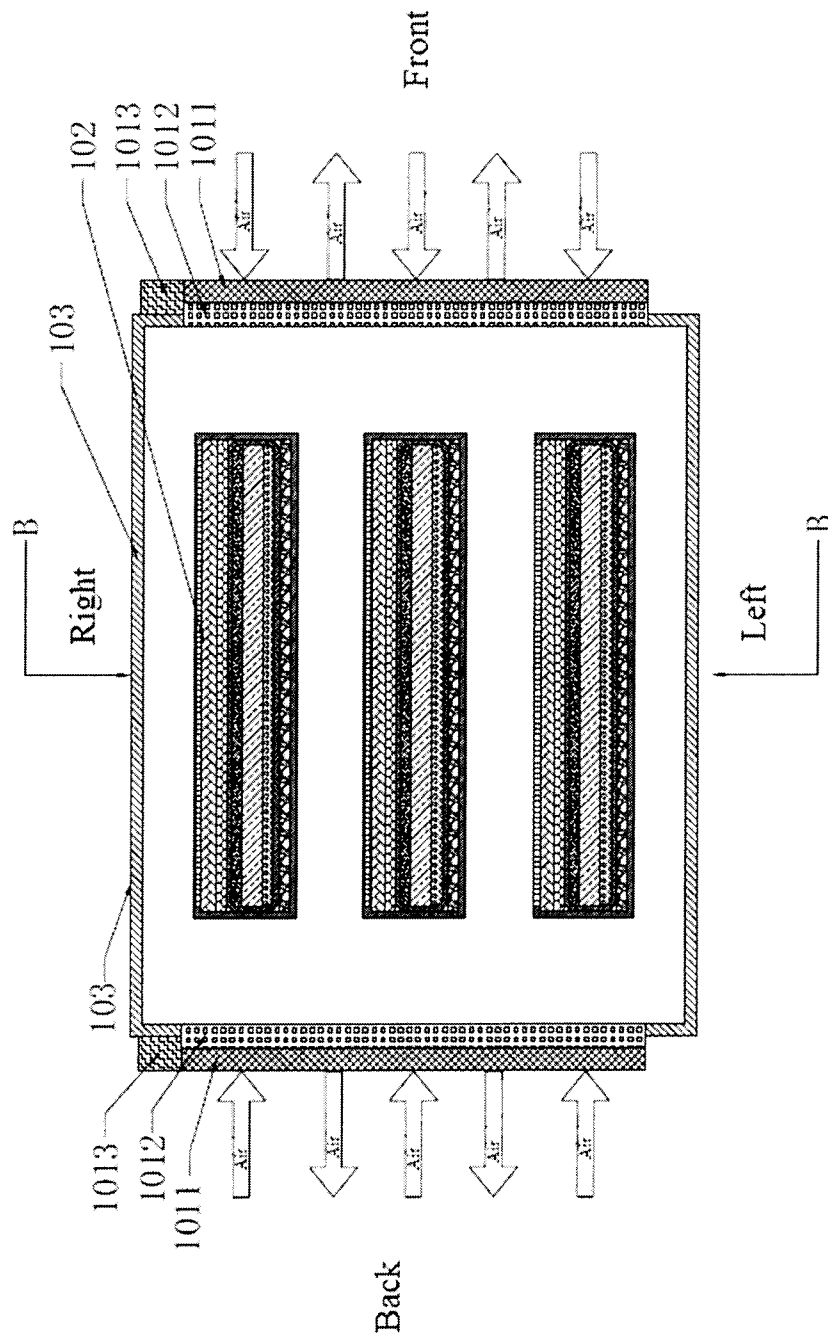


Figure 89

57/65

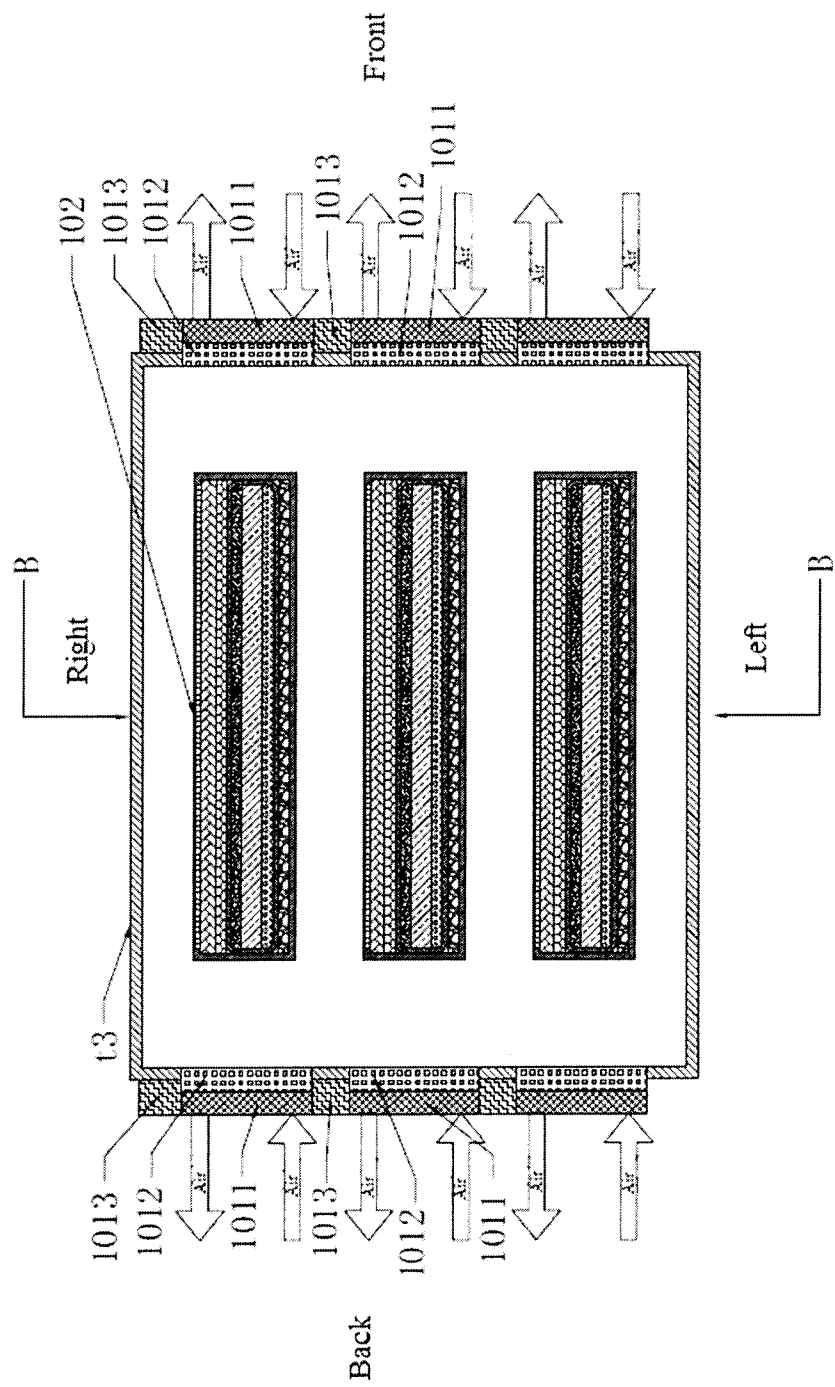


Figure 90

58/65

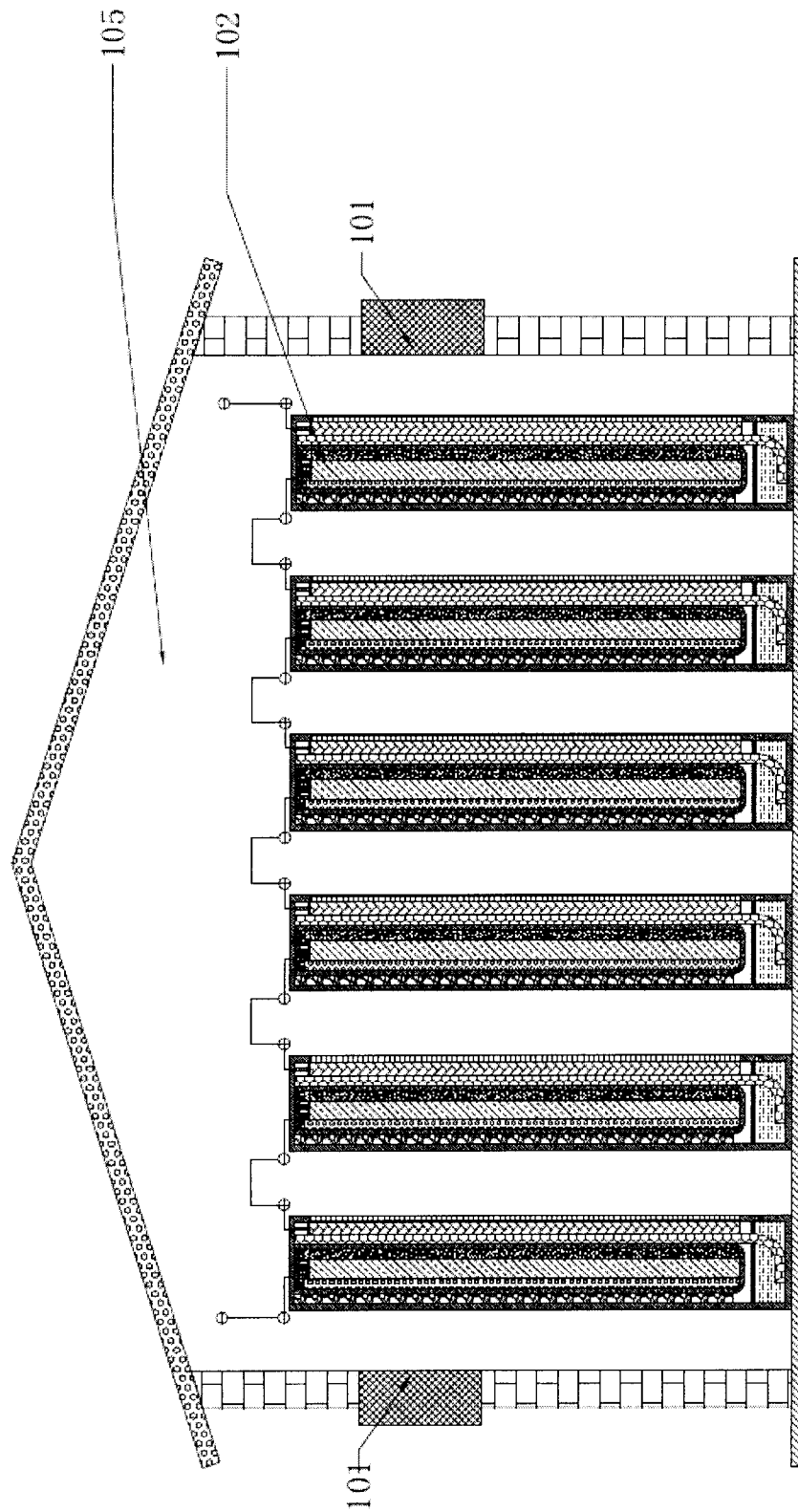


Figure 91

59/65

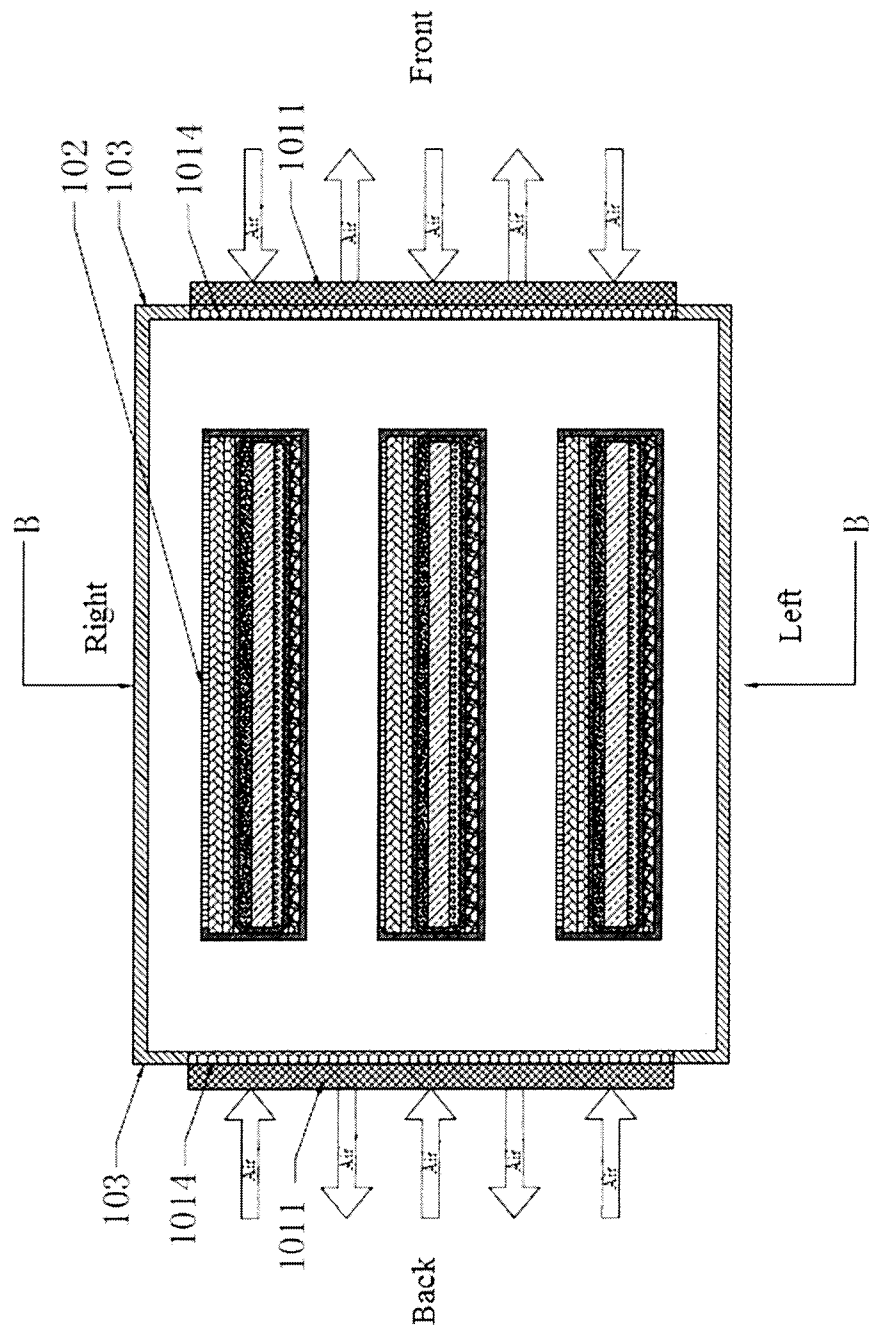


Figure 92

60/65

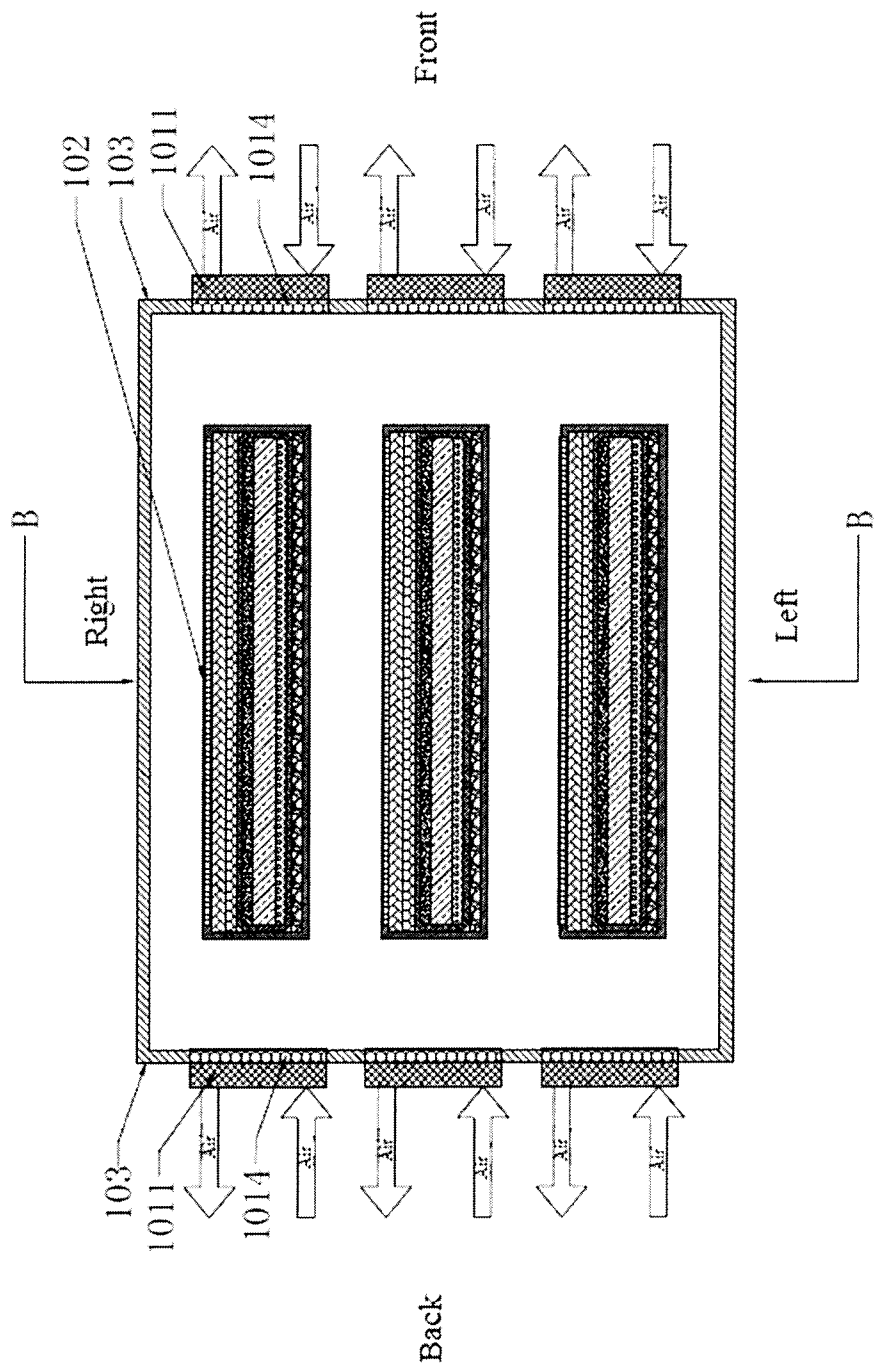


Figure 93

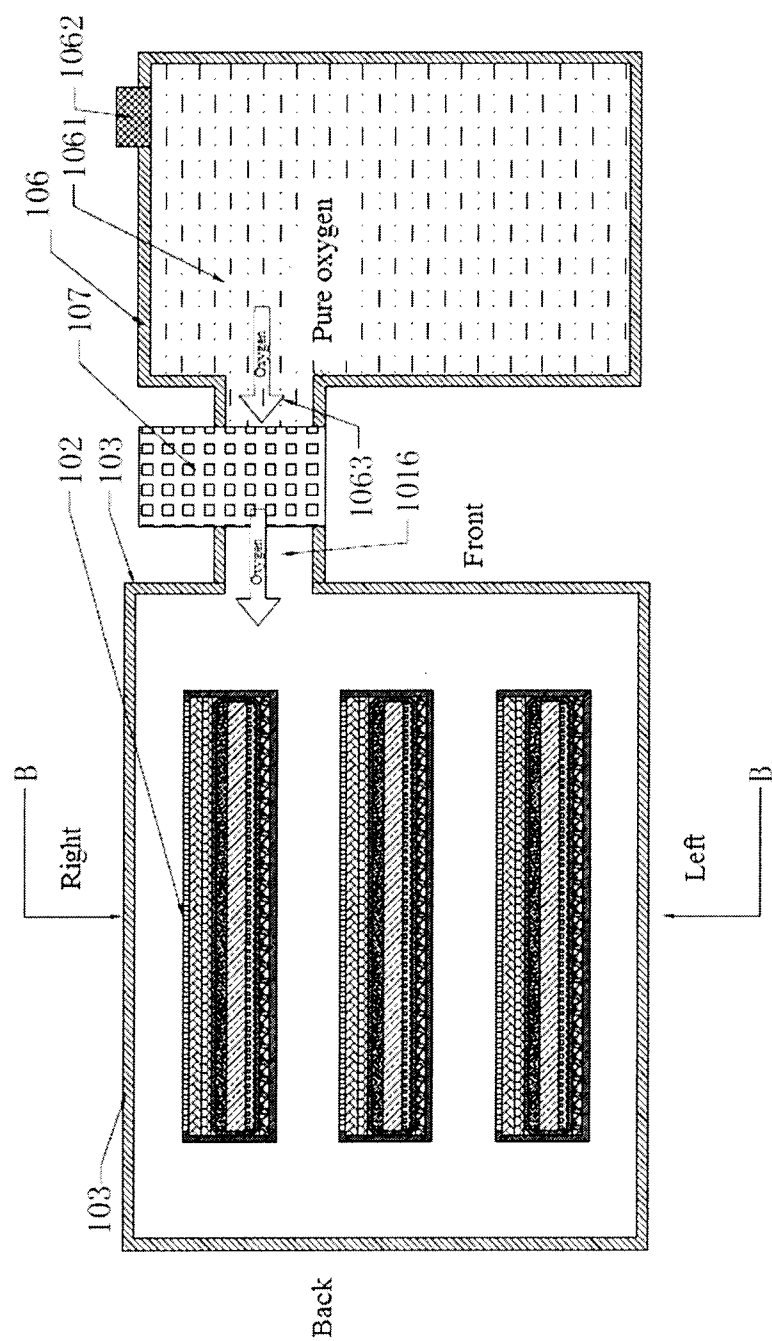


Figure 94

62/65

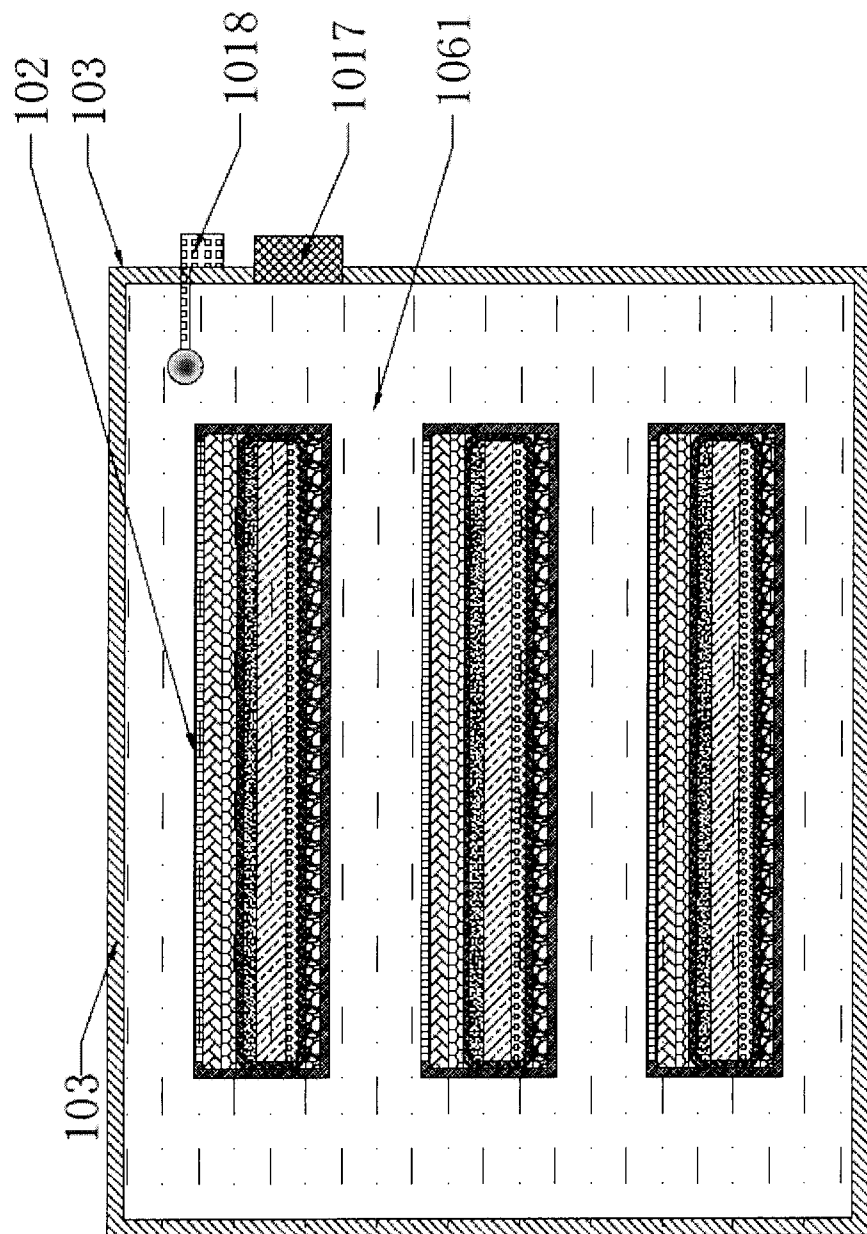


Figure 95

63/65

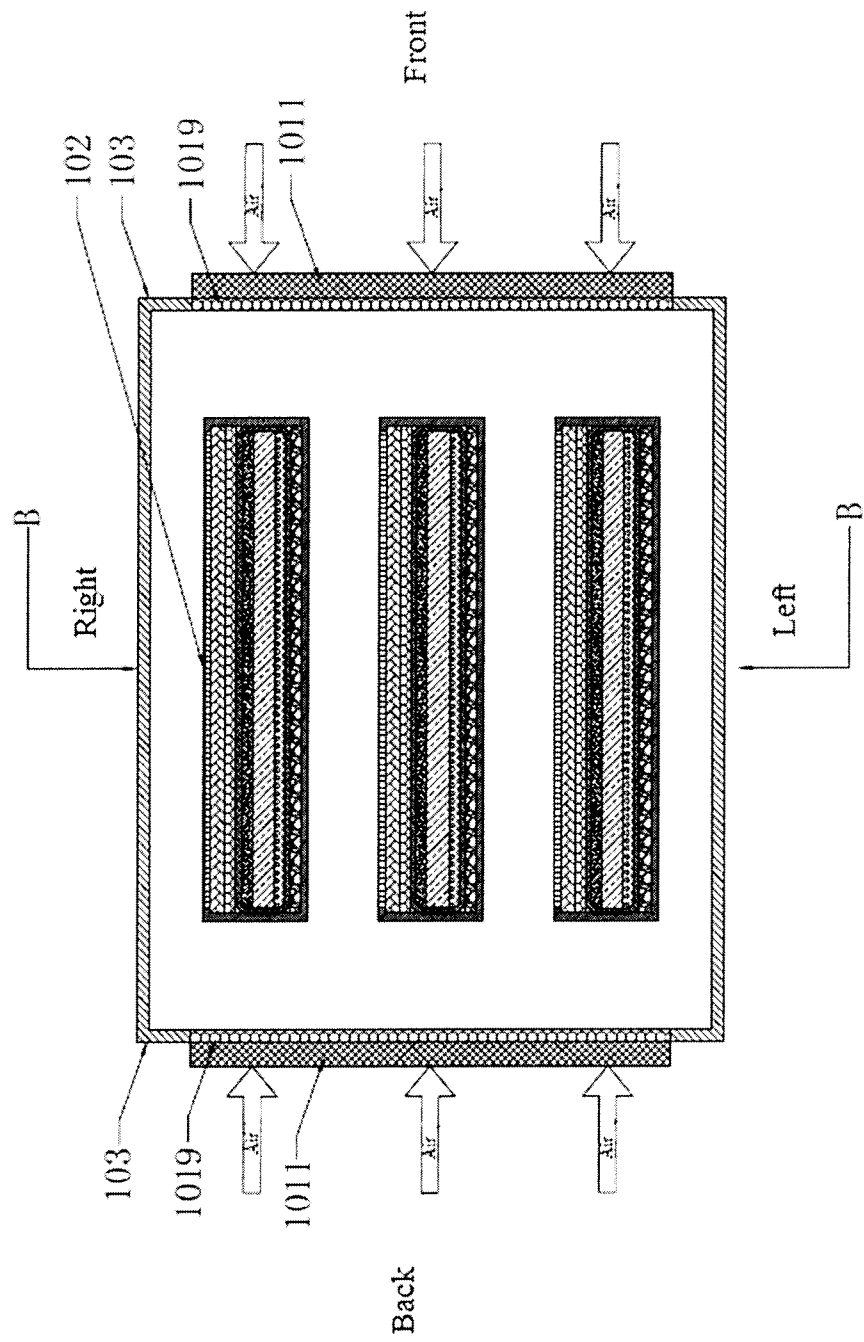


Figure 96

64/65

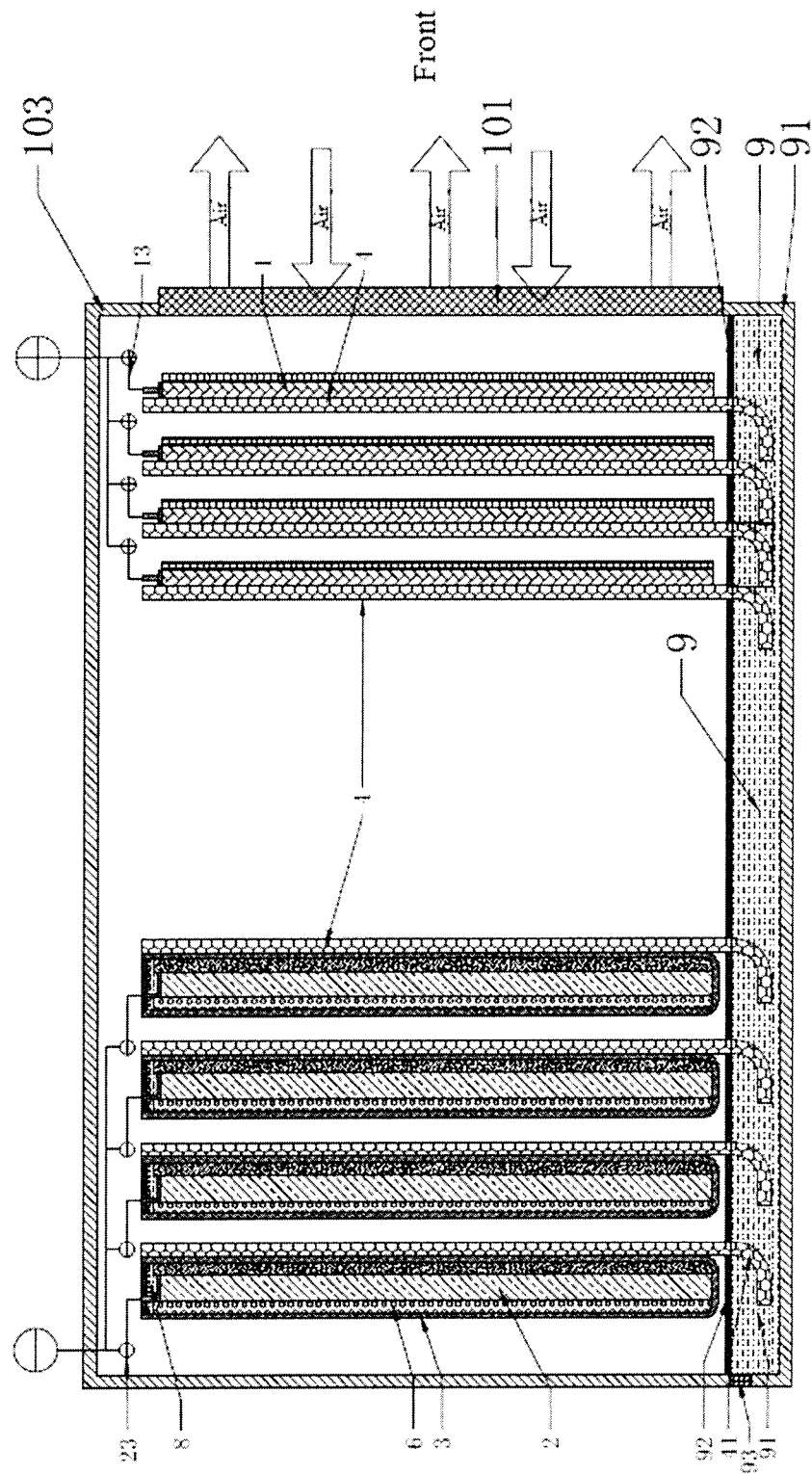


Figure 97

65/65

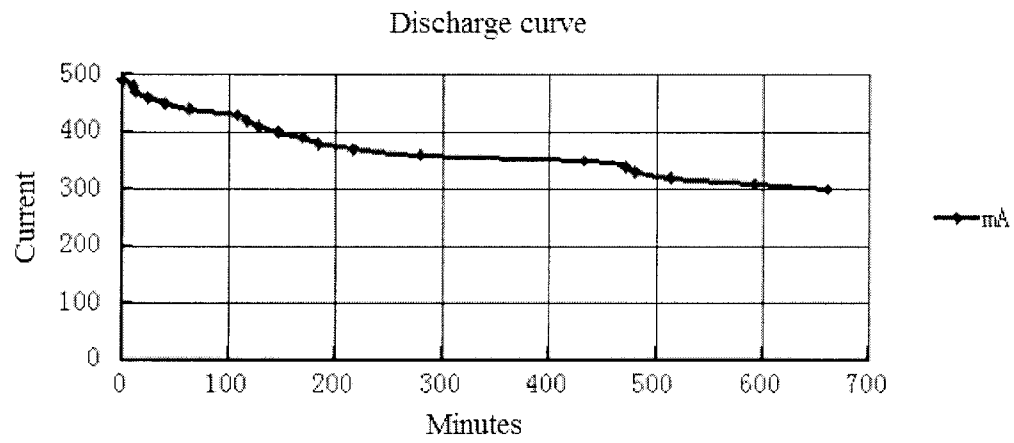


Figure 98

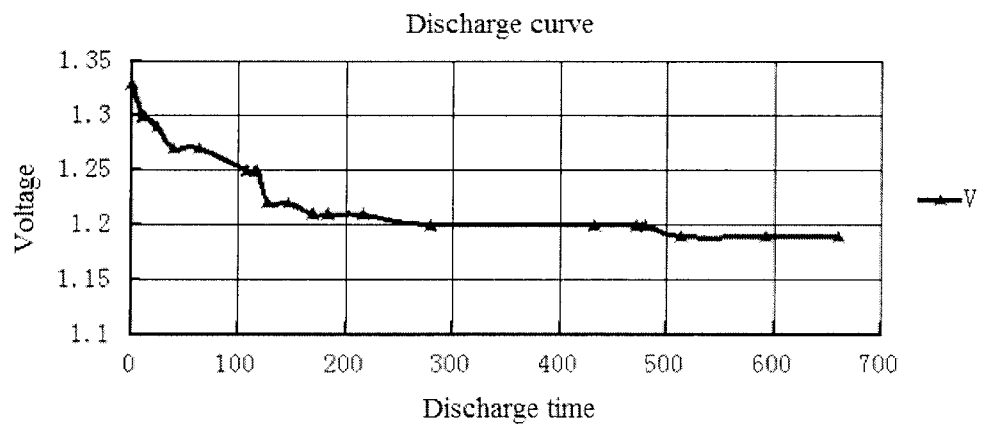


Figure 99

