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(54) **MANUFACTURING METHOD OF WATER
BLOCK**

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(57) **ABSTRACT**

A porous microchannel structure adopts a first casing and a second casing to form a water block. Water inlet and outlet pipes are extended from both ends of the first casing respectively. The second casing has a porous microchannel structure made by sintering a heat conducting powder and formed on an internal side of the second casing. The second casing has a contact surface on its external side for absorbing and conducting a heat source to the porous microchannel structure, such that a coolant can flow from the water inlet pipe into the water block. The porous microchannel structure produces turbulent flows to the coolant, so as to extend the staying time of the coolant in the water block, and allow the coolant to fully exchange heat with the porous microchannel structure and flow out from the water outlet pipe.

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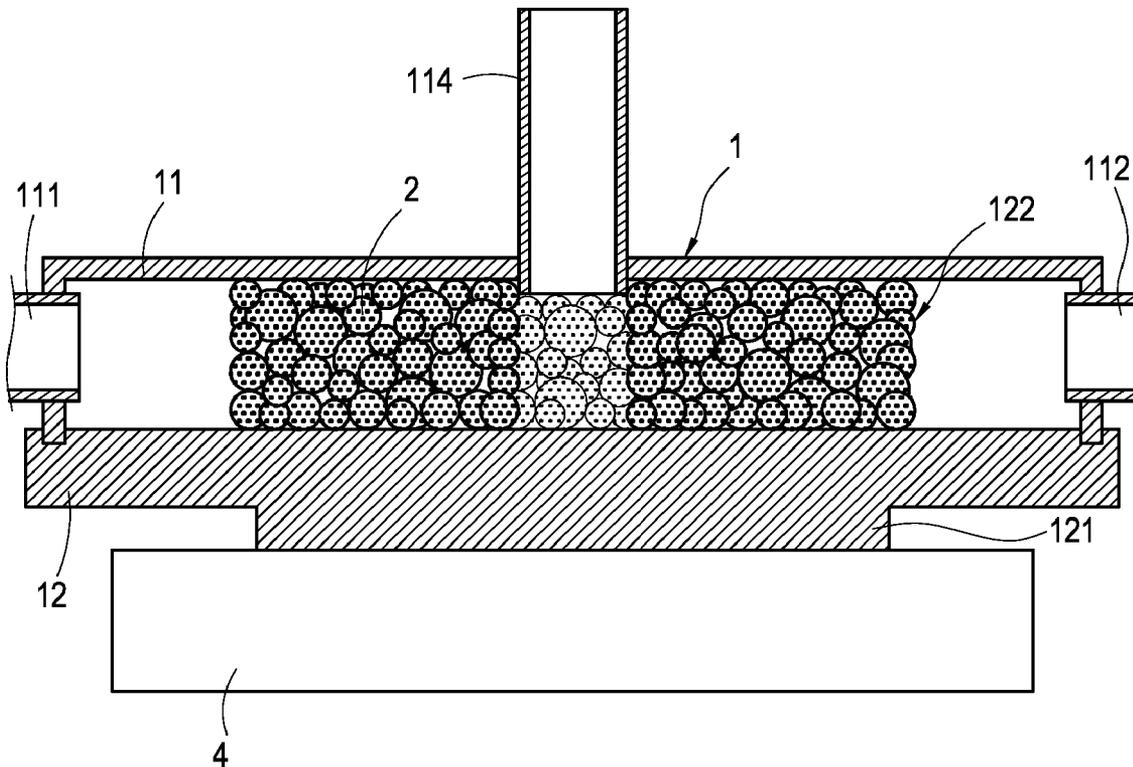
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(63) Continuation-in-part of application No. 11/549,673,
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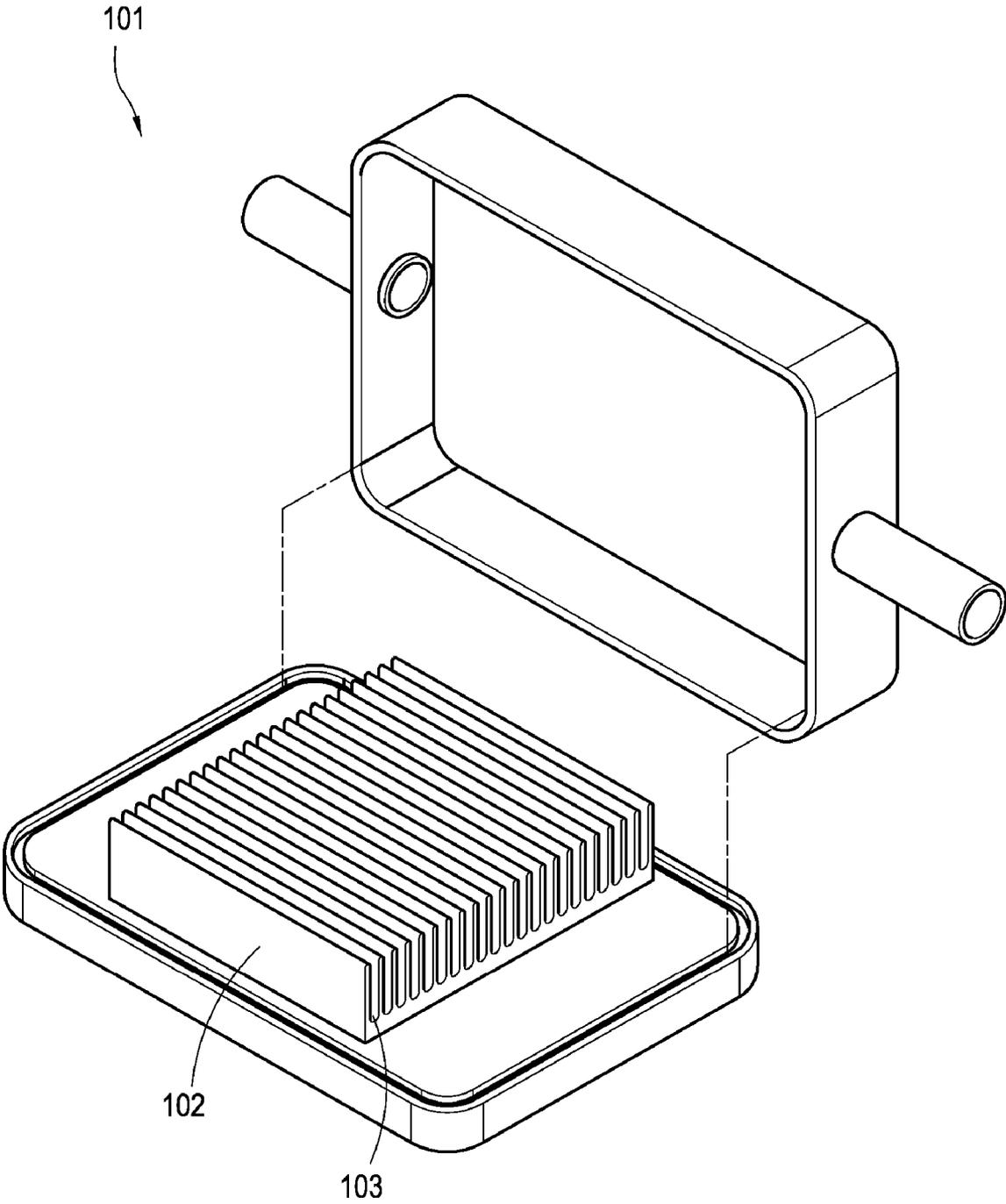


FIG. 1

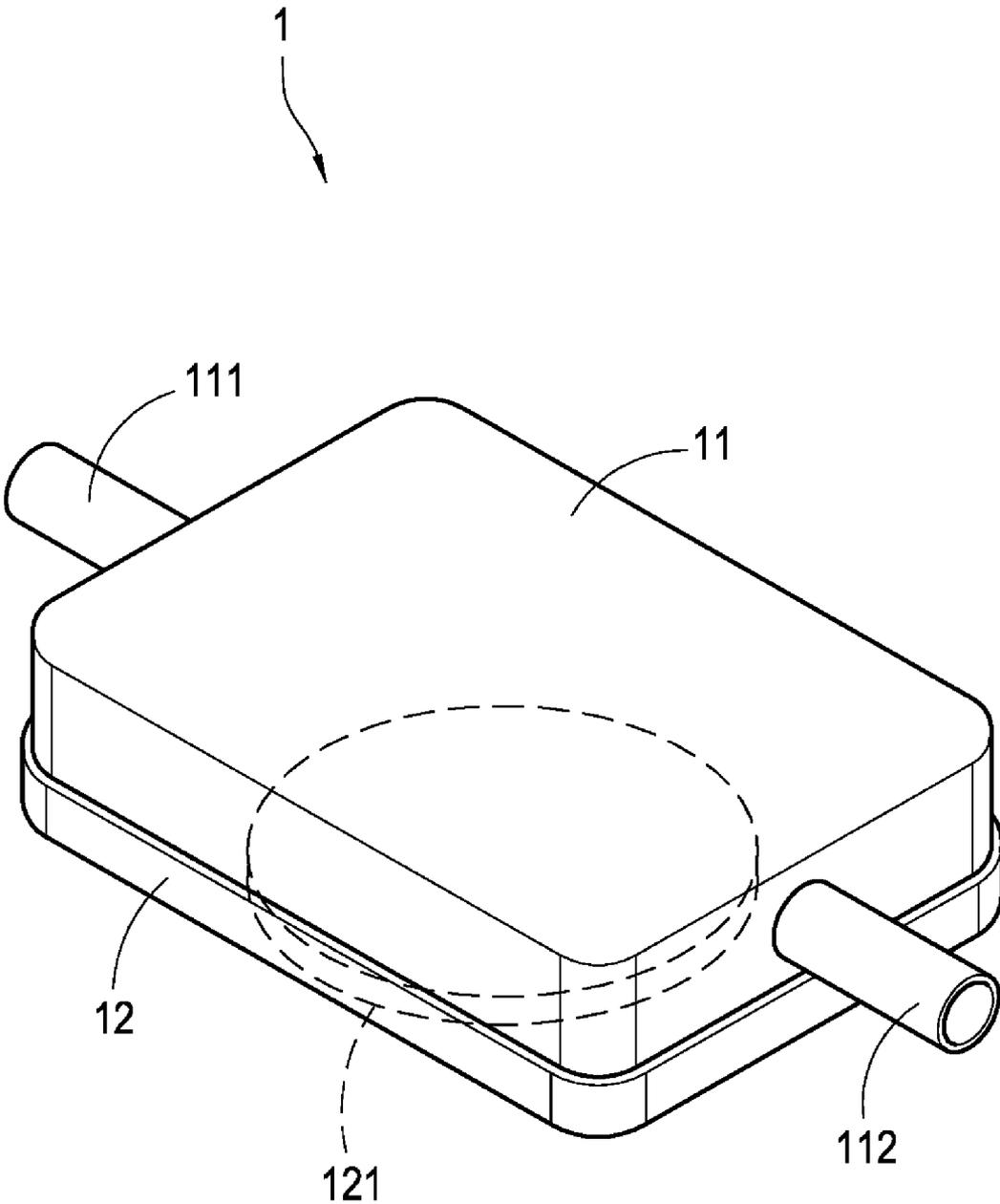


FIG. 2

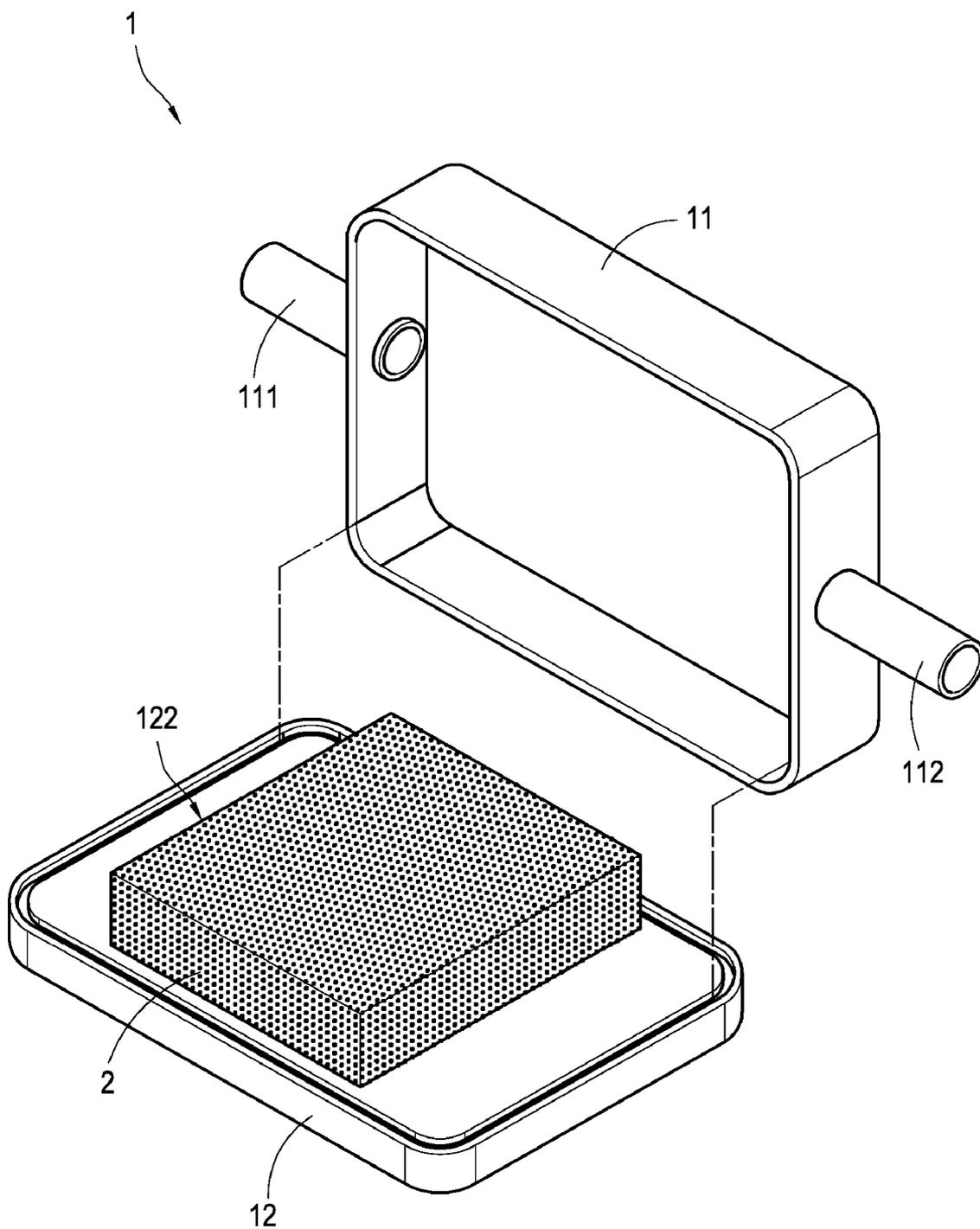


FIG.3

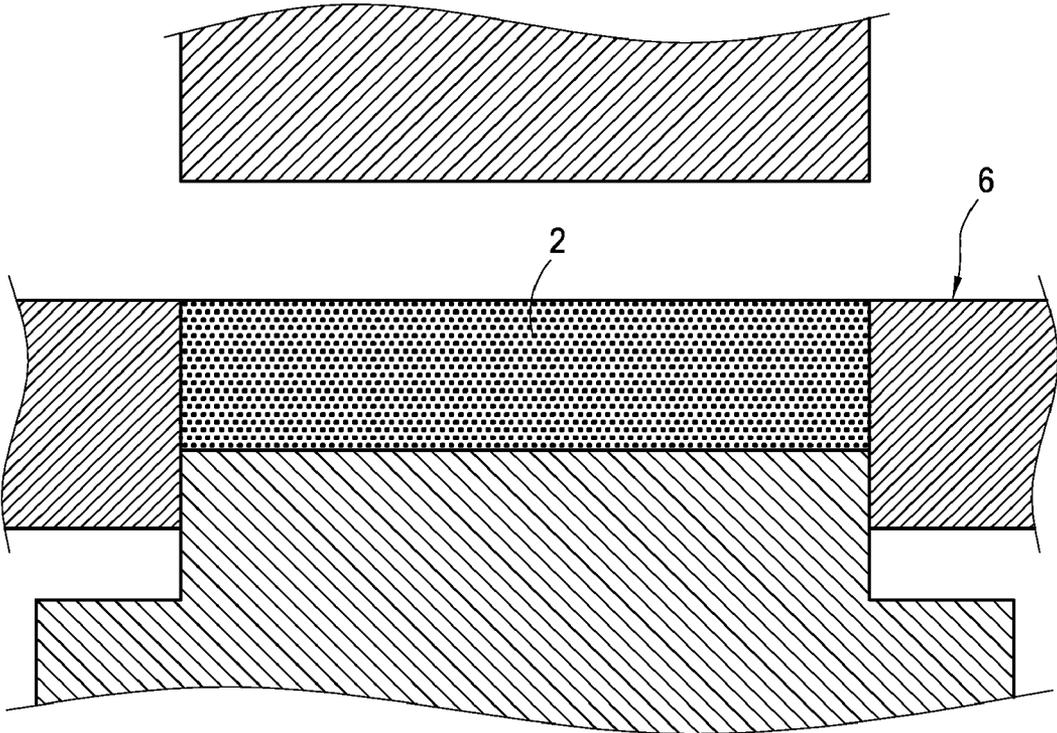


FIG. 4

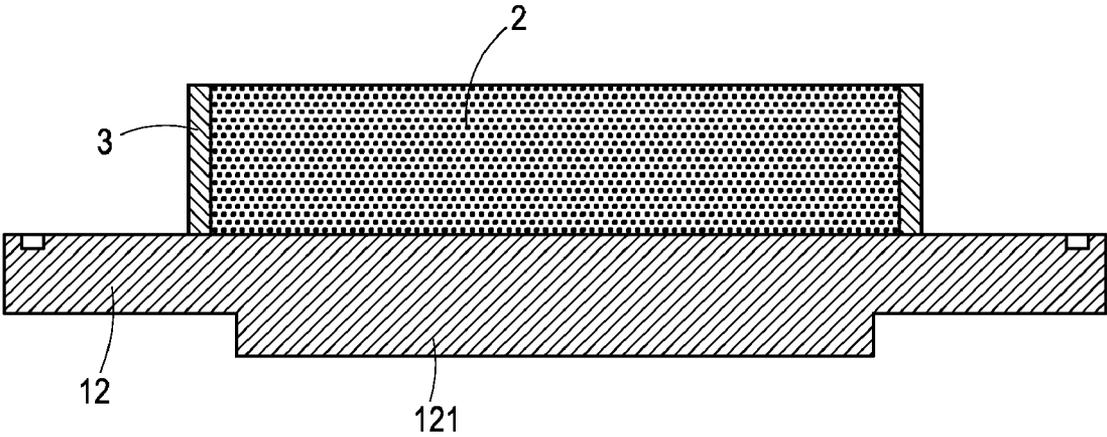


FIG. 5

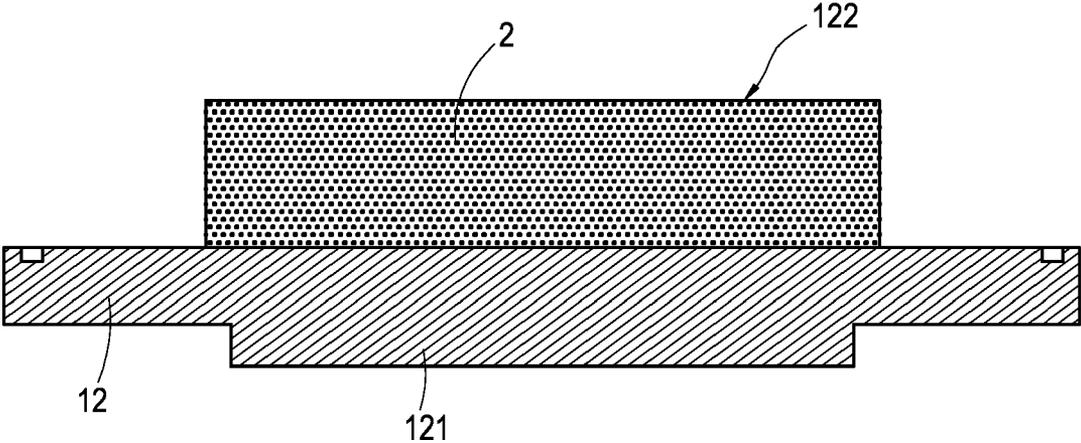


FIG. 6

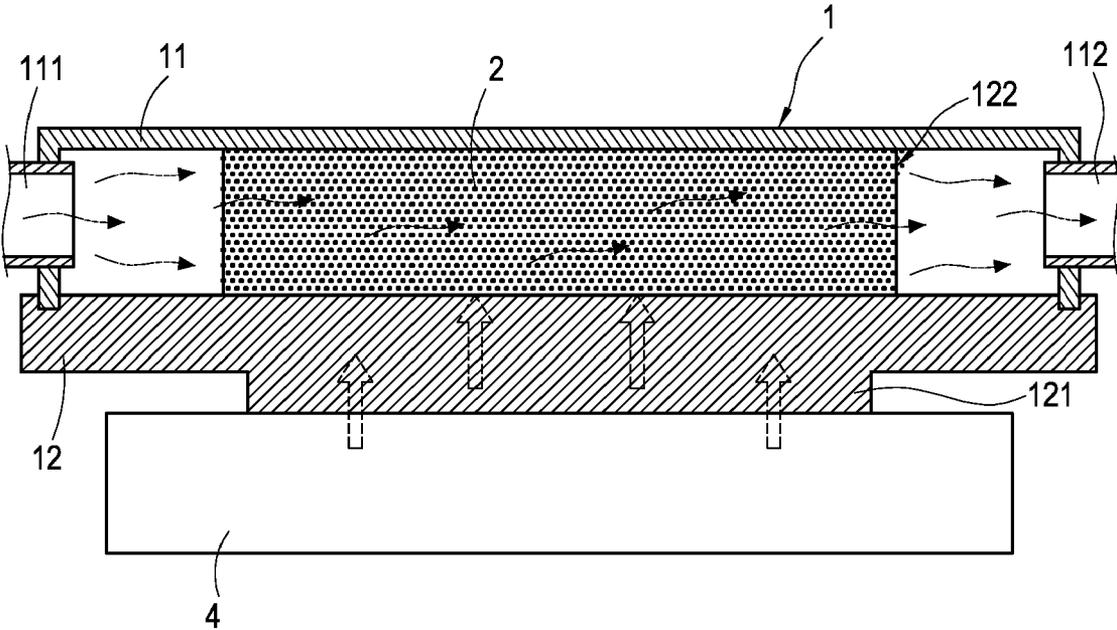


FIG. 7

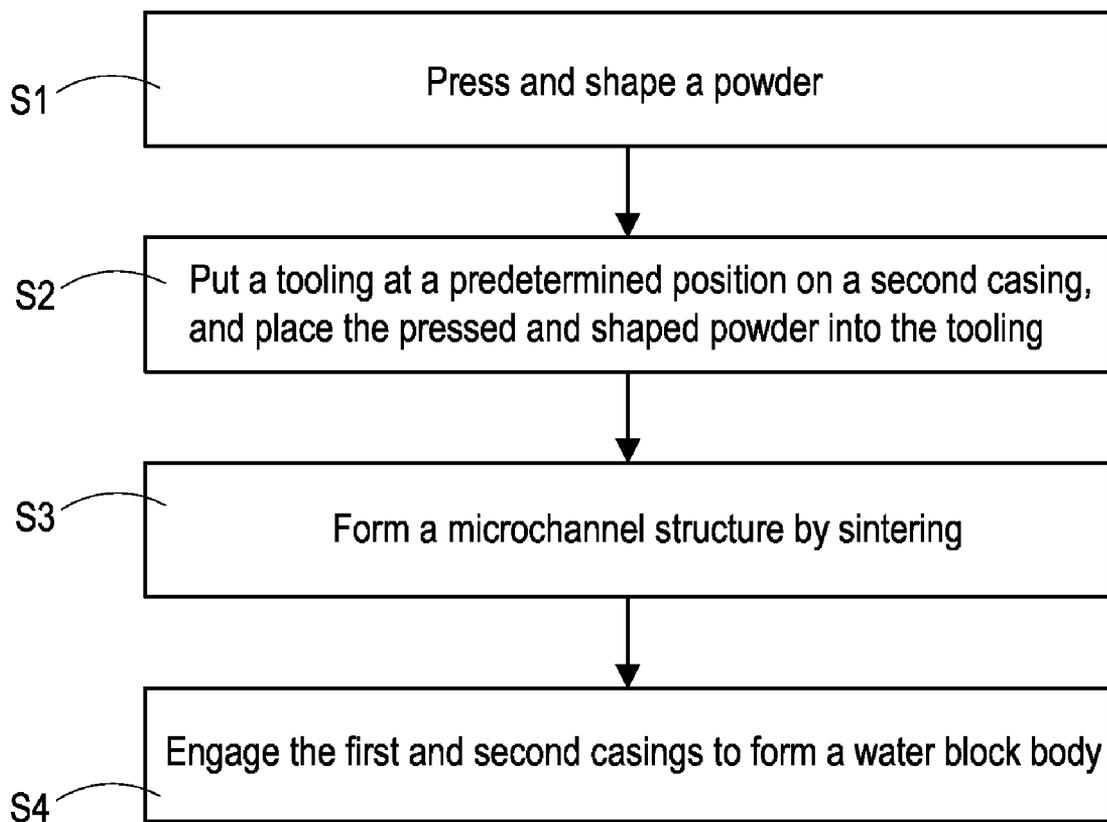


FIG.8

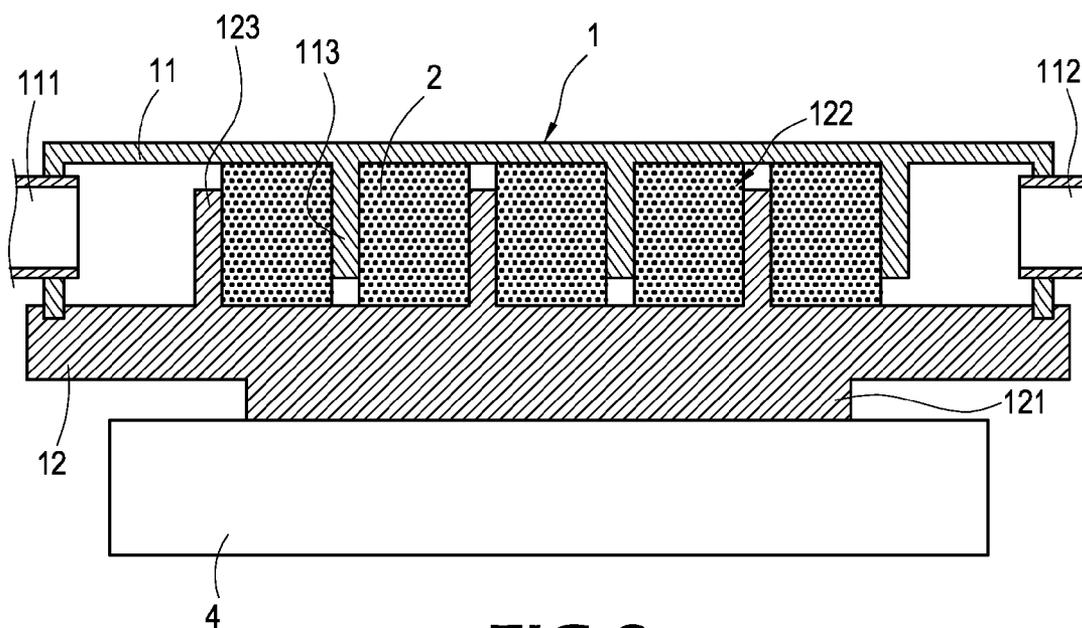


FIG. 9

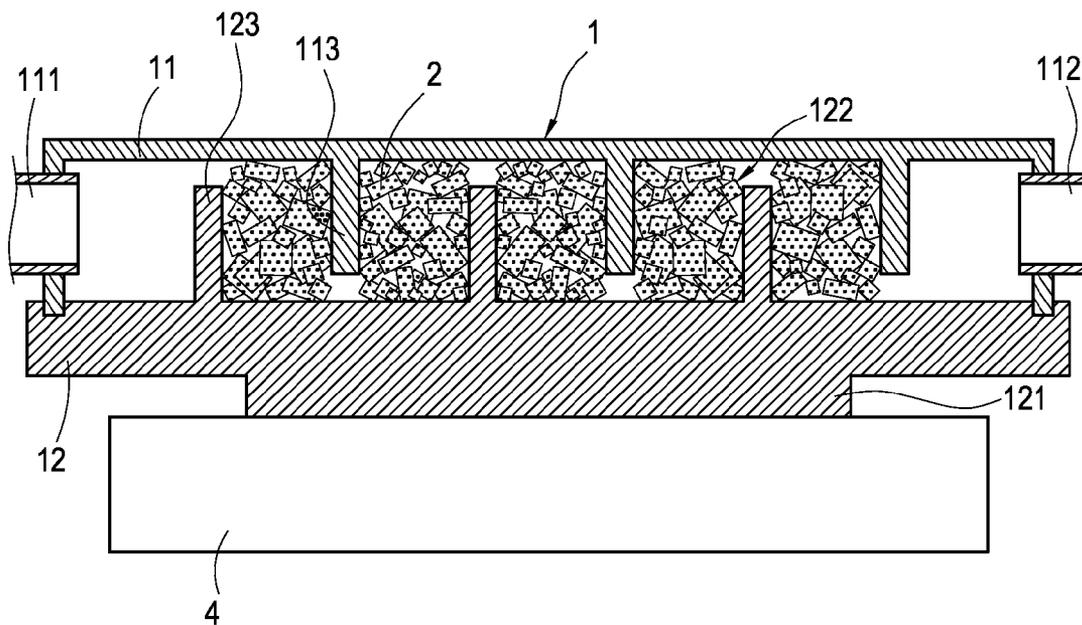


FIG. 10

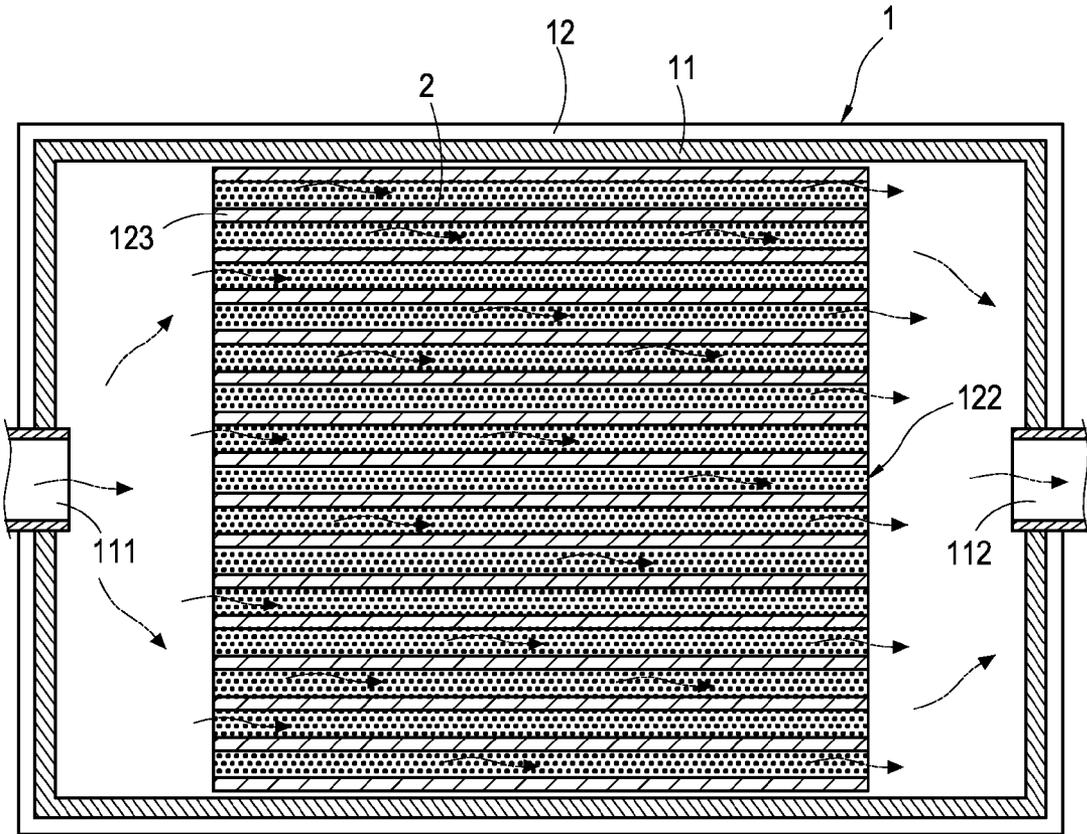


FIG. 11

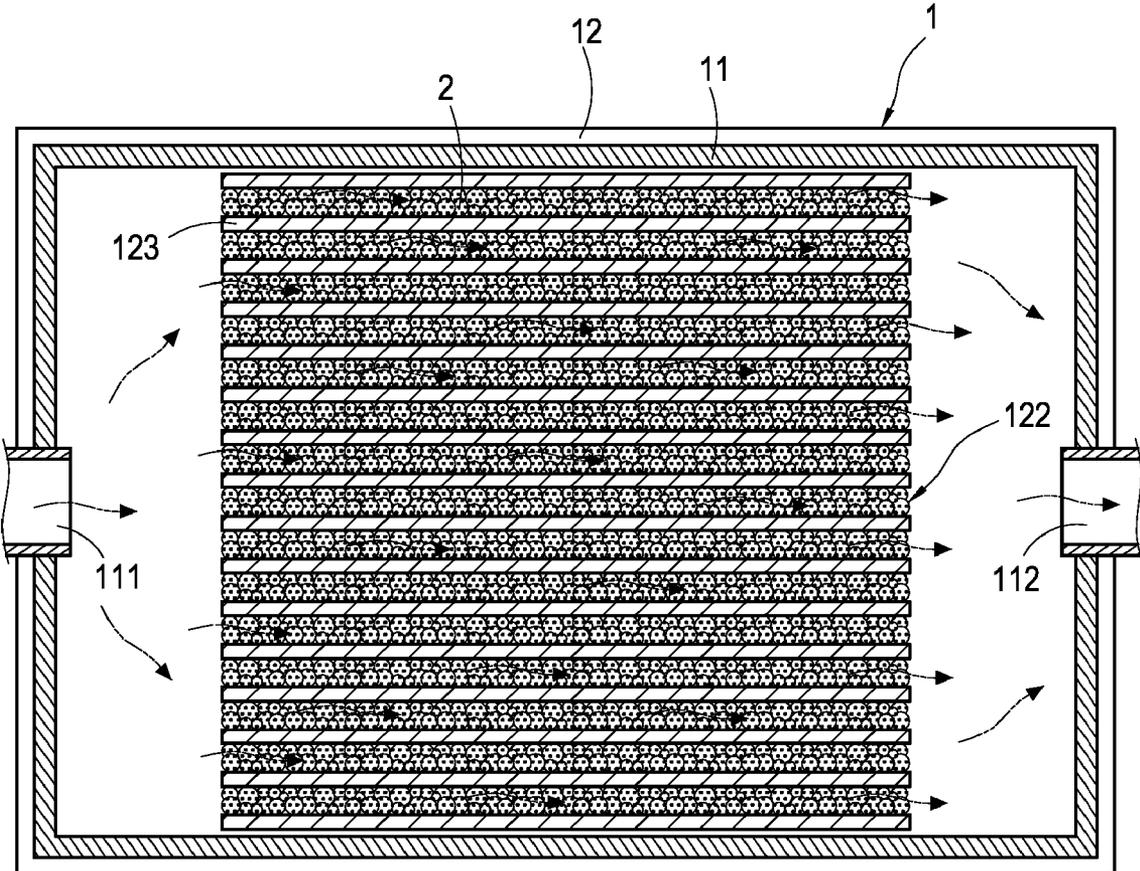


FIG. 12

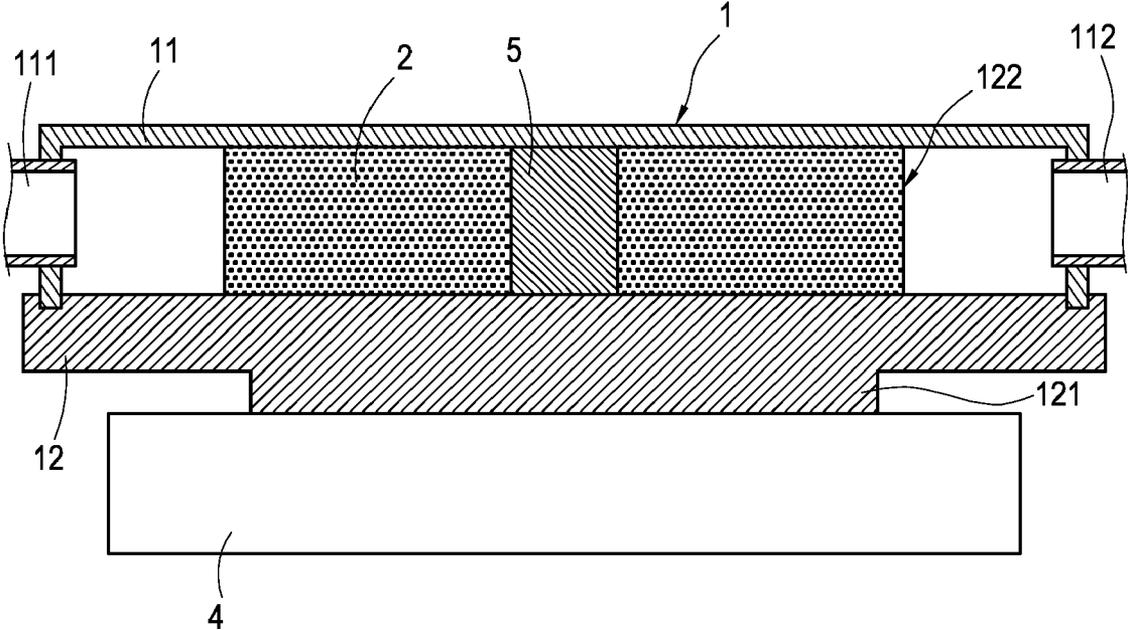


FIG. 13

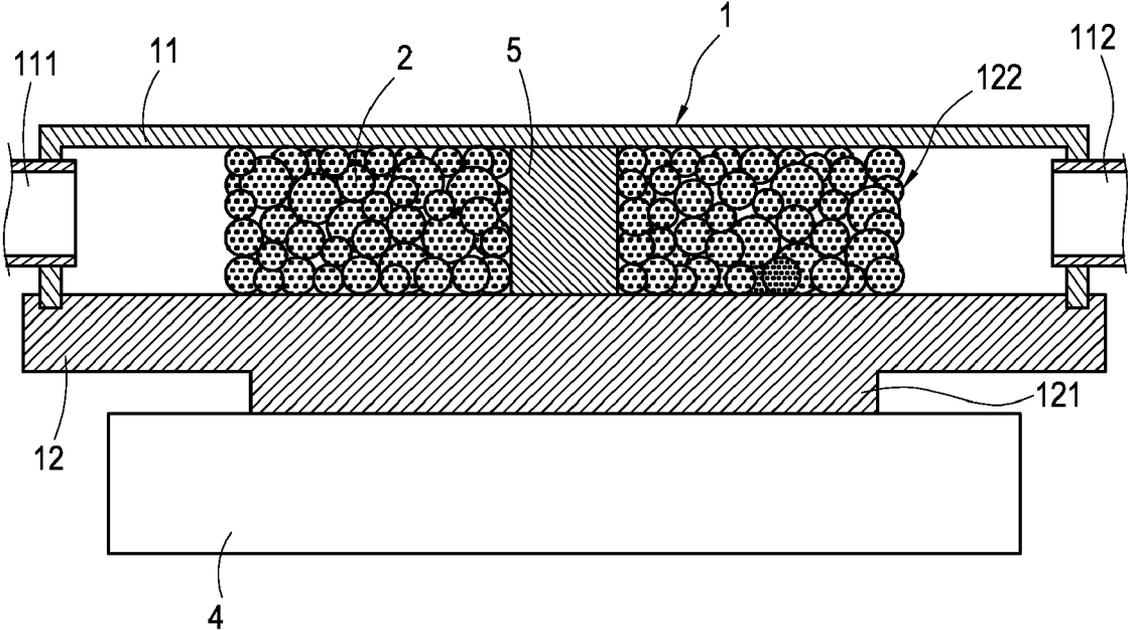


FIG. 14

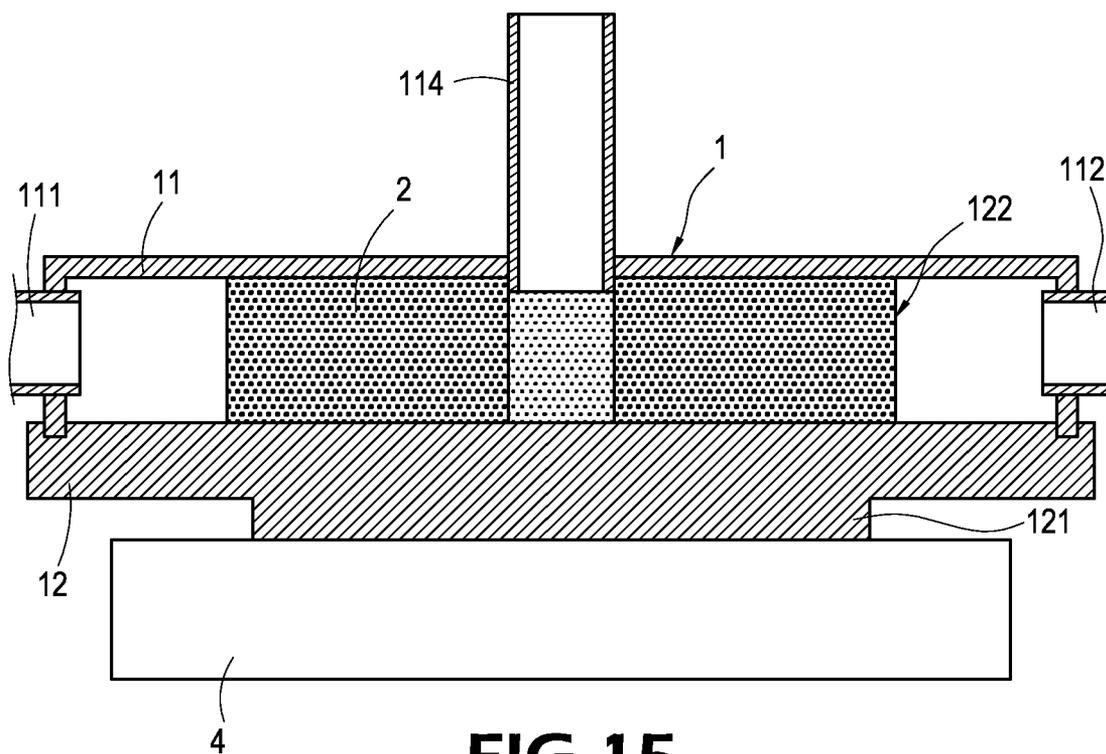


FIG. 15

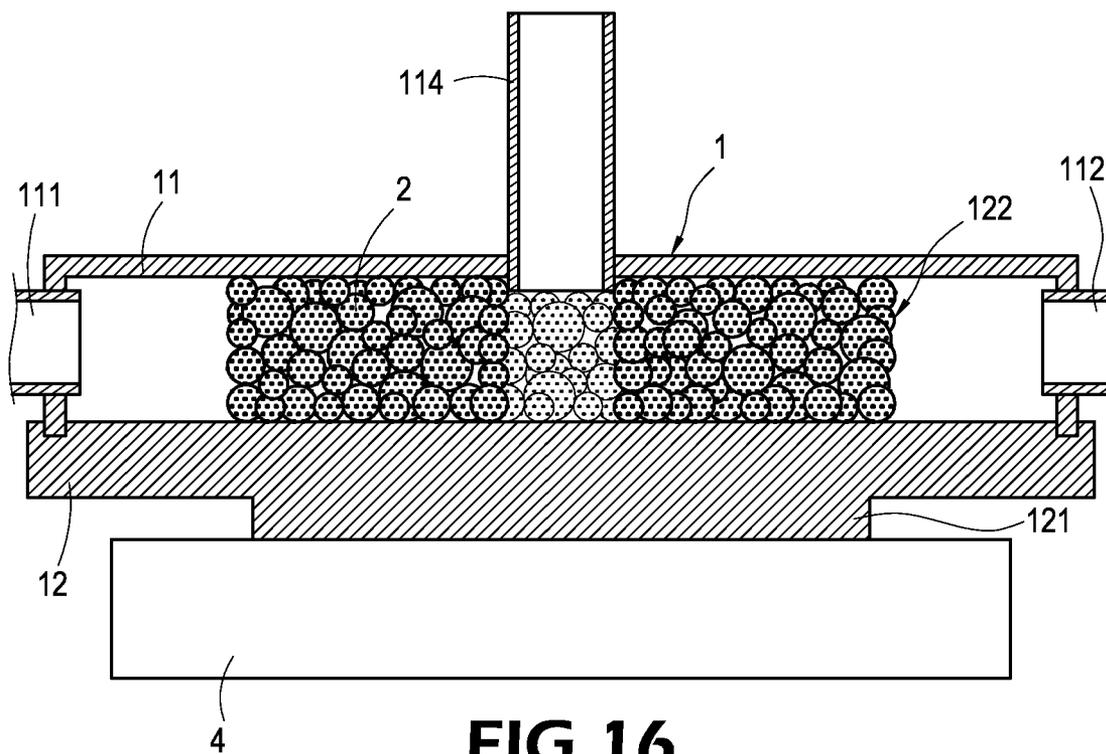


FIG. 16

MANUFACTURING METHOD OF WATER BLOCK

[0001] This application is a divisional application of U.S. patent application Ser. No. 11/549,673, filed on Oct. 16, 2006.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a water-cooling heat dissipating structure and its manufacturing method, and more particularly to a water block applicable for electronic components and its manufacturing method.

[0004] 2. Description of Prior Art

[0005] The operation of any electric appliance may cause overheats inevitably due to the issue of efficiency or friction. Particularly, products produced by manufacturers of the present technological industry such as integrated circuits and personal electronic products tend to be developed with a high precision. Besides the minimization of volume, these products (particularly computers) also produce increasingly more heat. Since the operation performance of these products is enhanced continuously, the overall heat quantity produced by computes is also increased accordingly, and the main heat source no longer limits to CPU only, but high-speed devices including chip modules, graphic processing units, dynamic random access memories and hard disks also produce a considerable amount of heat. To maintain the normal operation of a computer within a permitted operating temperature range, we rely on additional heat dissipating devices to prevent overheats and adverse effects on computer components.

[0006] A fan is a simple, easy and popular heat dissipating device which can produce a fast flow of air around a heat generating component by vanes, and quickly carry away the heat produced by heat generating components to achieve the heat dissipation effect, but the heat dissipating effect may not be able to satisfy the efficiency required for the heat conduction due to an insufficient heat dissipating area, and thus the actual heat dissipating efficiency is below the expected efficiency. Although a plurality of heat sink structures may be attached onto heat generating components, such arrangement can increase the heat dissipating area and improve the thermal conducting efficiency. Further, a fan can be used for blowing and carrying away the heat source compulsorily, but the airflow volume of the fan is very limited, and the heat dissipating effect still cannot be improved effectively. Thus, prior arts try to improve the airflow volume by connecting a plurality of fans in series, but such arrangement is limited by the available space and it is very difficult to implement. Furthermore, an increase of the rotary speed of a motor for improving the airflow volume gives rise to a higher level of difficulty for manufacturing the motor, and the increase of the rotary speed of a motor has an upper limit, and even causes noises, vibrations and heat easily. All of the aforementioned factors make it difficult to achieve the required heat dissipating effect.

[0007] In view of the description above, there are limitations on the breakthrough of the improvement of fan performance, heat dissipating effect, and temperature drop. To meet the heat dissipating requirements for electronic components operated at a high speed, it is necessary to find other feasible solutions. A prior art discloses a water-cooling heat dissipating device that adopts a water block attached onto a heat generating component such as a CPU or a disk drive and uses a motor to pump a coolant from a water tank into a water

block. After the heat produced by heat generating components is absorbed by the water block and the coolant has a heat exchange with the water block, the coolant flows from the water block to a heat dissipating module, and then returns to the water tank after the coolant is cooled, so that the circulation of coolant can assist the heat dissipation and lower the temperature of the heat generating components to maintain a normal operation of the system.

[0008] Although the heat exchange between the water block and the coolant is conducted by letting the coolant flow through the water block and the heat source, a heat dissipating effect that is better than the airflow heat dissipation can be achieved. However, the heat absorbing surfaces of the foregoing water block is concentrated at the same spot, and thus only a portion of the coolant entering into the water block can have a heat exchange at the heat absorbing surface, and the staying time of the coolant in the water block is too short. As a result, the coolant will flow out from another pipe before the coolant absorbs enough heat from the heat source, and the effect of the water-cooling heat dissipation will become very limited. Another prior art discloses a water-cooling heat dissipating structure as shown in FIG. 1, and the water block body 101 has a plurality of heat sinks 102 attached onto an internal side of the water block body 191 to form a plurality of unidirectional channels 103, and the plurality of heat sinks 102 can increase the heat dissipating area. After the coolant is directed into the water block body 101 and passed through the plurality of unidirectional channels 103, a heat exchange is performed between the coolant and the heat sinks 102 to improve the heat dissipating effect.

[0009] In the foregoing heat dissipating structure, the heat sinks 102 can increase the heat dissipating area, and the plurality of channels 103 formed in the heat sinks 102 can direct the flow of the coolant in the water block, such that the contact surface area of the coolant and the plurality of heat sinks 102 can be increased greatly to perform the heat exchange. However, the space available in the unidirectional channels 103 is not close enough, and thus the coolant will pass through the unidirectional channels 103 too quickly, and its staying time cannot be improved. As a result, the coolant cannot achieve the effect of absorbing enough heat of the heat source which is absorbed by the heat sinks 102, nor enhancing the heat dissipating effect. Such prior arts definitely require further improvements.

SUMMARY OF THE INVENTION

[0010] In view of the foregoing shortcomings of the prior art, the inventor of the present invention based on years of experience in the related industry to conduct experiments and modifications, and finally designed a water block and its manufacturing method in accordance with the present invention.

[0011] Therefore, the present invention is to provide a water block having porous microchannels and its manufacturing method, and a thermal conducting powder is sintered to form a porous microchannel structure that can produce a turbulent flow effect on a coolant and greatly improve the staying time of coolant at the water block. Meanwhile, the contact surface area formed by the porous microchannel structure produces a heat exchange effect, such that the coolant can greatly absorb the heat of a heat source conducted from a heat generating component, so as to effectively enhance the heat dissipating effect.

BRIEF DESCRIPTION OF DRAWINGS

[0012] The features of the invention believed to be novel are set forth with particularity in the appended claims. The invention itself however may be best understood by reference to the following detailed description of the invention, which describes certain exemplary embodiments of the invention, taken in conjunction with the accompanying drawings in which:

[0013] FIG. 1 is an exploded view of a water block of a prior art;

[0014] FIG. 2 is a perspective view of a water block of the present invention;

[0015] FIG. 3 is an exploded view of a water block of the present invention;

[0016] FIG. 4 is a schematic view of manufacturing a porous microchannel structure in accordance with the present invention;

[0017] FIG. 5 is a schematic view of shaping a porous microchannel structure in accordance with the present invention;

[0018] FIG. 6 is a schematic view of a porous microchannel structure in accordance with the present invention;

[0019] FIG. 7 is a schematic view of operating a porous microchannel structure in accordance with the present invention;

[0020] FIG. 8 is a flow chart of a manufacturing method in accordance with the present invention;

[0021] FIG. 9 is a schematic view of a porous microchannel structure in accordance with another preferred embodiment of the present invention;

[0022] FIG. 10 is a schematic view of a granular structure in accordance with a preferred embodiment of the present invention;

[0023] FIG. 11 is a schematic view of parallel heat sink structures in accordance with the present invention;

[0024] FIG. 12 is a schematic view of parallel heat sink granular structures in accordance with the present invention;

[0025] FIG. 13 is a schematic view of a heat column in accordance with the present invention;

[0026] FIG. 14 is a schematic view of a granular structure of a heat column in accordance with the present invention;

[0027] FIG. 15 is a schematic view of a porous microchannel structure in accordance with another preferred embodiment of the present invention; and

[0028] FIG. 16 is a schematic view of a granular structure in accordance with a further preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0029] The technical characteristics, features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments with reference to the accompanying drawings. However, the drawings are provided for reference and illustration only and are not intended for limiting the scope of the invention.

[0030] Referring to FIG. 2, a water block body 1 of the invention comprises a first casing 11 and a second casing 12 engaged with each other to form a hollow sealed box body, and the shape of the water block body 1 can be varied appropriately according to different requirements. The first casing 11 and the second casing 12 of this embodiment are cuboids (but not limited to such arrangement) made of a metal material or a ceramic material. The first casing 11 and the second casing 12 are coupled by soldering, riveting or binding. In addition, the first casing 11 has a water inlet pipe 111 and a water outlet pipe 112 extended outward (or upward) from both left and right ends of the first casing 11 respectively and provided for the coolant to enter and exit the water block body 1. The second casing 12 has a contact surface 121 at the bottom of the second casing 12 for contacting a heat source (not shown in the figure).

[0031] Referring to FIG. 3 for an exploded view of the present invention, the second casing 12 of the water block body 1 further comprises a microchannel structure 122 disposed on an internal side of the second casing 12, and the microchannel structure 122 is made by sintering a thermal conducting powder 2, such that the porous structures with fine particles form a plurality of substantial microchannels, and the thermal conducting powder 2 is made of a metal material (such as copper) or a ceramic material.

[0032] Referring to FIG. 4 for a method of manufacturing the water block body 1 in accordance with the present invention, a power 2 is added (or not added) with a binder (such as stearic acid or wax) and shaped into a circular shape, a square shape, or an irregular shape by a shaping machine, and then the shaped powder 2 is put into a tooling 3 having the same shape of a shaping mold, and the tooling 3 is put at a predetermined position of an internal side of the second casing 12 as shown in FIG. 5, and then the binder in the tooling 3 is removed, and the powders 2 are bound with each other to form a porous structure and attached on the surfaces of panels of the second casing 12. After the tooling 3 is removed, the powders 2 form the foregoing microchannel structure 122 as shown in FIG. 6. Referring to FIG. 7, the first casing 11 and the second casing 12 are coupled by soldering, riveting or binding to accomplish the water block body 1.

[0033] Referring to FIG. 8 for a flow chart of a method of manufacturing the water block body 1 in accordance with the present invention, the method comprises the steps of: pressing and shaping a thermal conducting powder 2 (Step S1), putting a tooling 3 at a predetermined position of a second casing 12 and then putting the whole pressed and shaped powder 2 into the tooling 3 (Step S2), and gaps are formed naturally between fine particles, and the powders 2 are combined by sintering to form a microchannel structure 122 (Step S3), and then coupling the first casing 11 and the second casing 12 by soldering, riveting or binding, and finally completing the procedure of manufacturing the water block body 1 (Step S4).

[0034] Referring to FIG. 7, the water block body 1 is attached onto a heat generating component 4 (which is a CPU or any other heat generating chip), and the contact surface 121 absorbs the heat of a heat source on the heat generating component 4, and conducts the heat of the heat source to the microchannel structure 122 at the internal side of the water block body 1, such that after the coolant is directed from the water inlet pipe 111 to the water block body 1 (wherein an arrowhead in FIG. 7 indicates the direction of a water flow),

the turbulent flow effect of the microchannel structure **122** greatly extends the staying time of the coolant at the water block body. As a result, the thermal conducting materials of the coolant and the microchannel structure **122** perform a heat exchange to absorb enough heat and then discharge the heat from the water outlet pipe **112**, so as to achieve the required heat dissipating effect.

[0035] Referring to FIG. 9 for another preferred embodiment of the present invention, the first casing **11** and second casing **12** are perpendicular to a plurality of heat sinks (or fins) **113**, **123** on the panel, and the heat sinks **113**, **123** form a plurality of intervals which are arranged alternately, and the intervals are interconnected with each other to form circuitous unidirectional channels. Then, the microchannel structure **122** made of a thermal conducting powder **2** is put into the intervals, wherein the microchannel structure **122** can be made of square particles of different sizes as shown in FIG. 10, such that when the contact surface **121** of the water block body **1** is attached onto the heat generating component **4**, the contact surface **121** absorbs the heat of a heat source and conducts the heat to the heat sink **113**, **123** and dissipates the heat to the microchannel structure **122** made of the powder **2**. After the coolant is directed from the water inlet pipe **111** to the circuitous unidirectional channels, the turbulent flow effect of the microchannel structure **122** performs a heat exchange with the plurality of heat sinks **113**, **123** and the microchannel structure **122**, such that the coolant can carry away the heat of the heat source and flow out from the water outlet pipe **112**, so as to achieve the required heat dissipating effect. Referring to FIG. 11, only a plurality of heat sinks **123** are set perpendicularly to a panel of the second casing **12** and form a plurality of parallel channels, and then the microchannel structure **122** made by sintering the powder **2** is put into the channels. The microchannel structure **122** is a structure in the shape of a long strip, and the microchannel structure **122** can be a circular granular structure made of powders **2** of different sizes as shown in FIG. 12.

[0036] Further, one or more heat columns **5** are installed at a predetermined position of the microchannel structure **122** of the second casing **12** and erected from a panel on an internal side of the second casing **12** as shown in FIG. 13 (which illustrates an embodiment having one heat column **5**), and the microchannel structures **122** formed by sintering the thermal conducting powder **2** are set around the heat column **5**, wherein the microchannel structure **122** can be a granular structure made by sintering powders **2** of different sizes as shown in FIG. 14.

[0037] Referring to FIG. 15 for a further preferred embodiment of the present invention, the first casing **11** has a third pipe **114** aligned precisely with the contact surface **121**, while

the microchannel structure **122** installed in the water block body **1** has a hollow opening aligned precisely with the position of a third pipe **114**, such that after the coolant is directed from the third pipe **114**, the coolant flows directly through the contact surface **121** attached with the heat generating component **4** and has a direct heat exchange effect with the contact surface **121**, and then the heat is discharged from the water outlet pipe **112** of the porous microchannel structure **121**, and thus the number of pipes is not limited. In addition, the microchannel structure **122** could be made of circular granular powders of different sizes as shown in FIG. 16.

[0038] The present invention is illustrated with reference to the preferred embodiment and not intended to limit the patent scope of the present invention. Various substitutions and modifications have suggested in the foregoing description, and other will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended claims.

What is claimed is:

1. A method of manufacturing a water block, comprising the steps of:
 - preparing a first casing and a second casing;
 - pressing and shaping a powder;
 - putting a tooling at a predetermined position of a second casing;
 - putting the powder in the tooling;
 - sintering the powder into a porous microchannel structure; and
 - coupling the first casing and the second casing to form a water block body.
2. The method of claim 1, further comprising a step of adding a binder on the powder.
3. The method of claim 2, wherein the binder is one selected from stearic acid and wax.
4. The method of claim 1, wherein a shaping machine is used for pressing and shaping the powder.
5. The method of claim 1, wherein the powder is pressed and shaped in a shape selected from the collection of a circular shape, a square shape, and an irregular shape.
6. The method of claim 1, wherein the powder is pressed and shaped in a particle in a shape selected from the collection of a circular shape, a square shape, and an irregular shape.
7. The method of claim 1, wherein the first casing and the second casing are coupled by soldering, riveting, or binding.

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