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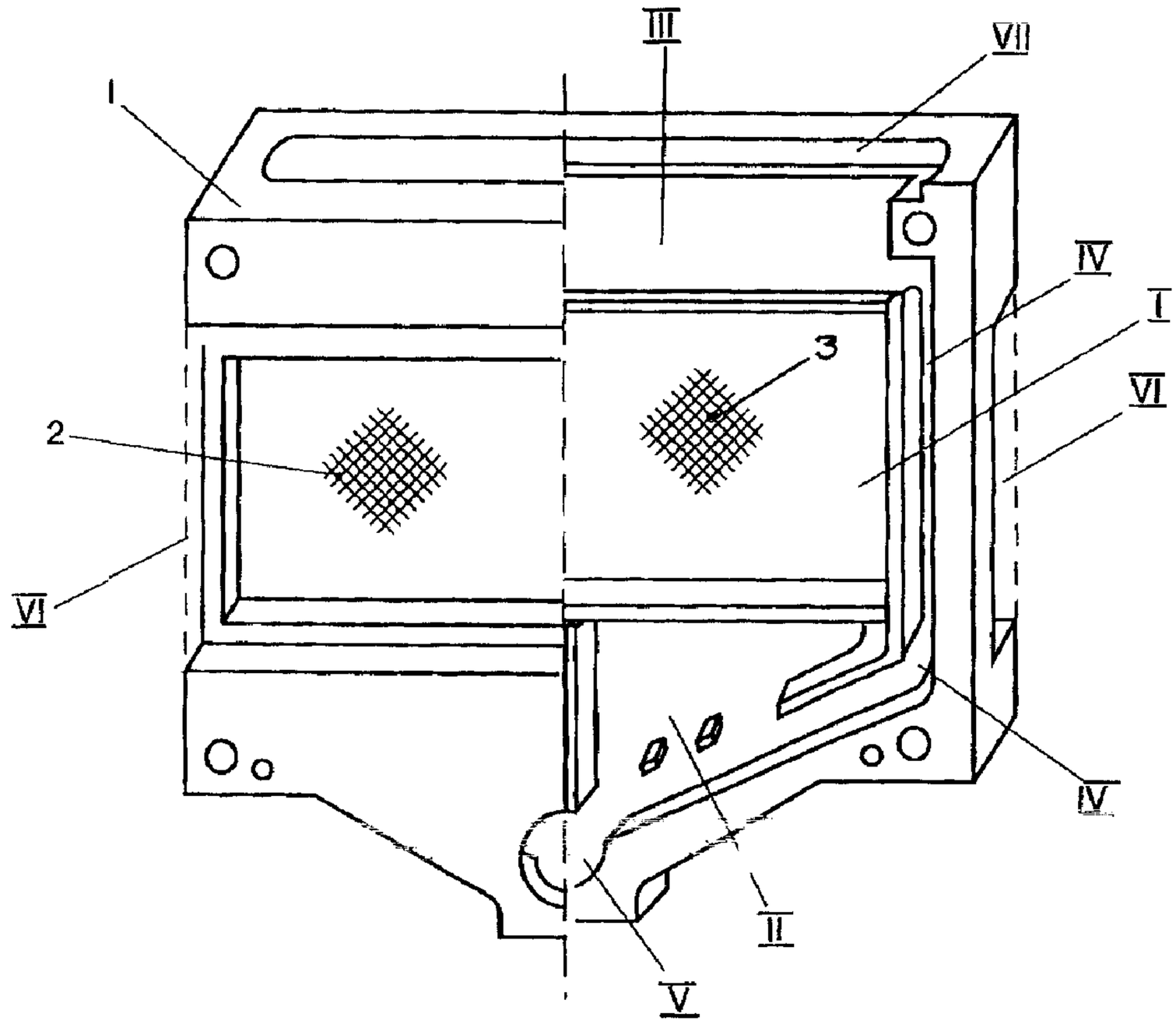
(54) Titre : PILE METAL-AIR, ET SYSTEME DE PRODUCTION D'ENERGIE ELECTROCHIMIQUE S'INSPIRANT DESDITES PILES

(54) Title: METAL-AIR CELL AND ELECTROCHEMICAL POWER GENERATION SYSTEM BASED ON METAL-AIR CELLS



Metal – Air Cell. Three-Dimensional Overall View.

(57) Abrégé/Abstract:
An electrochemical power generation system is comprised of metal - air (aluminum - air) cells. Each aluminum - air cell represents a source of electrical current and is mechanically rechargeable. The distinctive feature of this invention is that each

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(57) Abrégé(suite)/Abstract(continued):
aluminum - air cell of a bi-cathode type has a form of a flat multichamber structure. It is the preferred arrangement to connect seven aluminum - air cells into a section, sections comprise modulates and modules comprise the electrochemical power generation system. The preferred number of section in each module is two. The distinctive features of this invention is that the electrochemical power generation system is an independent source of electric power, self - contained environmentally - friendly. This technology can form a solid base for the distributed electric power generation for residential, commercial, and industrial customers. In particular, it is applicable as power supply for electric vehicles, back-up supply for telecommunication equipment, appliances, computers, radio-electronic equipment.

Abstract of the Disclosure.

An electrochemical power generation system is comprised of metal - air (aluminum - air) cells.

Each aluminum - air cell represents a source of electrical current and is mechanically rechargeable. The distinctive feature of this invention is that each aluminum - air cell of a bi-cathode type has a form of a flat multichamber structure. It is the preferred arrangement to connect seven aluminum – air cells into a section, sections comprise modules, and modules comprise the electrochemical power generation system. The preferred number of section in each module is two. The distinctive features of this invention is that the electrochemical power generation system is an independent source of electric power, self – contained, environmentally – friendly. This technology can form a solid base for the distributed electric power generation for residential, commercial, and industrial customers. In particular, it is applicable as power supply for electric vehicles, back-up supply for telecommunication equipment, appliances, computers, radio-electronic equipment.

METAL– AIR CELL AND ELECTROCHEMICAL POWER GENERATION SYSTEM BASED ON METAL-AIR CELLS.

Field of Invention.

The invention relates to the area of distributed electric power generation, specifically to the area of metal - air aluminum electrochemical systems, preferably aluminum-air cells, comprising an electrochemical power generation system suitable as an independent power supply for the following applications: electric vehicles, housing, electrical appliances, radio-electronic equipment, computers, back-up supply for telecommunication equipment, air conditioning equipment.

Summary of the Invention.

The following are the goals of the present invention:

- Providing an independent, self-contained, source of power
- Implementation of aluminum - air cells as a source of electric current
- Environmentally-friendly electrochemical power generation system
- Applicable as an independent power supply for electric vehicles
- Applicable for distributed power generation for residential, commercial and industrial users
- Increased reliability as an independent source of electrical current
- Low life-cycle cost of the compact home power generation station

Description of the invention.

In the invention, the electrochemical power generation system is comprised of metal – air cells. Each metal – air cell of a bi-cathode type includes a flat multi-chamber structure, anode sealed by a cover, two gas-diffusion cathodes, a chamber for electrolyte, oxidizing chamber, multi-functional surfaces located at each side and butt-ends of the cell frame.

In a multi-chamber structure of each of the metal - air cell, one or more chamber(s) function as a thermal-gas-hydrodynamic lift and that, along with other chambers (distribution, relieving etc.), provide the following:

- natural circular movement of electrolyte into a cell,
- optimal thermal operating conditions of the aluminum - air cell in particular and of the electrochemical power generation system as a whole,
- equalizing concentration of the electrolyte components
- improvement of the energy and operational characteristics of the cells, as well as of the electrochemical power generation system as a whole.

Metal-air cells connected in series comprise a section. Sections comprise modules of the electrochemical generator of power. The number of sections in the module can be one or more. It is preferred that for aluminum-air cells seven cells are connected in series forming a section. For aluminum – air cells each module of the electrochemical generator consists of two sections.

Due to series connection of the metal-air cells into a section, the multifunctional surfaces of the adjacent cells form an air chamber used for the convective intake of air. Therefore, for a section of seven cells, there will be formed six full air chambers, and half-chambers at both ends of the section.

The electrochemical power generation system consists of one or more modules and a unit for flow distribution and tapping the power at the electrochemical power generation system to the customer(s).

There are available version(s) of a power supply unit without the unit for flow distribution and tapping the power. In this case, the electrochemical power supply unit is composed of one module or, alternatively, a combination of modules connected in series and parallel.

The major features of the invention.

The overall view of the cell is shown on the attached Figure 1 (without anode).

The aluminum - air cell with a bi-cathode is made as a flat-box cell- frame 1.

Gas-diffusion cathodes 2 and 3 respectively that have a form of a flat sheet are located on each side of the cell-frame.

Anode that has a form of a flat plate or a U-shape is inserted in the space between the two gas-diffusion cathodes. The tail part of the anode plate is equipped with a conductor jumper that is imbedded into the sealing cover of the anode.

The multi-chamber structure of the metal-air cell is shown on Figure 1 and 2 (a simplified version).

Figure 2 shows laminar flow of electrolyte throughout the chamber.

The flat-box cell frame 1 includes multi-functional surfaces located at each side and butt-ends that are forming seven chambers, namely:

- active chamber I is located in the operation zone,
- distribution chamber II is located between the internal surfaces of the front and back walls of the cell - frame,
- relieving chamber III that has a rectangular form,
- chambers IV and IV'' are located symmetrically on each side of the active chamber I,

- chamber V is a collector and distribution chamber,
- chamber VI serves for convective intake of air for forced or natural cooling of the cells, sections, and modules of the electrochemical power generation system.
- Chamber VII is the hermetizing chamber that provides access of the anode into operation zone I during the mechanical recharging of the metal-air cell.

When the cells are connected in series into a section, module, electrochemical generator, hydrogen-exhausting distributing manifold connected to a device to convert hydrogen to water that can be returned into electrolyte or withdrawn into the atmosphere.

The preferred composition of the gas-diffusion cathode is a three-layer structure consisting of active hydrophilic (gas-impermeable) layer made of a mixture of powders of the industrial carbon and activated coal of different fractures with high specific surface containing carbon 99.95 to 99.995 per cent by mass, a mixture of polymeric fluorine and/or high-molecular carbon polymers with modifying additives.

As a part of this invention, different solutions can be utilized, e.g. alkali (NaOH or KOH) or salt solution, electrolyte, as well as their mixture, modified using different additives $Sn^{=4}$, $Pb^{=4}$, $Ga^{=3}$, $Zn^{=3}$.

Anode electrode can be made of any anodic metal that is usually utilized in metal-air cells. For example, the following metals can be used: Al, Zn, Fe, Be, Cd, Mg, Li and Pb, as well as alloys and their composites.

The preferred anodic metal utilized in this invention is aluminum alloy with additives Ga, Zn, Fe, Sn, Cd, Pb, Mn, Fe, Mg used in proportions that provide high energy and operational characteristics during the reaction under a condition of minimum allowable corrosion levels.

The second layer represents a current-conducting mesh made of nickel or its alloys, that represents the base of the cathode and, simultaneously, functioning as a current collector mesh.

The third layer represents a hydrophobic (gas-permeable) layer, made of a mixture of powders

of the industrial carbon and activated coal of different fractures with high specific surface containing carbon

99.95 to 99.995 per cent by mass, a mixture of polymeric fluorine and/or high-molecular carbon

Polymers with modifying additives.

This invention suggests to use technologically simple and efficient compositions for anodes and electrolytes, namely

For anodes:

AL 99.95 plus additives: 0.6 % by mass of In; 0.6 % by mass of Cu; 0.02 % by mass of Fe

For electrolytes:

4 mol/L NaOH or 4 mol/L KOH plus additives: 0.5 % by mass of Sn; 0.2 % by mass of Su; 0.5 % by mass of D (glucose).

Although this disclosure has described and illustrated certain preferred embodiments of the invention, it is to be understood that the invention is not restricted to those particular embodiments. Rather, the invention includes all embodiments which are functional or mechanical equivalents of the specific embodiments and features that have been described and illustrated.

Claim

Claim 1: An electrochemical power generation system comprising a plurality of metal – air cells, wherein each metal – air cell is of a bi-cathode type having a cell frame, a flat multi-chamber structure, anode sealed by a cover, two gas-diffusion cathodes, a chamber for electrolyte, oxidizing chamber, multi-functional surfaces located at each side and butt-ends of the cell frame.

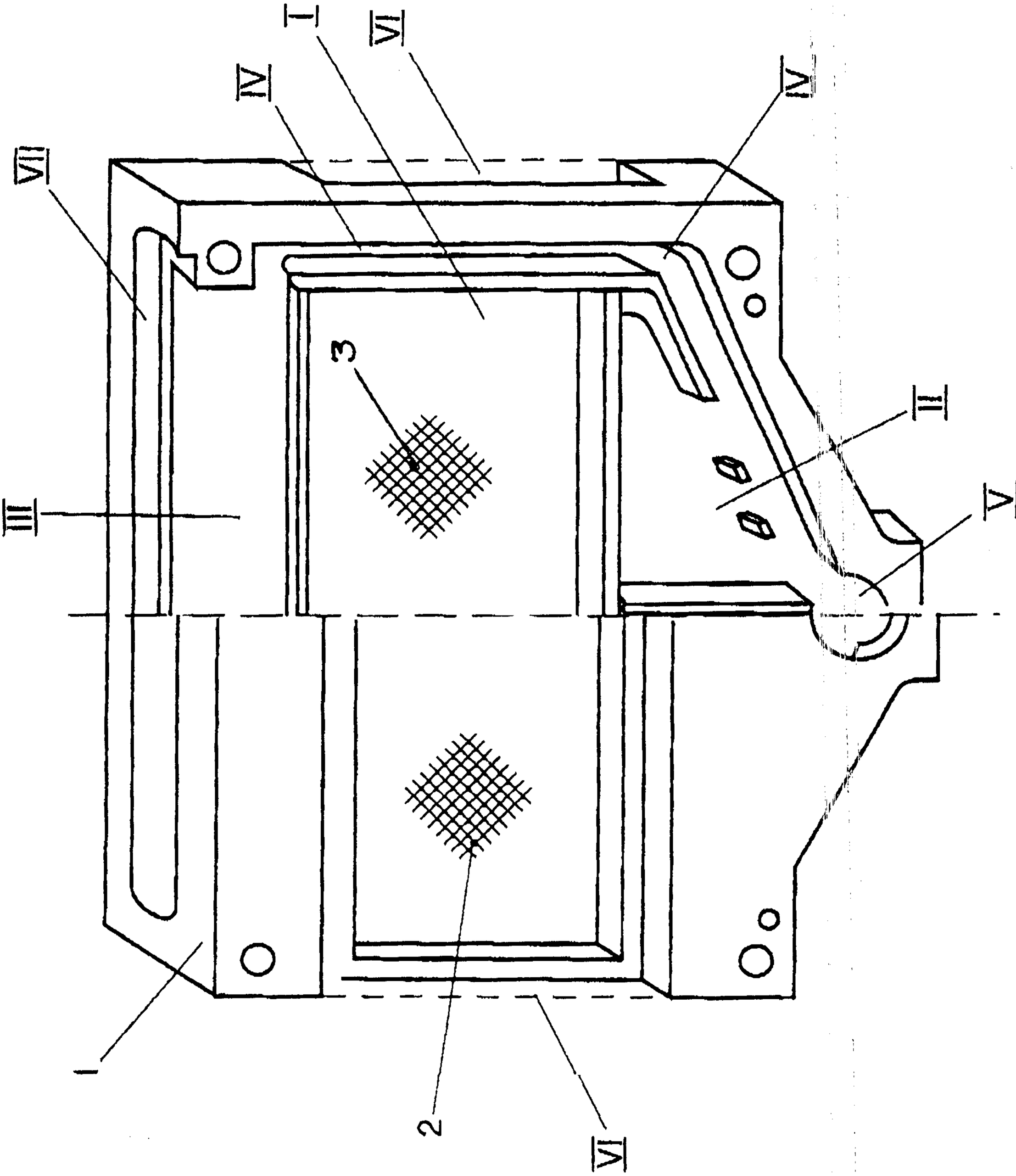


Fig.1 Metal – Air Cell. Three-Dimensional Overall View.

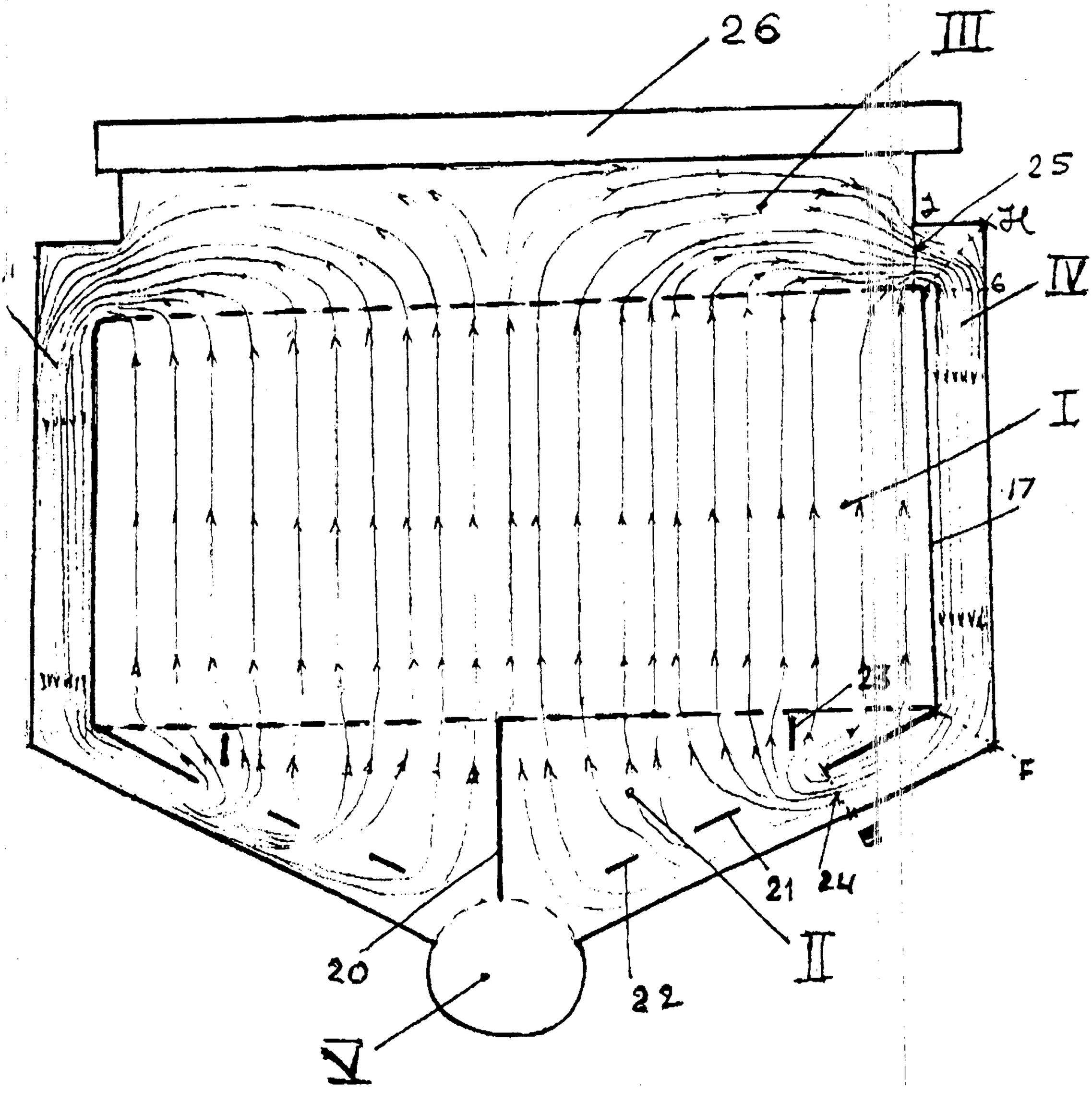


Fig.2 Metal – Air Cell. Diagram of Laminar Flow of Electrolyte.

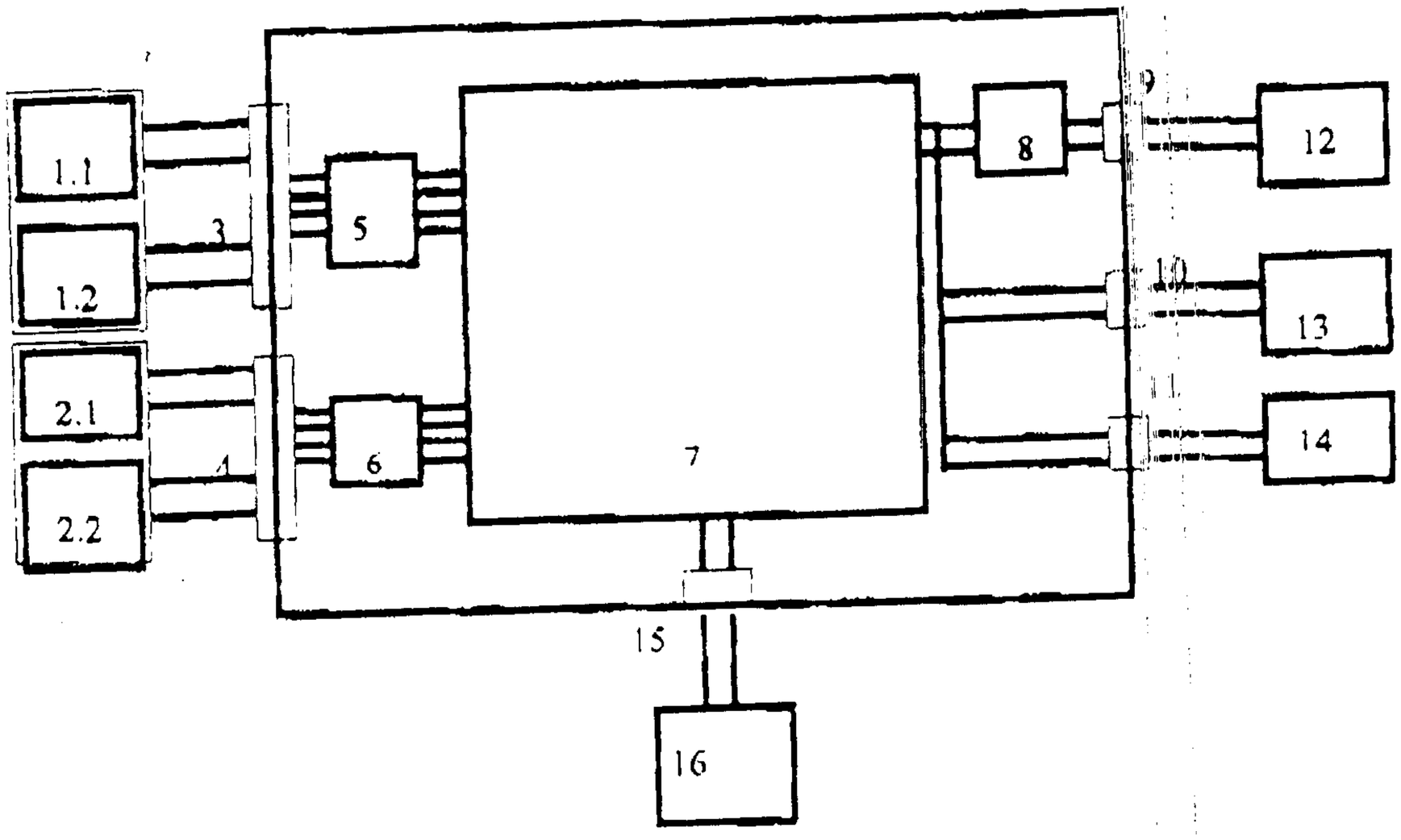
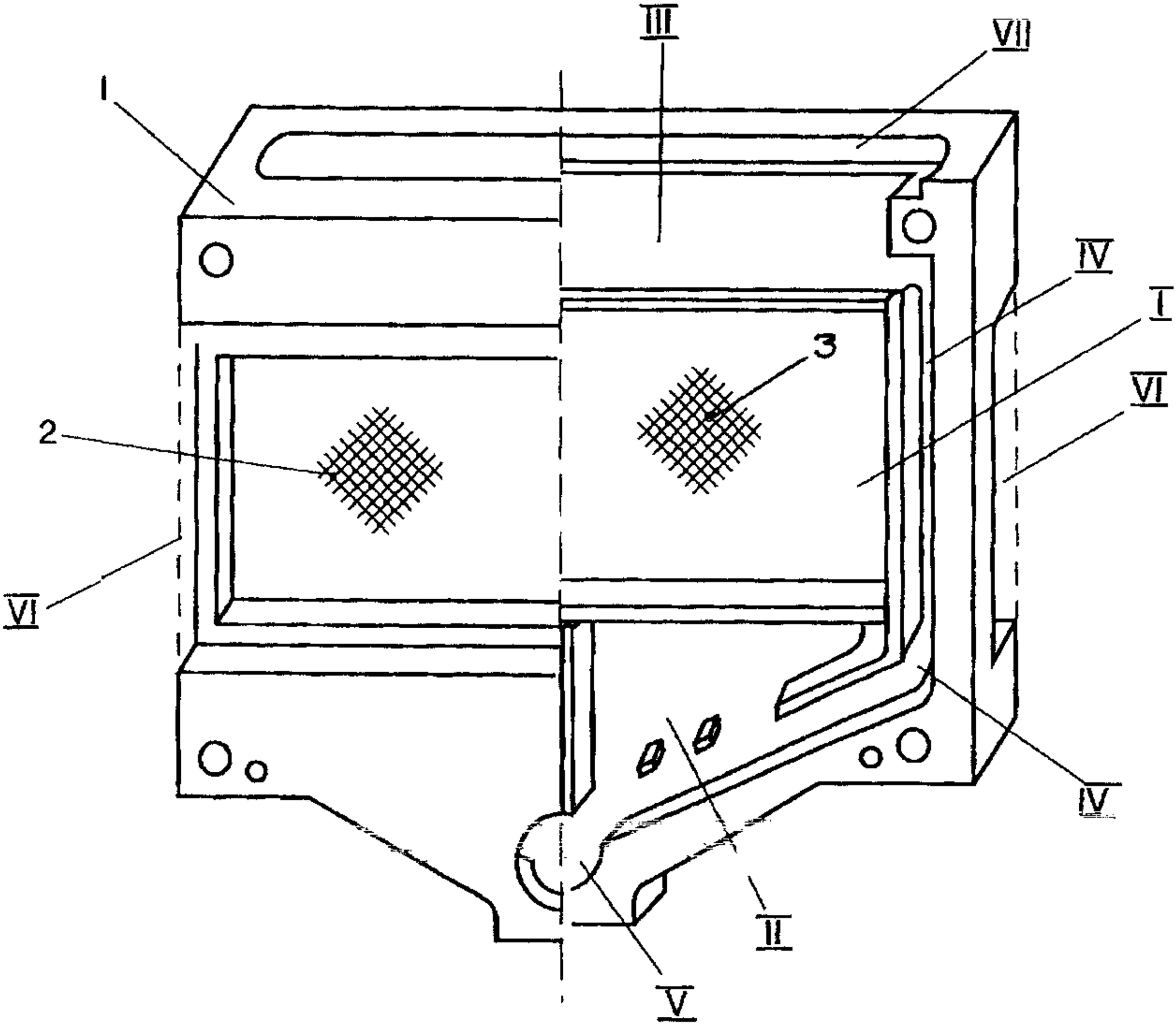


Fig.3 Electrochemical Power Generation System Based on Metal – Air Cells.
Block - Diagram of the System.



Metal – Air Cell. Three-Dimensional Overall View.