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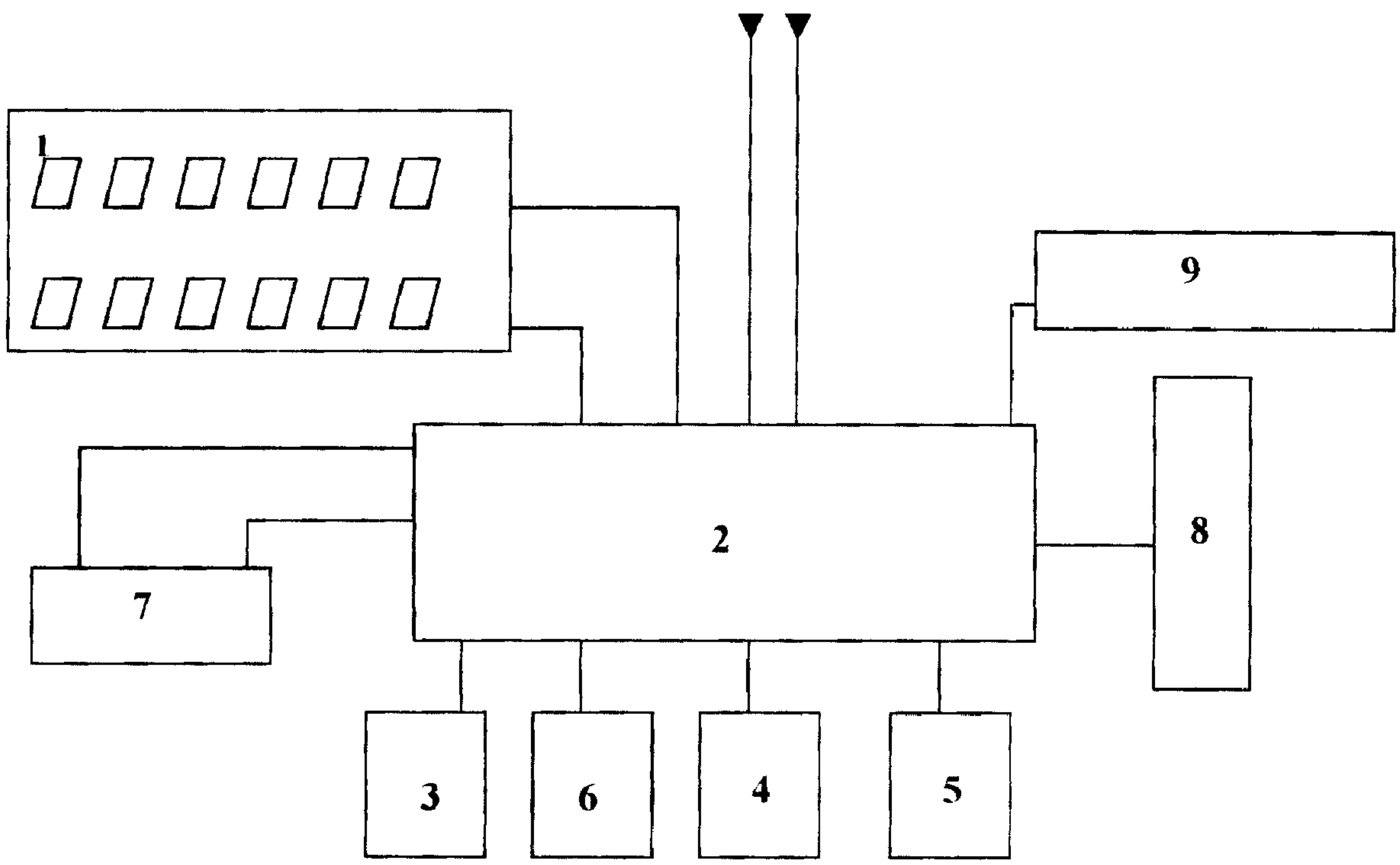
(54) Titre : SYSTEME DE REGULATION DE LA TEMPERATURE ALIMENTE PAR L'ENERGIE SOLAIRE OU UNE BATTERIE POUR L'INTERIEUR D'UN VEHICULE AUTOMOBILE

(54) Title: SOLAR-POWERED TEMPERATURE REGULATION SYSTEM FOR THE INTERIOR OF AN AUTOMOBILE/MOTOR VEHICLE TO SOLAR-POWERED TEMPERATURE REGULATION SYSTEM FOR THE INTERIOR OF AN AUTOMOBILE/MOTOR VEHICLE




(57) Abrégé/Abstract:
A cooling unit which can cool the interior temperature of an automobile/motor vehicle, when it is parked under the sun, substantially below the external temperature was designed and produced. The unit was powered by solar cells, thus functioning without dissipating any energy from the vehicle's battery. The cooling unit incorporated Peltier elements, heat sinks and fans, all controlled by a circuit board. When the automobile was switched on, the unit could be further used as an automobile air conditioning unit withdrawing the supplementary electricity from the battery, another feature controlled by the circuit board.

**ABSTRACT**

A cooling unit which can cool the interior temperature of an automobile/motor vehicle, when it is parked under the sun, substantially below the external temperature was designed and produced. The unit was powered by solar cells, thus functioning without dissipating any energy from the vehicle's battery. The cooling unit incorporated Peltier elements, heat sinks and fans, all controlled by a circuit board. When the automobile was switched on, the unit could be further used as an automobile air conditioning unit withdrawing the supplementary electricity from the battery, another feature controlled by the circuit board.

## BACKGROUND INFORMATION

Thermoelectric modules are solid-state devices (no moving parts) that convert electrical energy into a temperature gradient known as the "Peltier effect" or convert thermal energy from a temperature gradient into electrical energy, the "Seebeck effect". Although thermoelectric(TE) modules used as thermoelectric generators are rather inefficient, they may be used as thermocouples for temperature measurements. That is the thermoelectric module, or Peltier element, can function as a heat pump. When the appropriate power is applied from a battery or another DC source, one side of the element will become cold while the other will become hot. (Reversing the polarity through the element will make the cold side hot and hot side, cold.) This provides Peltier elements to be very useful for heating, cooling and temperature stabilisation.

From the Second Law of Thermodynamics, we know that heat will move to a cooler area. Hence, the Peltier element will absorb heat on the "cold side" and eject it out the "hot side" to a heat sink. In addition to the heat being removed from the object being cooled, the heat sink must be capable of dissipating the electrical power applied to the element, which also exists through its hot side. It is well known that the resistive or "Joule heat" created is proportional to the square of the current applied. With Peltier elements, this is not the case because the heat created is actually proportional to the current since the flow of current is working in two directions (the Peltier effect). Therefore, the total heat ejected by the Peltier element is the sum of the current times the voltage plus the heat being pumped through the cold side. The cooler the hot side of the Peltier element, the cooler the cold side will be. When power is applied to the element, the hot side will begin ejecting this as heat to the heat sink causing it to rise in temperature. The ability of the heat sink to dissipate this heat as well as the heat being pumped through the cold side will determine the actual operating temperature of the hot side and, thus, the cold side.

In general, when the heat sink is better (i.e. having a lower thermal resistance), it is easier to keep the hot side temperature from increasing. Although liquid heat sinks typically have the lowest thermal resistance, they are relatively expensive and require 'plumbing'. The most common type of heat sink used in thermoelectric applications is made from a thermally conductive material such as aluminum or copper with fins which are perpendicular to a base. In TE applications, however, a heat sink alone is not able to remove a sufficient amount of heat by natural convection in order to keep the hot side at an acceptably low temperature. To help the heat sink remove heat on and around the heat sink fins, a fan must be attached which forces ambient air over the fins and exhausts the heat to ambient.

Previously, it was mentioned that Peltier elements operate using a DC power source. Solar cells are photovoltaic (PV) cells which can convert sunlight directly into electricity. PV cells are made of semiconductors, such as silicon. When sunlight strikes the cell, a certain portion of it is absorbed within the semiconductor material, i.e. silicon, because the energy needed to ionise a silicon electron matches the typical energy of photons coming from the sun. The energy of the absorbed light is transferred to the semiconductor, knocking electrons loose and allowing them to flow freely.

PV cells have one or more electric fields which act to force electrons freed by light absorption to flow in a certain direction. This flow of electrons is a current and, by placing metal contacts on the top and bottom of the PV cell, one can draw that current off to use externally. This current along with the cell's voltage (which is a result of its built-in electric field or fields) defines the power that the solar cell can produce. Moreover, it is a direct current since the flow of electrons is in one direction.

## SUMMARY OF INVENTION

It is very well-known that, when an automobile/motor vehicle is parked under the sun, the interior becomes very hot. Very few attempts have been made to design a product that can cool the interior of a parked automobile. The only device which attempts to lower the interior temperature of a parked automobile is a solar-powered ventilator. This device is placed on the window of a parked automobile. It uses solar energy to work a small fan which exhausts the hot air from inside of the parked vehicle and introduces fresh air from the outside to the inside of the parked vehicle. Unfortunately, this system is neither very efficient nor very effective for several reasons. The first is that the driver or someone must manually place the item on the window when the automobile is parked. Secondly, more than one unit must be used to have even a noticeable effect on the interior of the parked automobile. Finally, even using the optimum number of units for a given interior volume, the inside temperature would only be as low as the outside temperature, which may be still very high in certain geographical locations.

We have found that these two established technologies, i.e. the Peltier effect and solar energy, can be combined to yield satisfactory, sufficient and reasonable quantities of coldness which we have used in adverse heated conditions normally not conducive to conventional cooling methods. In particular, we have designed and produced a simple device to cool and maintain the interior temperature of an automobile, substantially below the external temperature, when it is parked under the sun. It is important to note that the device functions without dissipating any power from the automobile, when it is not running (i.e. when it is parked), since the energy source is the sun. We have further found that, by extending the design of the device, we were able to yield an air conditioning unit that was partially powered by solar energy and supplementarially by the automobile itself. Even when the automobile is running, this system used substantially less energy than an ordinary automobile air conditioning unit and has the further advantages of no moving parts, no Freon refrigerant, no vibration, long life and the capacity of precision temperature control.

According to the present teachings, the solar powered cooling system is comprised of an array of solar cells, an electronic control unit, and an open ended mechanical unit having sides for supporting a cold source. The array of solar cells can be comprised of multiple cells attached one to another for generating energy. The array can be connected to the electronic control unit, for controlling the distribution of energy and for controlling the interaction between the system and a vehicle. The electronic control unit can also activate the mechanical unit. On at least one side of the mechanical unit, openings can be provided to accommodate one or more Peltier elements, having an inner surface and an outer surface. Each surface of a Peltier element can be attached to a heat sink, one providing the cold source and the other providing the hot source. At one end of the mechanical unit, a main fan can be provided to thrust air across the cold surface for passage through the opposite end and into the interior of the vehicle. Additional fans can be provided to dissipate heat from the hot source. Accordingly, in various embodiments, the electronic control unit can be an electrical circuit board and the mechanical unit can be an insulated tube.

## BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a block diagram of the whole system.

Figure 2 is a longitudinal cross-sectional view of the cooling unit.

Figure 3 is a cross-sectional view of the cooling unit.

## DESCRIPTION OF INVENTION

By connecting solar cells in series and then sets of solar cells in parallel, we have used energy from the sun to power a unit which cooled the interior of a parked automobile substantially below the outside temperature. Since the "cooling unit" received its power from the sun, there was no dissipation of energy from the battery. Moreover, this cooling unit functions in a directly proportional relationship to the strength of the sun. Whenever the sun is strong, the interior of the automobile would increase in temperature but, at the same time, the more abundant brightness goes to generate more power for the unit, thus cooling the interior. (Of course, there is a levelling off point.)

Briefly, the system is comprised of solar cells, 1, connected to an electronic control unit, 2, which then dictates how the electricity coming from the solar cells should be distributed to the various parts of the cooling unit, i.e. the two types of fans, 3 & 6, and the stage one cooling elements, 4, when the automobile is parked (Figure 1). The cooling unit, itself, contains Peltier elements, 4 & 5, heat sinks, 10, and two types of fans, 3 & 6 (Figure 2). It is comprised of an insulated tube (basically, a housing) with space cut out for the Peltier elements, 4 & 5, on either side. On the outer side of the housing where the hot side of the Peltier elements are, there are heat sinks, 10, and fans, 6, on top of the heat sinks, in order to remove the heat from the hot side and lower the temperature of the cold side. The cold side of the Peltier element is on the inside of the housing and also has heat sinks, 10, attached to them (Figure 3). However, on the inside of the housing where the coldness exists, there is a major fan, 3, at one open end to flush and expel the coldness out the opposite open end (Figure 2). The open end is then attached to the interior of the automobile.

We have found that a certain number of Peltier elements (for example, 2) works very well to lower the temperature of the interior of an automobile when it is parked. By using a reasonable number of solar cells, the power coming from them is sufficient to activate approximately 50% to 60% of the elements' capacity. When the number of Peltier elements is increased (for example, 4) and the automobile was switched on, the interior temperature of the automobile was significantly reduced. The extra power from the battery (Figure 1, 7) generated the necessary energy for all the Peltier elements to function at 100%. This was an additional feature of the electronic control unit, i.e. the withdrawing of the supplementary energy for the stage 1 cooling elements and the activation of the stage 2 cooling elements (Figure 1, 5). The electronic control unit took the extra needed electricity from the battery for maximum Peltier element output. It also had a temperature regulator, (Figure 1, 8) to control the interior temperature, when the automobile is running, and a switch to turn off the system completely, when a sensor (Figure 1, 9) detected high levels of carbon monoxide. Moreover, the electronic control unit had a safety feature when cooling the interior of the automobile was not a priority but yet a great deal of sunlight was prevalent. Under such circumstances, solar energy should be consumed one way or another because, if it is not, the stored energy in the solar cells coming from the sunlight would destroy them. In order to dissipate the unused energy, we designed the electronic control unit to feedback this unused energy to the battery, i.e. to charge the battery.

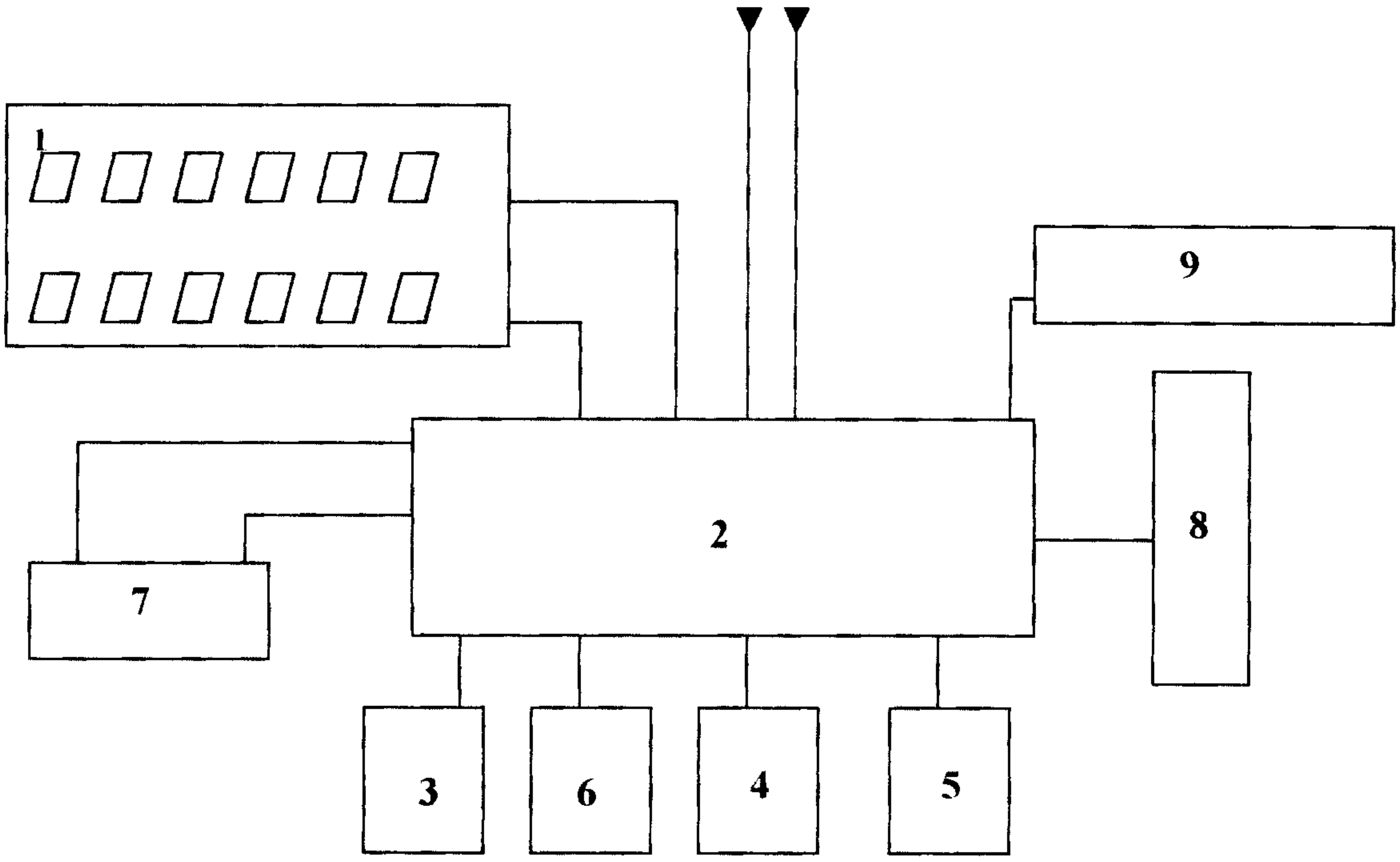



FIGURE 1

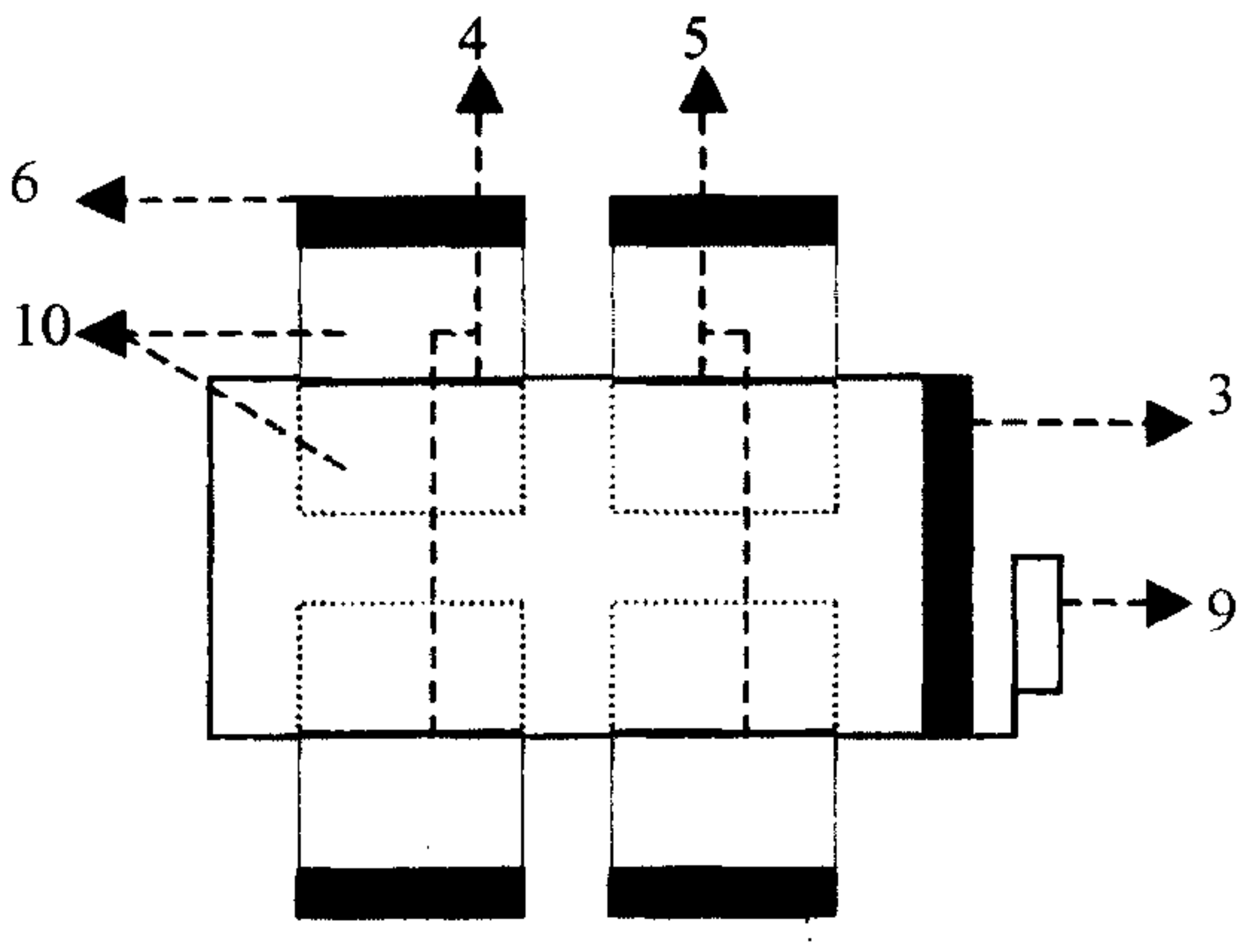



**FIGURE 2**

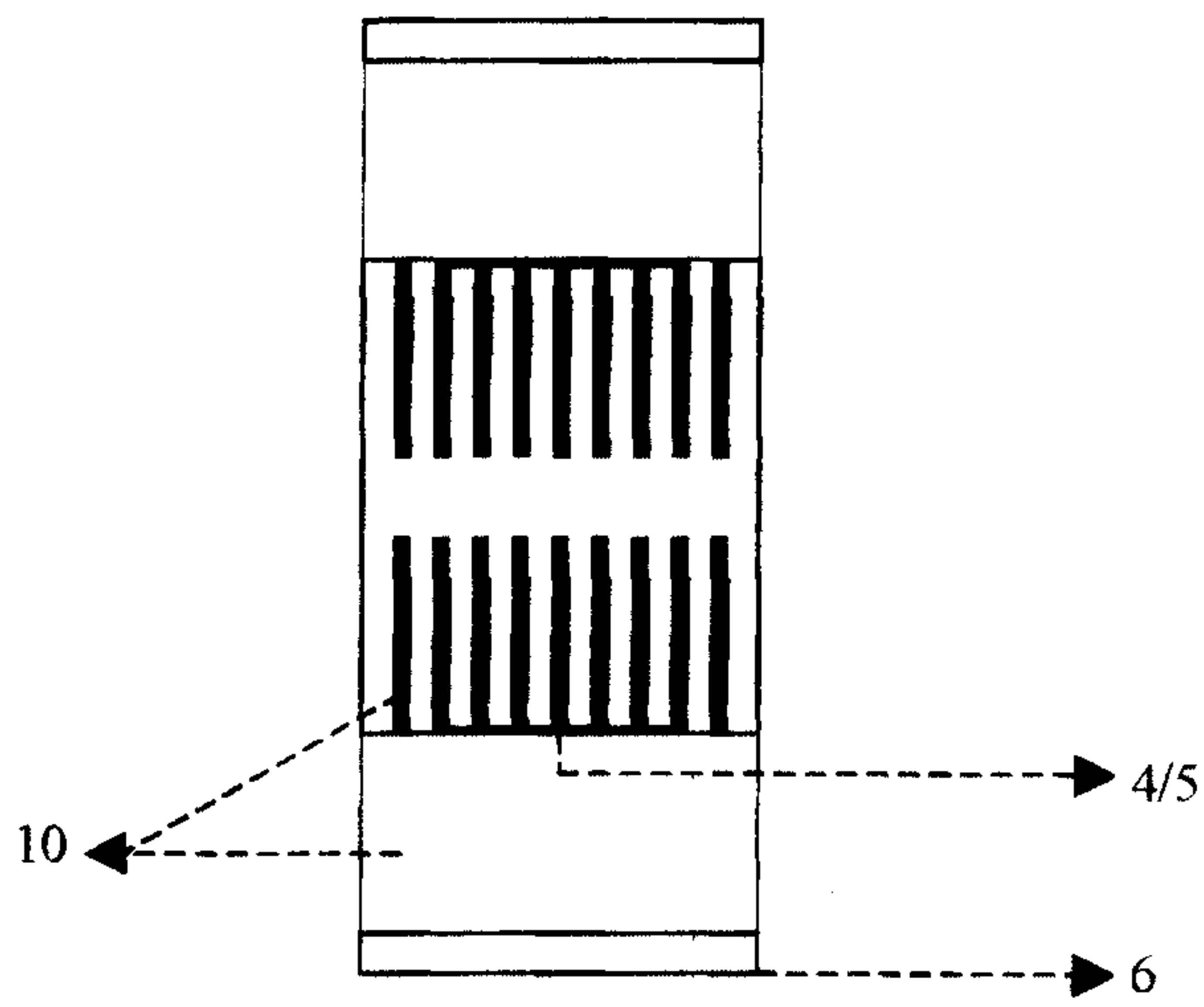
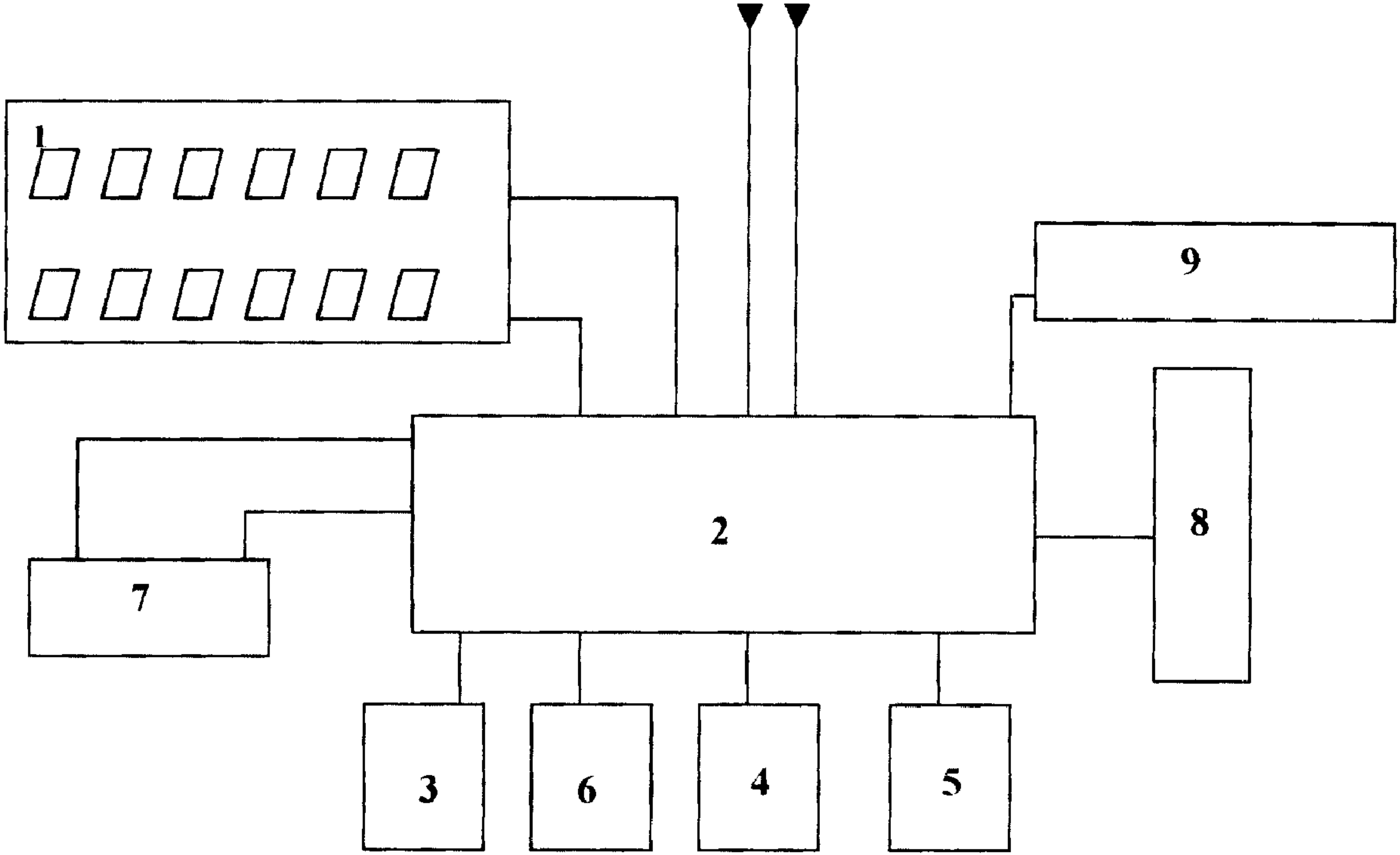



**FIGURE 3**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