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Electrical Energy Through Single-Phase Generators at Nanometer Scale Using Ambient Heat

Description

Electricity (electrical energy) can be generated or produced in many ways: for example, through Lorentz forces in magnetic fields, Coulomb forces, redox reactions, movement of charge carriers by convection, diffusion of charge carriers due to concentration differences, diffusion current, displacement current, and so on.

Many IPC classifications have been created, such as:
- Single-phase generator for generating electrical energy,
- Fuel cells, piezoelectric power generator, dynamoelectric machines,
- Generation of electrical energy by conversion of infrared radiation, visible light, or ultraviolet light,
- Harvesting electrical energy from radioactive sources;
- Light-sensitive inorganic semiconductor devices,
- Thermoelectric devices, light-sensitive organic semiconductor devices,
- Pyroelectric devices,
- Thermoelectric devices without a junction between dissimilar materials;
- Thermomagnetic devices, e.g., using the Nernst-Ettinghausen effect;
- Electrostatic generators or motors with a fixed moving electrostatic charge carrier;
- Generators in which thermal or kinetic energy is converted into electrical energy by ionization of a liquid or gas and removal of the charge from it;
- Magnetohydrodynamic generator, etc.

Magnetic fields can be generated by moving charges, for example, when current flows. Magnetic moments are also generated at the atomic level by the movement of charges, such as the movement of electrons.

My invention is based on the further development of single-phase generators to obtain inexpensive, mobile, and widely available power generators that operate without a temperature difference at low temperatures—ambient heat (e.g., at 10 degrees Celsius; 283.15 Kelvin). The following states of matter refer to this temperature example.

There are many solutions with single-phase generators, e.g.:
- EP000000924838A1, a normal-sized single-phase generator, and
- EP000003247034A1, an electrostatic induction generator.

Other approaches include:
1. M. Josefsson et al. (2018) developed a prototype thermoelectric nanogenerator with a quantum dot and thus a thermoelectric heat engine. In this engine, electrons are exchanged between the two heat reservoirs driven by a thermal potential. In their microscopically small setup, two delicate wires served as heat reservoirs, each with different temperatures. In between, they positioned a tiny structure of nanowires made of indium arsenide and indium phosphide.
2. Y. Xu et al. (2017) generated electricity from the energy of blood flow. A one-dimensional, highly efficient nanogenerator produces electricity from flowing media. A polymer fiber core was wrapped with layers of aligned carbon nanotubes. The finished threads thus consisted of a fibrous core wrapped with nanotube layers with a thickness of less than half a micrometer. To generate electricity with this thread, it was placed in a water flow or simply repeatedly dipped in and pulled out of a saline solution. The electricity was generated by the relative movement between the thread and the solution.
3. There are already other inventions with carbon nanotubes (CNT) that conduct electricity much better than a copper wire. For example, CNTs and liquid plastic (also for clothing) are cast into thin layers and then connected in series with alternating polarity, generating electricity from body heat.

The following approaches are particularly interesting in this context:
1. Thin layers of copper iodide have thermoelectric properties about a thousand times better than those of previously known comparable materials. This makes copper iodide an outstanding multifunctional material: transparent, semiconducting or highly conductive, thermoelectrically active, and suitable for invisible energy generation, such as through body heat (C. Yang et al., 2017).

2. Nanomaterials convert heat into electricity by suppressing long-wavelength emission and increasing the efficiency of thermophotovoltaic energy conversion (P. Dyachenko et al., 2016).
3. F. Yi et al. (2016) developed a nanogenerator that is surprisingly simple, versatile, and extremely elastic by using frictional electricity. The yield for these triboelectric modules could be greatly increased.

Prerequisites for my invention include:
An infrastructure for the production of computer chips with components under 10nm for the three-dimensional construction of coils, wiring, possibly nanodiodes, and other structures such as supports.

Nanodiodes:
Nanometer-sized diodes are quite limited due to the tunneling effect. X. Chen et al. (2017) managed to get the diode molecules to bend slightly toward the upper electrode when the applied voltage is in the correct direction, significantly enhancing the contact. In the opposite direction, this electrostatic effect is absent, so hardly any current can flow.
Further miniaturization is possible, as demonstrated by A. V. Rudnev et al. (2017), who developed a diode from a molecule: graphene-molecule interfaces form the basis for more efficient nanoelectronics.

The existing solutions fulfill their respective functions under the circumstances or are still in development, but they do not have the capabilities of the aforementioned invention.
A universally available and power-generating solution is desired, and the invention specified in claim 1 of single-phase generators at nanometer scale that produce electrical energy at ambient heat meets these requirements.

An Exemplary Embodiment:
Gas molecules move at approximately 500 m/s depending on temperature and contain a large amount of energy even at ambient temperature. The particles of a gas have different speeds, and the speed distribution is temperature-dependent. However, gas particles only travel very short distances in a straight path as they constantly collide with each other. The mean free path of gas particles is on the order of 10^{-7} meters. Each gas particle collides with another gas particle about 10^{10} times per second.

A ferromagnetic material is strongly attracted by a magnet. A paramagnetic substance (unpaired electrons) is only very weakly attracted. A diamagnetic substance is even slightly repelled as there are no unpaired electrons. Diamagnetism is a much weaker effect than paramagnetism. Paramagnets have permanent microscopic dipoles that are only aligned by the external field. Due to thermal motion, the dipoles of paramagnets are randomly distributed at room temperature since the thermal energy is far greater than the energy needed to flip the spins. A strong permanent magnet or an electromagnet creates the paramagnetic effect.

Oxygen is a paramagnetic gas that can be influenced by a magnetic field. This property is more pronounced in oxygen than in other gases ($\chi m = 1.9 \times 10^{-6}$). Oxygen serves here as an example of a working medium/working substance/paramagnet and thus as a heat carrier/heat transfer medium.

Figures 1 and 2 show schematic basic structures of the invention: the nanometer-sized coils 1, the working medium/heat carrier 2, and a magnet 3, which may be absent in some solutions (see below).
The disadvantage of the half-wave rectifier (Fig. 1) is usually the relatively large ripple on the DC side, which is eliminated by the unsynchronized power generation of the large number of coils. However, the efficiency is worse than with the bridge rectifier/Graetz circuit (Fig. 2).

The nanocoils are (according to claim 2) placed in close proximity to the working medium/heat carrier to achieve the highest possible efficiency. As shown in claim 3, nanodiodes as half-wave rectifiers or bridge rectifiers are connected before and after the nanocoils, ensuring direct current.

A design without nanodiodes is also possible. Without nanodiodes (according to claim 4), the nanocoils must be specially arranged, e.g., around chambers/recesses, so that no unproductive alternating current is generated. Furthermore, solutions without nanodiodes are possible by restricting the movement of the molecules of the working medium, e.g., in CNTs, as shown in claim 5.

Other possible working media/working substances/heat carriers (according to claim 6) are: elementary magnets and nano-ferroelectric crystals (analogy to ferromagnetism) in liquids or gases. Ferroelectric crystals form domains, i.e., the smallest areas with a few atomic layers and the same polarization direction. This is the target size.

The core diameter of superparamagnetic iron oxide nanoparticles (no permanent magnetization even at temperatures below the Curie temperature) is a few nanometers or larger.

Other paramagnetic gases and liquids could also be used as the working medium (including paramagnetic ferrofluid).

Ionized gas/"cold" plasma/non-thermal plasma (e.g., from commercial plasma generators) can consist of up to 100% ions. It can also be present in a high vacuum because no significant energy transfer occurs at reduced pressures. However, it should be noted that the free electrons should not have excessively high temperatures to avoid destroying the structures.

In addition, ions can be generated by salts dissolved in liquids. A normal nebulization, e.g., of a saline solution, has rather large droplets with at least 1µm. The goal is to produce much smaller droplets. All structures must be acid-resistant once strong acids are used (oxonium, formerly hydronium ions) or acid vapor in a vacuum.

Free magnets in the working medium would, of course, cluster together and not generate electricity. One solution would be to— as shown in claim 7—fix them in front of the coils and expose them freely moving to the working medium. As another solution (according to claim 8), nanomagnets could extend with one (even longer) end into the working medium and be movable, while the other end is shielded

from the working medium by a thin wall and moves in a cavity directly in front of the coils (a lever, a rocker, a non-rotating rotor in a kind of "reaction chamber," Fig. 3 - 3). The bearing of the nanomagnet is thus in the wall. It would also be possible to have a non-magnetic lever part in the working medium, so that— as shown in claim 9—a magnetic lever part moves in the "reaction chamber" in front of the nanocoils. This ensures the movement of the molecules in the working medium through completely non-magnetic material. Other solutions include completely non-magnetic lever parts that move ions, paramagnets, or magnets in the separated space in front of the nanocoils.

Electromagnets could be switched on and off for optimization, if necessary, or a strong permanent magnet could achieve the same effect through appropriate construction (e.g., several permanent magnets mounted at intervals on a wheel).

Water is diamagnetic (very weakly repellent). Water vapor generated by a vacuum with the characteristic dipole molecule would therefore not be the first choice.

The mentioned working media could be used in combination with CNT (carbon nanotubes). Specially constructed CNTs placed as a "reaction chamber" could (according to claim 10) ensure that the molecules (partially "trapped" in the CNT) of the working medium have limited movement possibilities, leading to higher efficiency.
Furthermore, ions or other charged particles can be aligned by magnets or in the electric field— as shown in claim 11—so that the molecules cannot move freely. This can increase efficiency, as the ideal vibrations/movements for power generation are then present.
The possibly present "reaction chambers" should be directly in front of the coils, another layer represents the coils and possibly nanodiodes. Then, alternately, there is a larger layer with the heat carrier/working medium (according to claim 12). Millions, billions, or trillions of these electrically connected layers represent a module, according to claim 13. Furthermore, as shown in claim 14, the coils with possibly nanodiodes or the thin layers can be "immersed" in the heat carrier/working medium like wires. Thus, different geometric structures of the invention are possible to achieve the highest possible efficiency.
The working medium circulates, cold heat carrier is pumped out (gas or liquid), follows gravity, is removed by magnets, or removed by differently polarized voltage, and is directed to the heat exchanger (according to claim 15). Subsequently, the heated working medium returns to the circuit.
The modules are— as shown in claim 16—scalable as desired. Thus, all sizes of circuit board components, batteries, to large systems are possible.

References

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Claims

1. Electrical energy through single-phase generators at nanometer scale using ambient heat, characterized in that nanocoils in single-phase generators produce electricity at low temperatures with or without permanent or electromagnets.

2. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to claim 1,
characterized in that the nanometer-sized coils are placed in close proximity to the working medium/heat carrier.

3. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that nanodiodes as half-wave rectifiers or bridge rectifiers are connected before and after the nanocoils.

4. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that without nanodiodes, the nanocoils are specifically arranged, e.g., around chambers or recesses.

5. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that without nanodiodes, electricity is generated by restricted movements of the molecules in carbon nanotubes (CNT).

6. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that the following working media/working substances/heat carriers are possible: elementary magnets and nano-ferroelectric crystals in liquids or gas, superparamagnetic iron oxide nanoparticles, ferrofluids, ionized gas/"cold" plasma/non-thermal plasma, ions generated by salts dissolved in liquids, finest nebulization of solutions, oxonium or acid vapor in a vacuum, water or water vapor, normal gases and liquids, and other paramagnetic gases and liquids.

7. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that freely movable nanomagnets in the working medium are fixed in front of the coils.

8. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that nanomagnets extend with one (even longer) end/pole into the working medium and are movable, while the other end is separated from the working medium by a wall and can move in a cavity directly in front of the coils. The bearing of the nanomagnet is in the separating wall.

9. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that in the working medium, there is a lever part made of non-magnetic material and a magnetic lever part (rocker part, non-rotating rotor part) moves in the separated space in front of the nanocoils, or completely non-magnetic lever parts move ions, paramagnets, or magnets in the separated space in front of the nanocoils.

10. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that working media are used in combination with nanodiodes and carbon nanotubes (CNT). Specially constructed and placed CNTs ensure that the molecules of the working medium (also in the CNT) have limited movement possibilities.

11. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that ions or other charged particles are aligned by magnets or in the electric field and can move mainly in a desired manner.

12. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,

characterized in that a recurring layer structure is present: possibly cavities/"reaction chambers" directly in front of the coils, the nanocoils themselves, possibly nanodiodes, and a larger layer with the heat carrier, the working medium.

13. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that, for example, billions or trillions of the recurring layers are electrically interconnected and form a module.

14. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that the coils with possibly nanodiodes and the power lines are "immersed" like wires by the working medium/heat carrier or represent other geometric structures.

15. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that the working medium circulates by pumping out the cold heat carrier, following gravity, removing it with magnets or by applying voltage, and then directing it to the heat exchanger. The heated working medium then returns to the circuit.

16. Electrical energy through single-phase generators at nanometer scale using ambient heat, according to one of the preceding claims,
characterized in that the power-generating modules are infinitely scalable.

Fig. 1

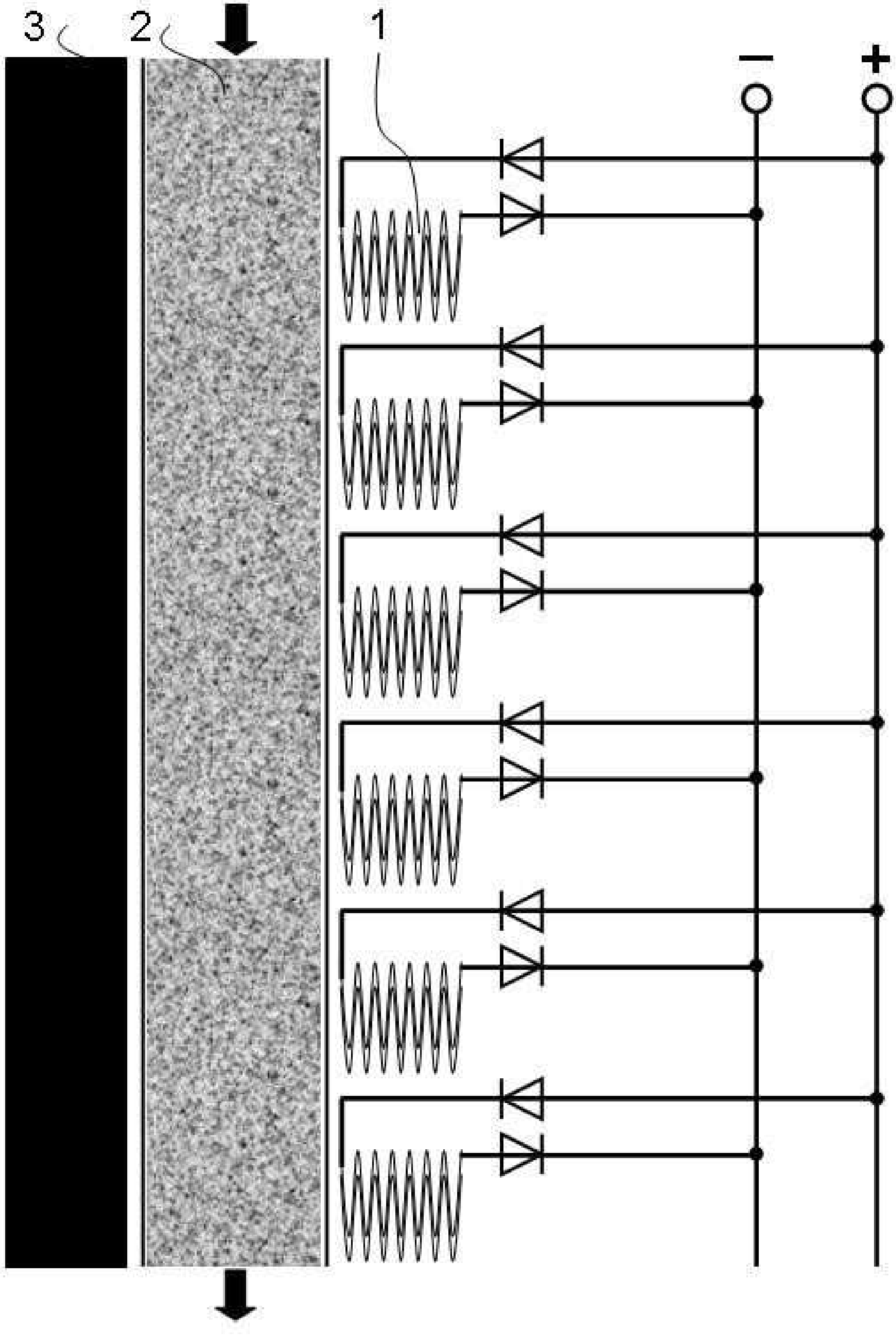

Fig. 2

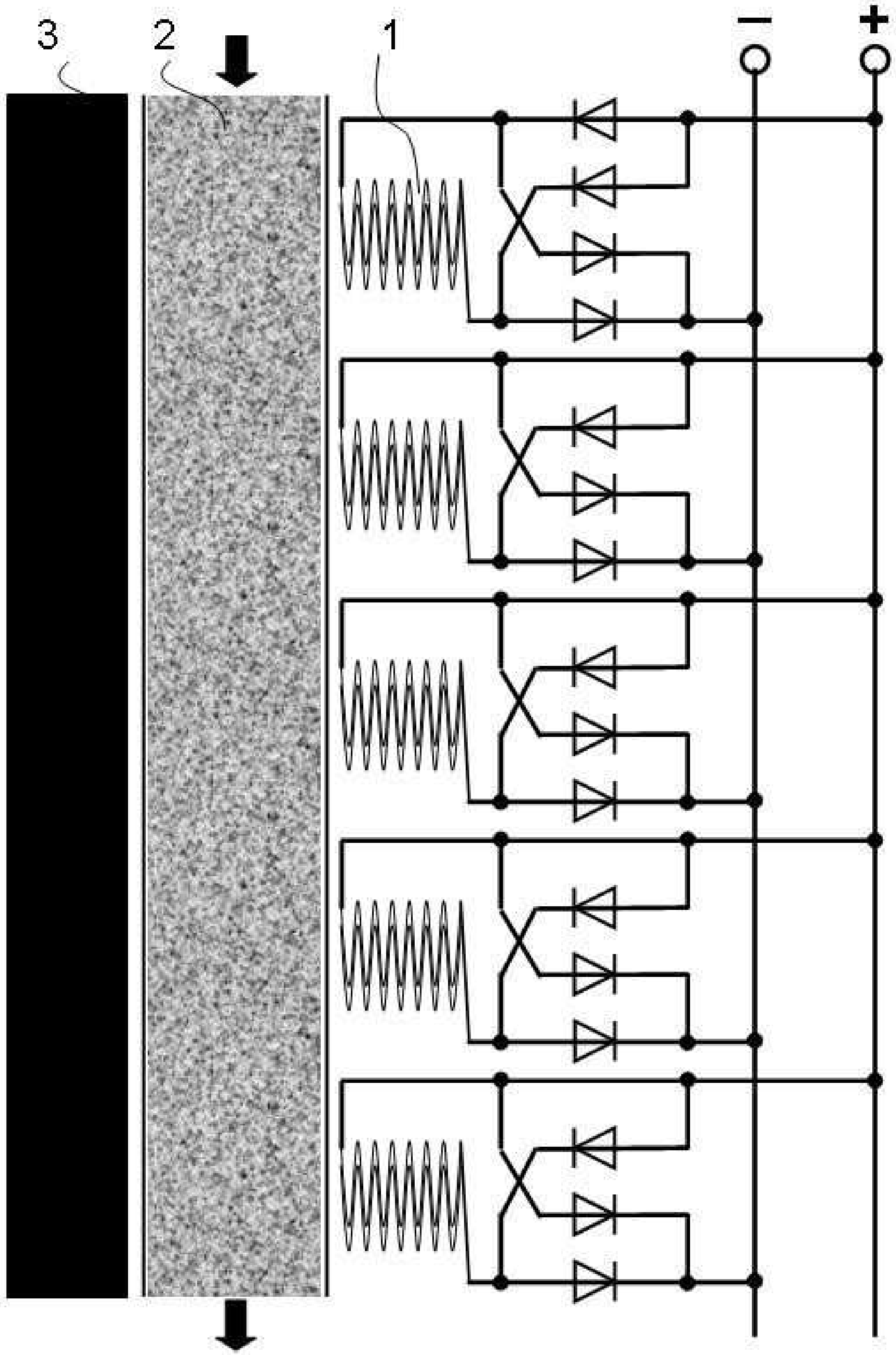

Fig. 3