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(54) Titre : METHODE ET SYSTEME DE CHARGEMENT DE BATTERIE SCELLEE A ENERGIE THERMIQUE

(54) Title: SEALED THERMAL POWER BATTERY CHARGING METHOD AND SYSTEM

(57) Abrégé/Abstract:

• A method and system for charging a battery comprises a fluid having a low boiling point, a reservoir for storing the fluid under pressure, a transparent evaporator for changing the fluid from liquid state to gaseous state by evaporation, a dark-coloured heat absorber for absorbing heat from sunlight, a generator for generating electrical power, and a condenser for changing the fluid from gaseous state to liquid state by condensation. The generator comprises an Archimedes Spiral Screw, a permanent magnet, a stationary coil, a rectifier, and an electrical cable for transmitting DC electrical power to a battery. The fluid in liquid state returns from the condenser to the reservoir by gravity. This invention relates to battery charging methods and systems with an Archimedes spiral screw, and the principal use of the invention is for charging a battery.

Abstract

- A method and system for charging a battery comprises a fluid having a low boiling point, a reservoir for storing the fluid under pressure, a transparent evaporator for changing the fluid from liquid state to gaseous state by evaporation, a dark-coloured heat absorber for absorbing heat from sunlight, a generator for generating electrical power, and a condenser for changing the fluid from gaseous state to liquid state by condensation. The generator comprises an Archimedes Spiral Screw, a permanent magnet, a stationary coil, a rectifier, and an electrical cable for transmitting DC electrical power to a battery. The fluid in liquid state returns from the condenser to the reservoir by gravity. This invention relates to battery charging methods and systems with an Archimedes spiral screw, and the principal use of the invention is for charging a battery.

Description

Title

- **Sealed Thermal Power Battery Charging Method and System**

Technical Field

- This invention relates to battery charging methods and systems, more particularly to a battery charging method and system with an Archimedes spiral screw.

Background Art

- There are many instances where it would be desirable to be able to charge a battery by thermal solar energy in the evaporation-condensation cycle of a circulating fluid with a low boiling point.
- A number of patents disclose various systems for generating electrical power with helical vanes.
- **U.S. Patent 4 262 483** discloses "Rotating heat pipe solar power generator". A rotating heat pipe solar power generator is provided in which a heat pipe has a tube concentrically positioned within it to define an annular evaporation chamber, the tube being fixed to the pipe near one end thereof by the stator blades of a turbine. The heat pipe includes a large diameter evaporator section and a small diameter condenser section remote from the turbine. The tube extends into the entrance portion of the condenser section, and liquid is pumped into the evaporation chamber through an annular throat with a tapered annulus constituting the juncture between the two sections of the heat pipe, this throat serving as a centrifugal pump. The turbine is geared to the heat pipe so that both rotate.
- **U.S. Patent 4 622 820** discloses "Absorption power generator". The absorption power generator is similar to a conventional steam power generator. High pressure vapor is produced in a vapor generator and expanded in a prime mover to produce power. Exhaust vapor from the prime mover is collapsed to liquid and pumped back into the vapor generator. The absorption power generator differs in that the temperature of the vapor generator heat source can be much lower. This is because a low boiling point liquid, such as ammonia, is vaporized instead of water. Instead of condensing the exhaust vapor from the prime mover in a condenser, the exhaust vapor is absorbed by an absorbent liquid in an absorber. For ammonia, water is the absorbent

liquid. Unused heat is rejected from the process, at normal heat rejection temperatures, by a high pressure condenser, working in parallel with the prime mover.

- **U.S. Patent 5 937 644** discloses "Device for extracting energy from moving fluid". An energy conversion apparatus for extracting useful energy from moving fluids such as water, the apparatus including a shaft and a plurality of integrally formed blade modules which are coupled together to form the shaft, a plurality of blades is integrally formed on the free ends of arms, the arrangement being such that the blades can be resiliently displaced relative to the arms when located in the moving fluid to thereby produce useful torque on the shaft.
- **U.S. Patent 6 741 000** discloses "Electro-magnetic archimedean screw motor-generator". An Archimedes' screw serves as a rotor, inducer, impeller, and/or driver with motor and/or generator configurations that surround the screw by attaching to an outer cylinder of the screw. The screw acts as the motor's rotor axis with attached permanent magnets and or frame and the stator is built around the auxiliary circumference of this rotor. The rotor may also house half the bearings and can be used for the movement of fluids and/or solids, for cavitation-less drive of water vehicles, or for the generation of electrical power when the fluids become the motive force to drive the unit.
- These prior art arrangements do not have a method and system for charging a battery by thermal solar energy in the evaporation-condensation cycle of a circulating fluid with a low boiling point. The impeller used in conventional power generator causes turbulent flow with high level of noise and vibration, and may create cavitation which leads to short life and high wear of the power generation mechanism.

Description of the Invention

- It is a primary object of the invention to provide a method for charging a battery by thermal solar energy.
- It is another object of the invention to provide a method for generating electrical power by the evaporation-condensation cycle of a circulating fluid with a low boiling point.
- It is another object of the invention to provide a method for rotating a permanent magnet by a helical vane which is capable of minimising turbulent flow and of maximising laminar flow.
- It is another object of the invention to provide a system for charging a battery by thermal solar energy.
- It is another object of the invention to provide a system for

generating electrical power by the evaporation-condensation cycle of a circulating fluid with a low boiling point.

- It is another object of the invention to provide a system for rotating a permanent magnet by a helical vane which is capable of minimising turbulent flow and of maximising laminar flow.
- A method and system for charging a battery comprises a fluid having a low boiling point, a reservoir for storing the fluid under pressure, a transparent evaporator for changing the fluid from liquid state to gaseous state by evaporation, a dark-coloured heat absorber for absorbing heat from sunlight, a generator for generating electrical power, and a condenser for changing the fluid from gaseous state to liquid state by condensation. The generator comprises an Archimedes Spiral Screw, a permanent magnet, a stationary coil, a rectifier, and an electrical cable for transmitting DC electrical power to a battery. The fluid in liquid state returns from the condenser to the reservoir by gravity.

Brief Description of the Figures in the Drawings

- In drawings which illustrate embodiments of the invention:
 - **Figure 1** is a side view of one embodiment of a system for charging battery according to the invention;
 - **Figure 2** is an top view of one embodiment of a system for charging battery according to the invention;
 - **Figure 3** is a sectional view of the generator assembly;
 - **Figure 4** is a top view of the helical vane with permanent magnets; and
 - **Figure 5** is a bottom view of the generator assembly with a stationary coil and a rectifier.

Modes for Carrying Out the Invention

- According to the present invention, a method for charging a battery comprises the steps of:
 1. providing a fluid having a low boiling point;
 2. storing the fluid under pressure in a reservoir;
 3. changing the fluid from liquid state to gaseous state by evaporation in a transparent evaporator;

4. absorbing heat from the sunlight by a dark-coloured heat absorber;
 5. generating electrical power by a generator assembly; and
 6. changing the fluid from gaseous state to liquid state by condensation in a condenser.
- The evaporator has fluid communication with the reservoir.
 - The heat absorber is placed inside the evaporator.
 - The generator assembly has fluid communication with the evaporator. The generator assembly comprises an Archimedes Spiral Screw for being rotated by the fluid in gaseous state, a permanent magnet for alternating magnetic field, a stationary coil for generating AC electrical power by the alternating magnetic field, a rectifier for transforming AC electrical power to DC electrical power, and an electrical cable for transmitting DC electrical power to a battery.
 - The permanent magnet of the generator assembly is embedded in the Archimedes Spiral Screw.
 - The rectifier of the generator assembly is electrically connected to the stationary coil.
 - The electrical cable of the generator assembly is electrically connected to the rectifier.
 - The condenser has fluid communication with the generator assembly and with the reservoir.
 - The fluid in liquid state returns from the condenser to the reservoir by gravity.
 - The method for charging a battery may further comprise the steps of cooling the fluid in the condenser by endothermic reaction of evaporation of water (H₂O) outside the condenser.
 - The fluid may be ammonia (NH₃) which is under pressure of higher than 100 kPa, carbon dioxide (CO₂) which is under pressure of higher than 100 kPa, or water (H₂O) which is under pressure of lower than 100 kPa.
 - In one embodiment of the invention shown in **Figure 1** (side view) and in **Figure 2** (top view), a system for charging a battery comprises a fluid 1-0, a reservoir 2-0 for storing the fluid under pressure, a transparent evaporator 3-0 for changing the fluid from liquid state to gaseous state by evaporation, a dark-coloured heat absorber 4-0 for absorbing heat from

sunlight, a generator assembly 5-0 for generating electrical power, and a condenser 6-0 for changing the fluid from gaseous state to liquid state by condensation.

- The fluid 1-0 has a low boiling point.
- The evaporator 3-0 has fluid communication with the reservoir 2-0.
- The heat absorber 4-0 is placed inside the evaporator 3-0.
- **Figure 3** shows a sectional view of the generator assembly 5-0.
- The generator assembly 5-0 has fluid communication with the evaporator 3-0. The generator assembly 5-0 comprises an Archimedes Spiral Screw 5-1 for being rotated by the fluid 1-0 in gaseous state, a permanent magnet 5-2 for alternating magnetic field, a stationary coil 5-3 for generating AC electrical power by the alternating magnetic field, a rectifier 5-4 for transforming AC electrical power to DC electrical power, and an electrical cable 5-5 for transmitting DC electrical power to a battery.
- The Archimedes Spiral Screw 5-1 of the generator assembly 5-0 acts as an expansion valve to lower the pressure.
- The permanent magnet 5-2 of the generator assembly 5-0 is embedded in the Archimedes Spiral Screw 5-1, as shown in **Figure 4**. Preferably, the permanent magnet 5-2 of the generator assembly 5-0 is made of a rare-earth permanent magnet.
- The rectifier 5-4 of the generator assembly 5-0 is electrically connected to the stationary coil 5-3, as shown in **Figure 5**.
- The electrical cable 5-5 of the generator assembly 5-0 is electrically connected to the rectifier 5-4, as shown in **Figure 5**.
- The condenser 6-0 has fluid communication with the generator assembly 5-0 and with the reservoir 2-0.
- The fluid 1-0 in liquid state returns from the condenser 6-0 to the reservoir 2-0 by gravity.
- The system for charging a battery may further comprise a cooler 7-0 for cooling the fluid 1-0 in the condenser 6-0 by endothermic reaction of evaporation of water (H₂O) outside the condenser 6-0.
- The system for charging a battery is hermetically sealed in a closed system so that there is no leakage of the fluid 1-0.

Claims

- The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for charging a battery, comprising the steps of:

- providing a fluid having a low boiling point;
- storing the fluid under pressure in a reservoir;
- changing the fluid from liquid state to gaseous state by evaporation in a transparent evaporator, the evaporator having fluid communication with the reservoir, the evaporator having a dome-shaped upper portion and a lower portion;
- absorbing heat from sunlight by a dark-coloured planar heat absorber, the heat absorber placed horizontally inside the lower portion of the evaporator;
- generating electrical power by a generator assembly, the generator assembly having fluid communication with the evaporator, the generator assembly comprising:
 - an Archimedes Spiral Screw for being rotated by the fluid in gaseous state, the Archimedes Spiral Screw having a rotational axis, a top end and a bottom end;
 - first two permanent magnets for alternating magnetic field, the first two permanent magnets embedded in the Archimedes Spiral Screw at the top end, the first two permanent magnets spaced with each other π radian apart around the rotational axis of the Archimedes Spiral Screw;
 - second two permanent magnets for alternating magnetic field, the second two permanent magnets embedded in the Archimedes Spiral Screw at the bottom end, the second two permanent magnets spaced with each other π radian apart around the rotational axis of the Archimedes Spiral Screw;
 - a first stationary coil for generating sinusoidal AC electrical power by the alternating magnetic field from the first two permanent magnets, the first stationary coil placed above the Archimedes Spiral Screw;
 - a second stationary coil for generating sinusoidal AC electrical power by the alternating magnetic field from the second two permanent magnets, the second stationary

coil below the Archimedes Spiral Screw;

- a rectifier for transforming AC electrical power to DC electrical power, the rectifier electrically connected to the stationary coil; and
 - an electrical cable for transmitting DC electrical power to a battery, the electrical cable electrically connected to the rectifier;
- changing the fluid from gaseous state to liquid state by condensation in a condenser, the condenser having fluid communication with the generator assembly and with the reservoir;

in which the top end of the Archimedes Spiral Screw and the bottom end of the Archimedes Spiral Screw are both pointy in shape in order to minimise friction, in which the first stationary coil placed above the Archimedes Spiral Screw for generating sinusoidal AC electrical power and the second stationary coil placed below the Archimedes Spiral Screw for generating sinusoidal AC electrical power are spaced with each other π radian apart around the rotational axis of the Archimedes Spiral Screw so that the electrical phase of the two sinusoidal AC electrical power is shifted by π radian in order to maximise the transformation of AC electrical power to DC electrical power.

2. The method for charging a battery as defined in claim 1, in which the fluid is ammonia (NH_3), the fluid being under pressure of higher than 100 kPa.
3. The method for charging a battery as defined in claim 1, in which the fluid is carbon dioxide (CO_2), the fluid being under pressure of higher than 100 kPa.
4. The method for charging a battery as defined in claim 1, in which the fluid is water (H_2O), the fluid being under pressure of lower than 100 kPa.
5. A system for charging a battery, comprising:
 - a fluid having a low boiling point;
 - a reservoir for storing the fluid under pressure;
 - a transparent evaporator for changing the fluid from liquid state to gaseous state by evaporation, the evaporator having fluid communication with the reservoir, the evaporator having a dome-shaped upper portion and a lower portion;

- a dark-coloured planar heat absorber for absorbing heat from sunlight, the heat absorber placed horizontally inside the lower portion of the evaporator;
- a generator assembly for generating electrical power, the generator assembly having fluid communication with the evaporator, the generator assembly comprising:
 - an Archimedes Spiral Screw for being rotated by the fluid in gaseous state, the Archimedes Spiral Screw having a rotational axis, a top end and a bottom end;
 - first two permanent magnets for alternating magnetic field, the first two permanent magnets embedded in the Archimedes Spiral Screw at the top end, the first two permanent magnets spaced with each other π radian apart around the rotational axis of the Archimedes Spiral Screw;
 - second two permanent magnets for alternating magnetic field, the second two permanent magnets embedded in the Archimedes Spiral Screw at the bottom end, the second two permanent magnets spaced with each other π radian apart around the rotational axis of the Archimedes Spiral Screw;
 - a first stationary coil for generating sinusoidal AC electrical power by the alternating magnetic field from the first two permanent magnets, the first stationary coil placed above the Archimedes Spiral Screw;
 - a second stationary coil for generating sinusoidal AC electrical power by the alternating magnetic field from the second two permanent magnets, the second stationary coil below the Archimedes Spiral Screw;
 - a rectifier for transforming AC electrical power to DC electrical power, the rectifier electrically connected to the stationary coil; and
 - an electrical cable for transmitting DC electrical power to a battery, the electrical cable electrically connected to the rectifier; and
- a condenser for changing the fluid from gaseous state to liquid state by condensation, the condenser having fluid communication with the generator assembly and with the reservoir;

in which the top end of the Archimedes Spiral Screw and the bottom end of the Archimedes Spiral Screw are both pointy in

shape in order to minimise friction, in which the first stationary coil placed above the Archimedes Spiral Screw for generating sinusoidal AC electrical power and the second stationary coil placed below the Archimedes Spiral Screw for generating sinusoidal AC electrical power are spaced with each other π radian apart around the rotational axis of the Archimedes Spiral Screw so that the electrical phase of the two sinusoidal AC electrical power is shifted by π radian in order to maximise the transformation of AC electrical power to DC electrical power.

6. The system for charging a battery as defined in claim 5, in which the permanent magnets are made of a rare-earth permanent magnet.

Figure 1

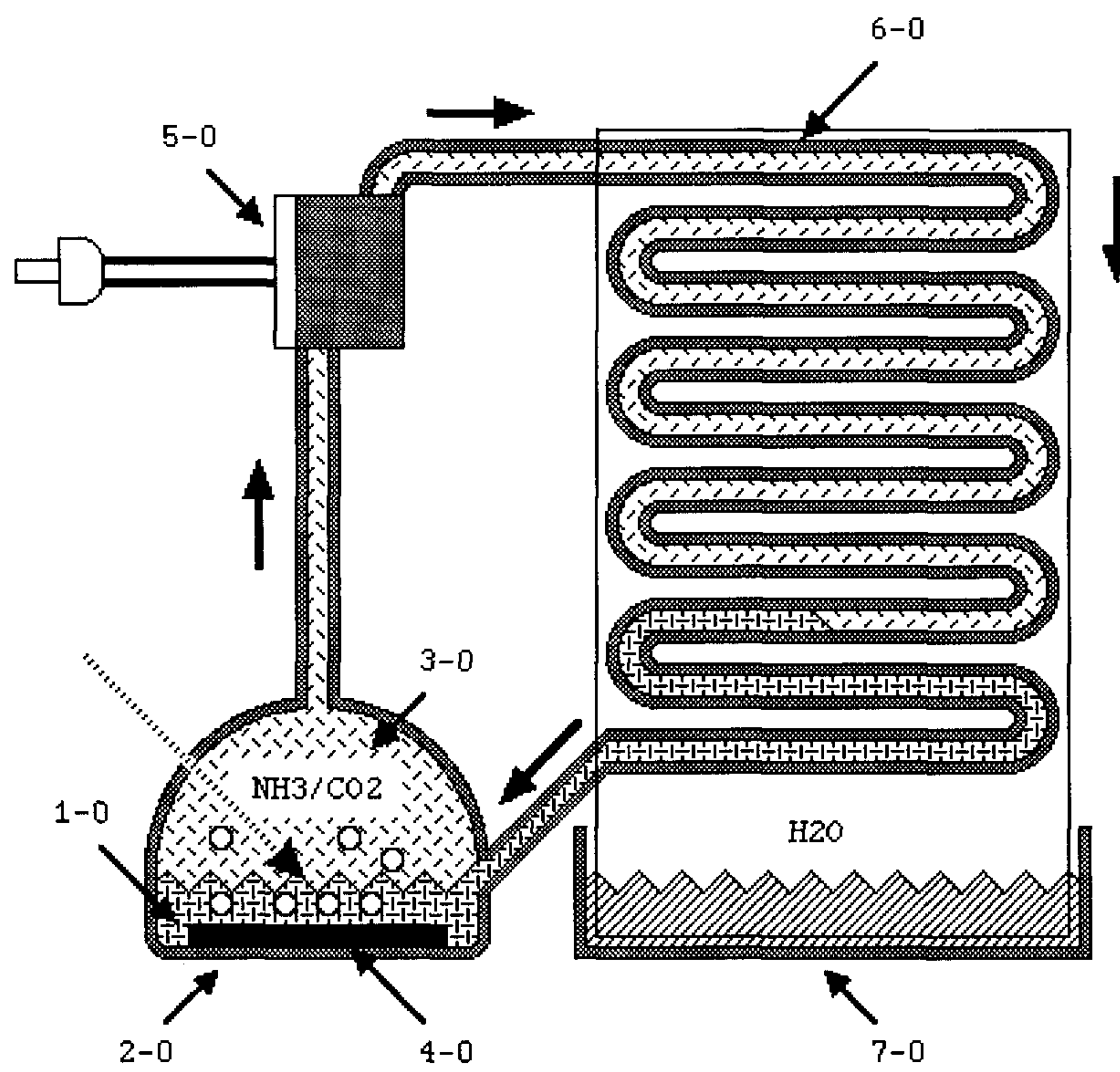


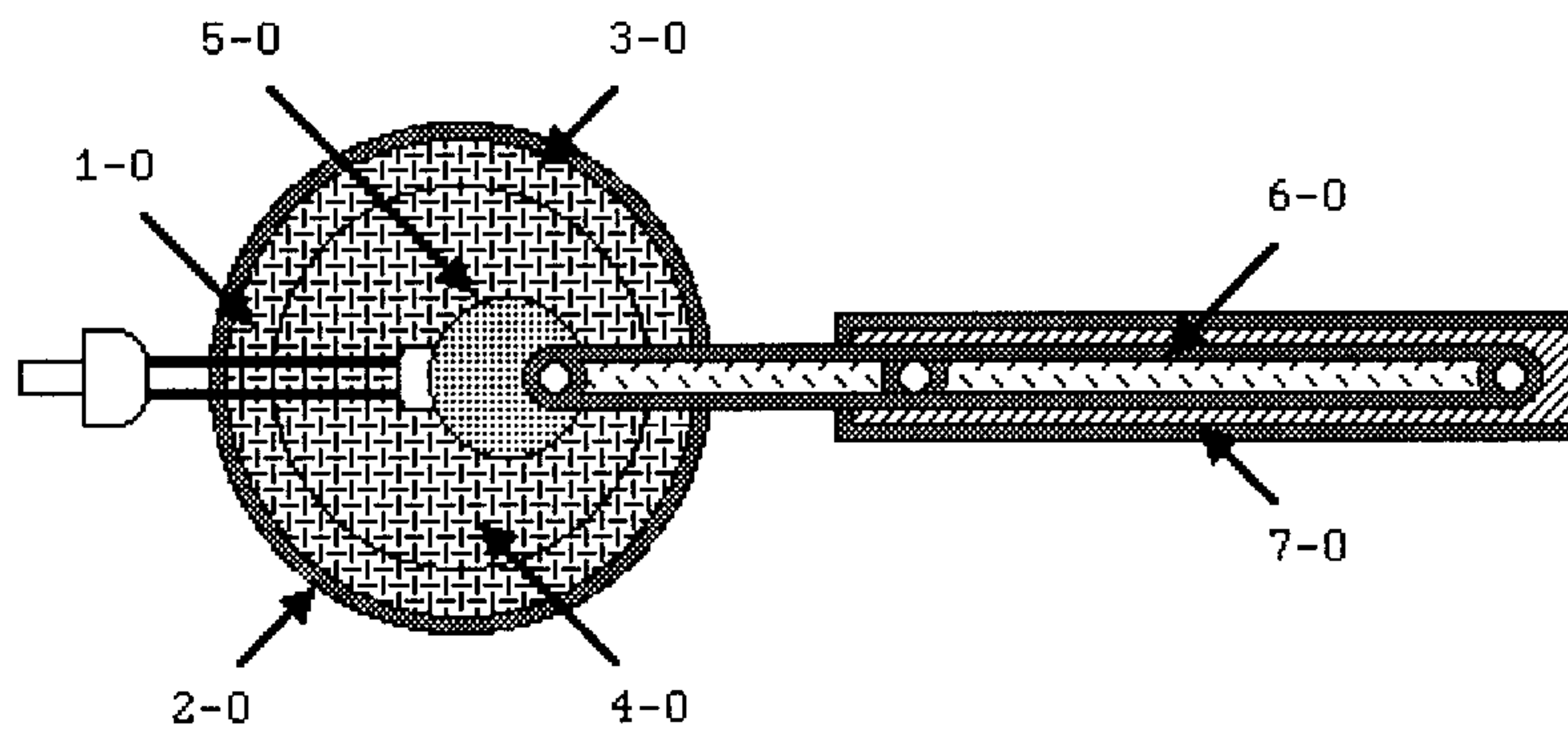
Figure 2

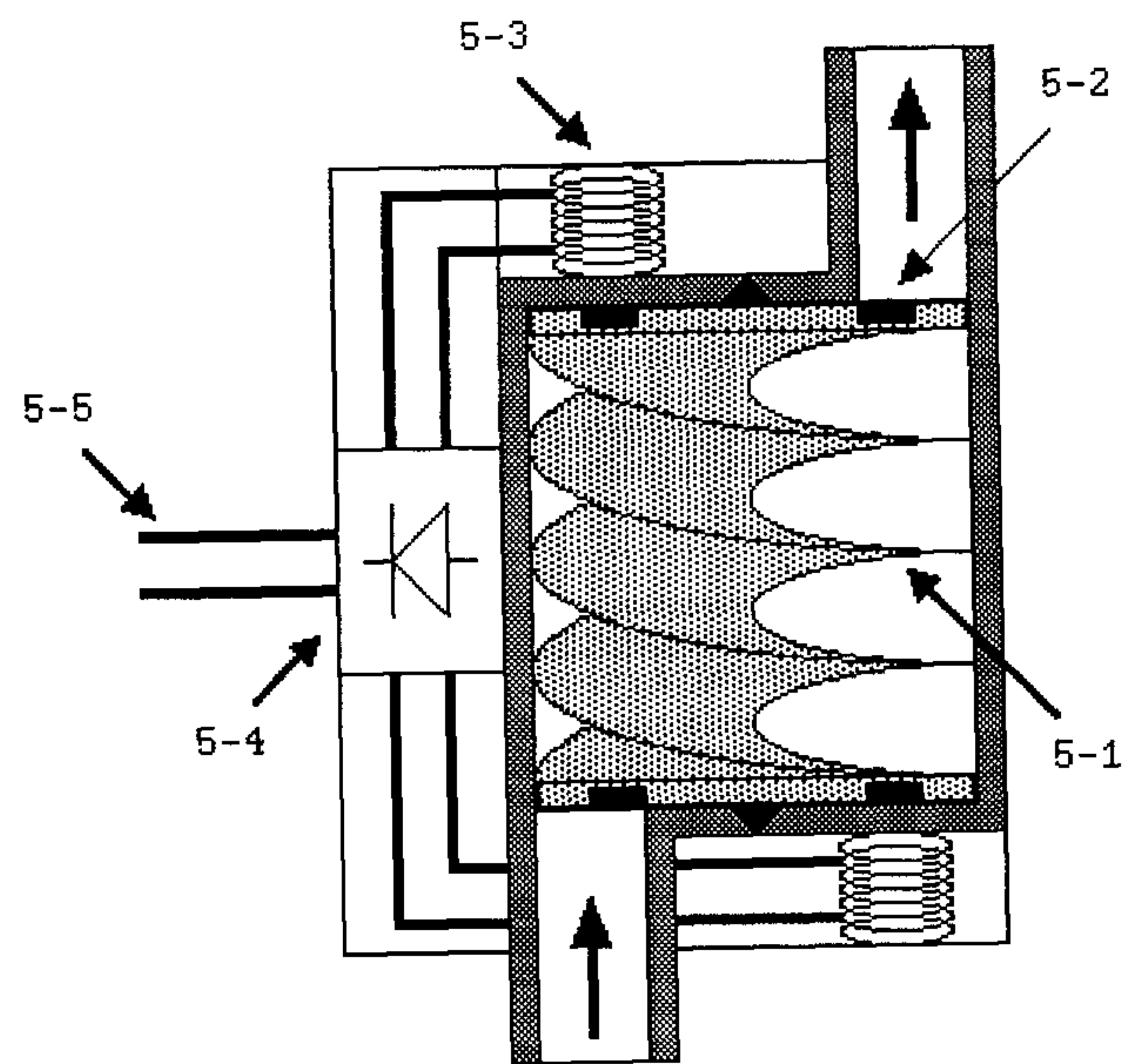
Figure 3

Figure 4

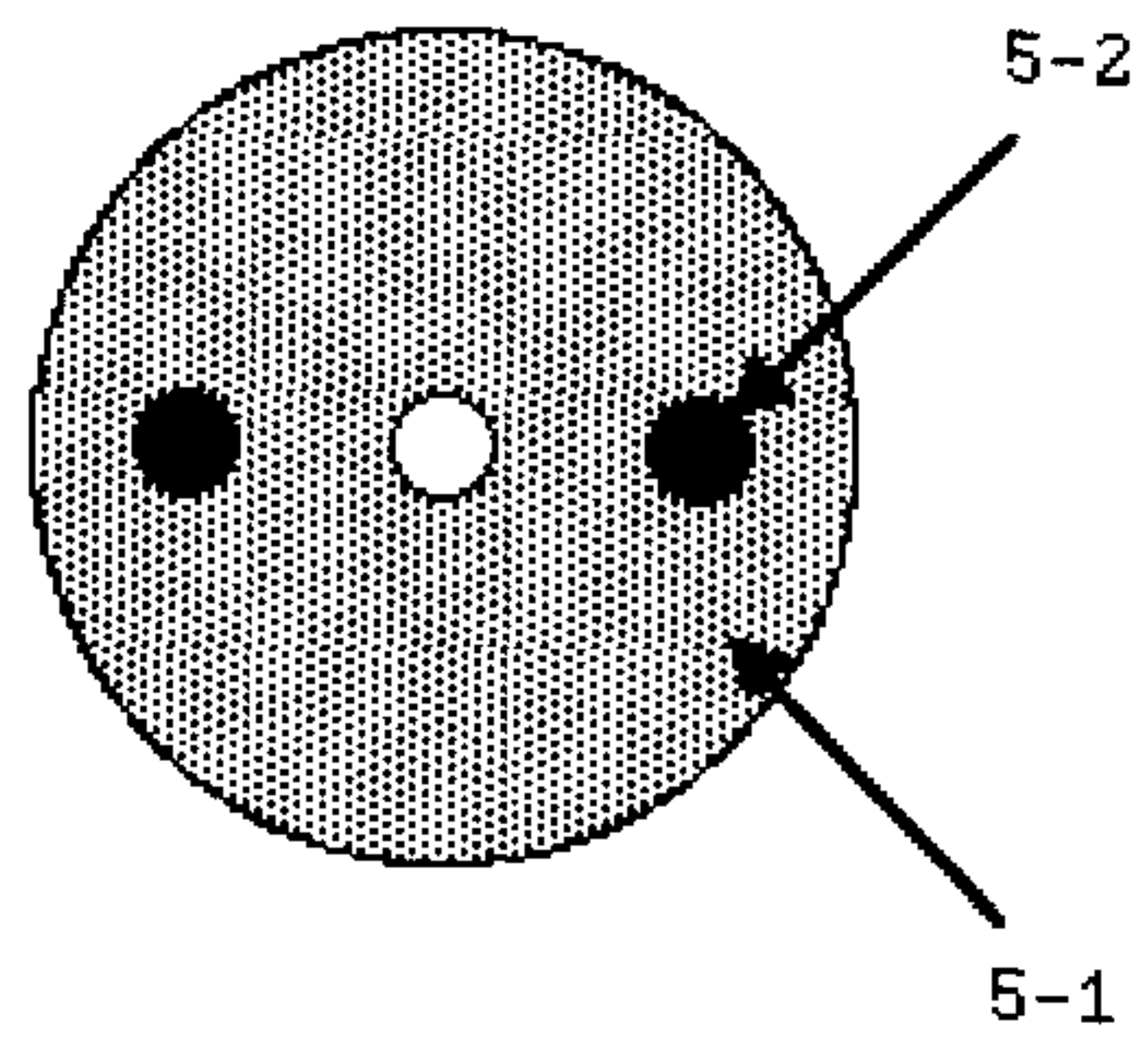


Figure 5

