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(54) **HEAT DISSIPATING DEVICE**

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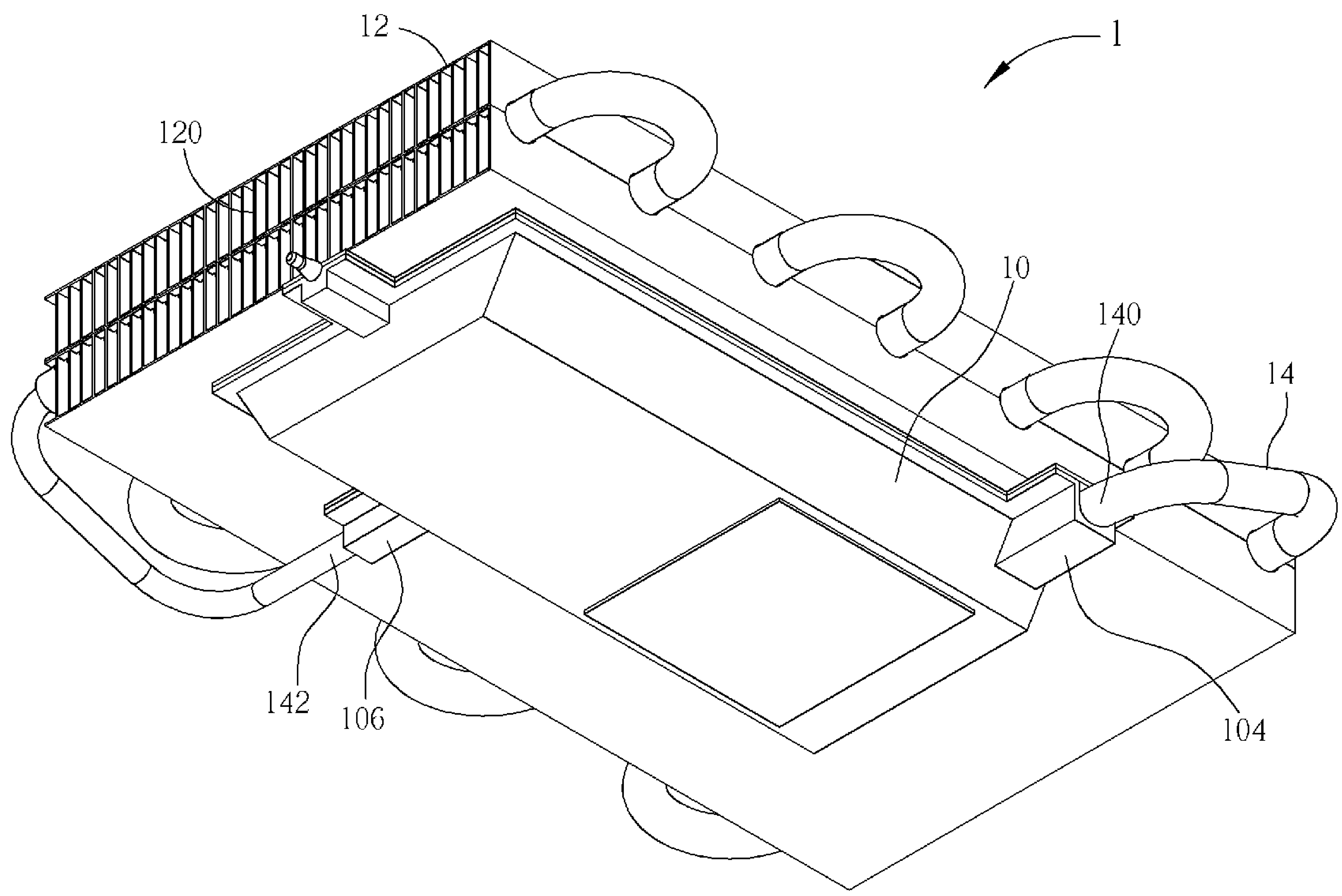
(57) **ABSTRACT**

A heat dissipating device includes a chamber body, a heat sink, a pipe, a first capillary structure and N vapor channels. The chamber body has an evaporation chamber and a compensation chamber, wherein the evaporation chamber has a vapor outlet and the compensation chamber has a liquid inlet. The heat sink is disposed on an outer wall of a first side of the chamber body and at least covers the compensation chamber. The pipe is installed within the heat sink, wherein a first end of the pipe is connected to the vapor outlet and a second end of the pipe is connected to the liquid inlet. The first capillary structure is formed in the evaporation chamber. The N vapor channels are formed in the first capillary structure. The N vapor channels and the compensation chamber are isolated by the first capillary structure.



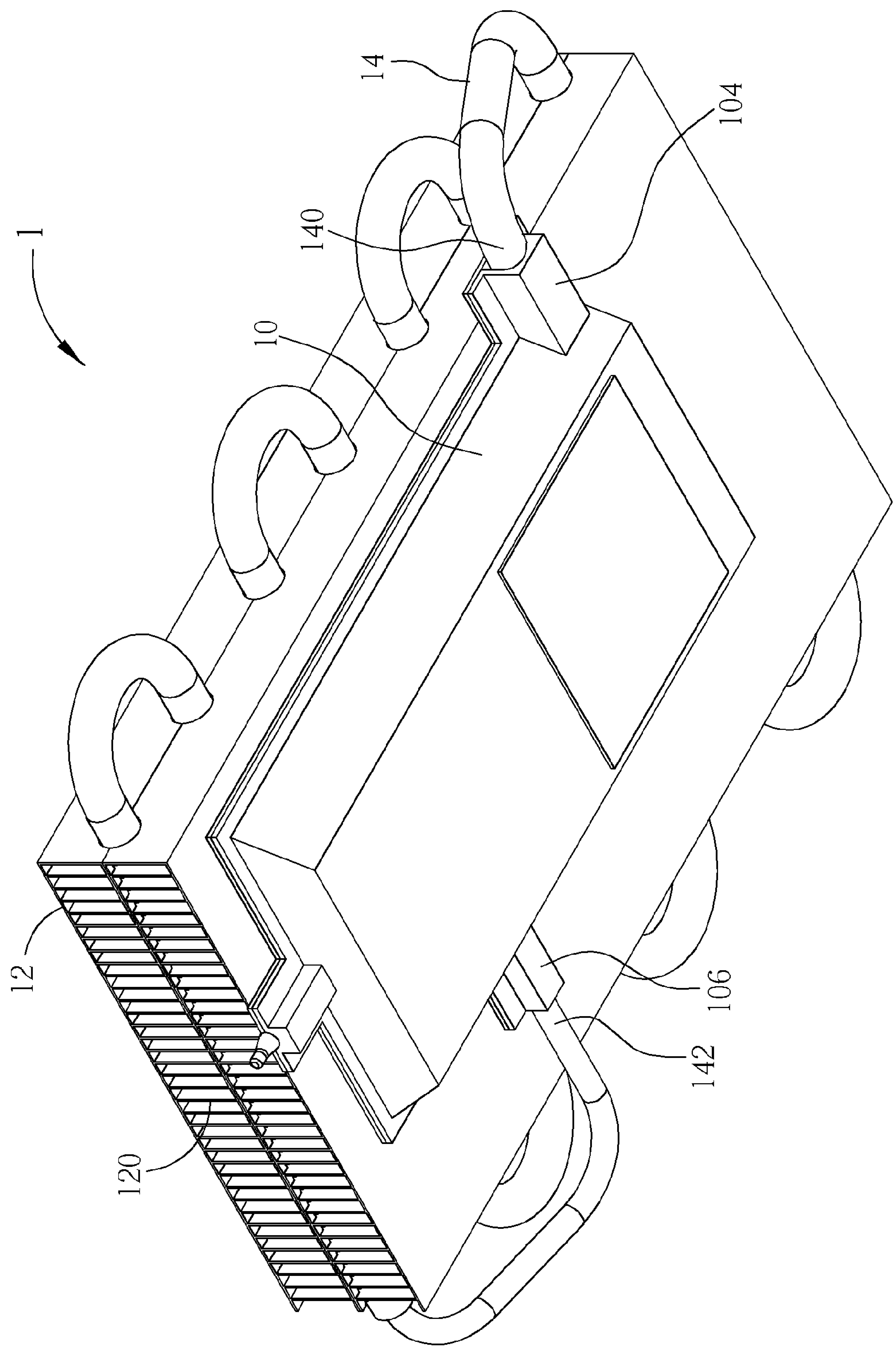


FIG. 1

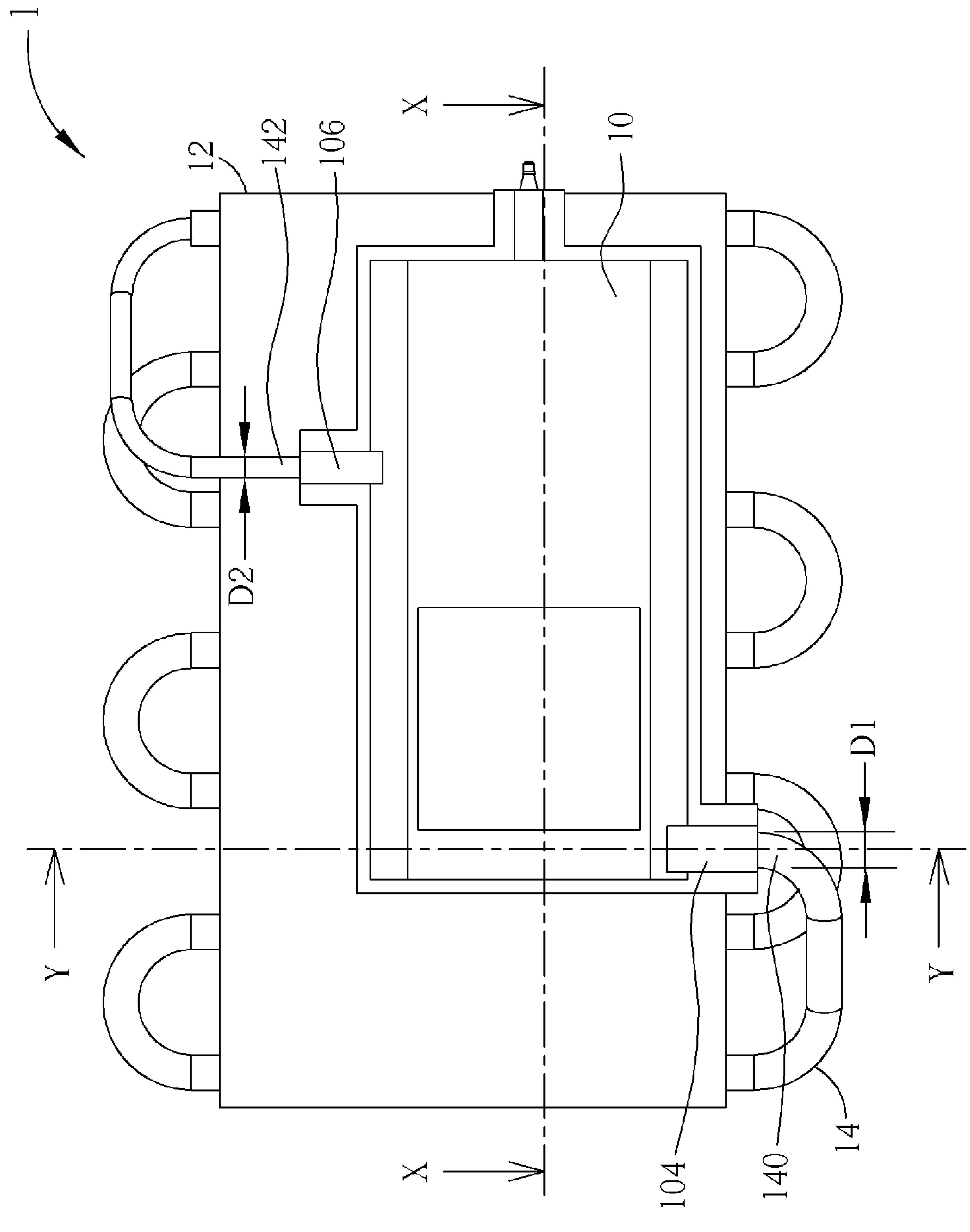


FIG. 2A

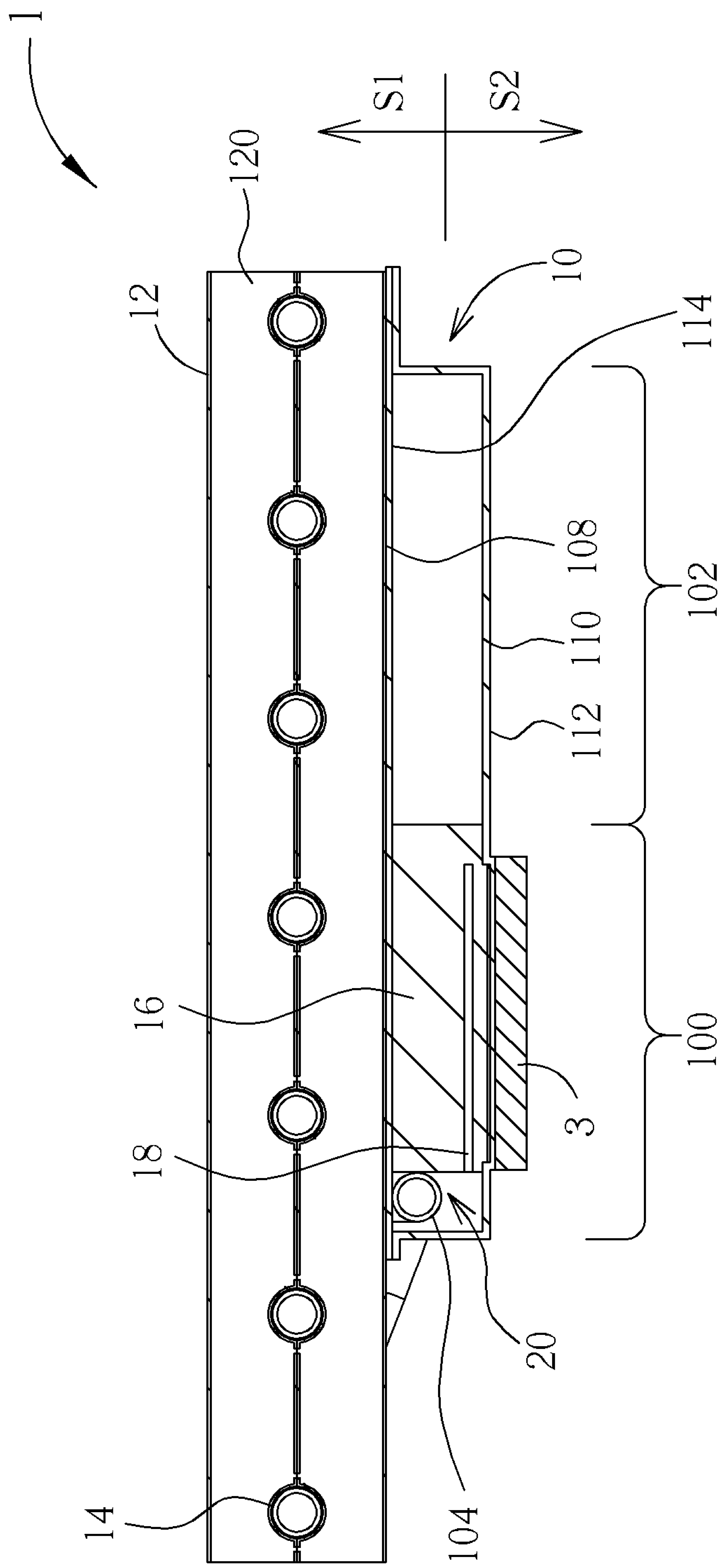


FIG. 2B

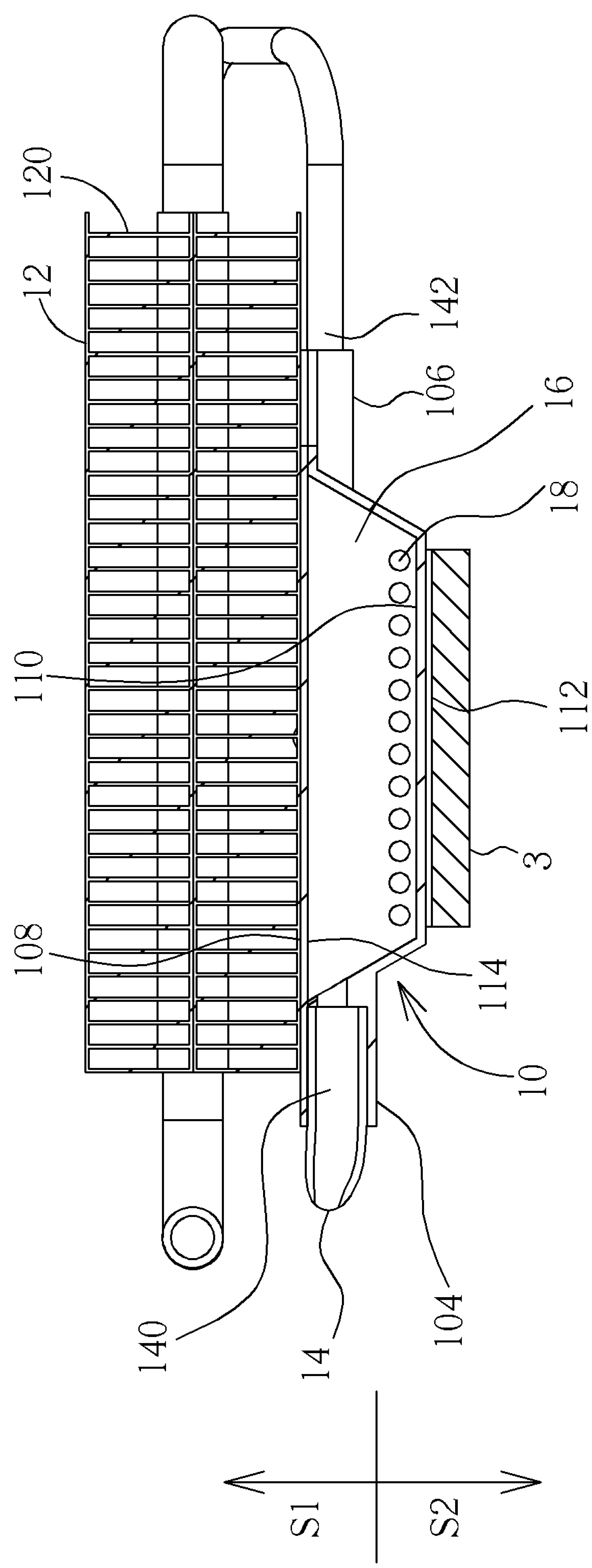


FIG. 2C

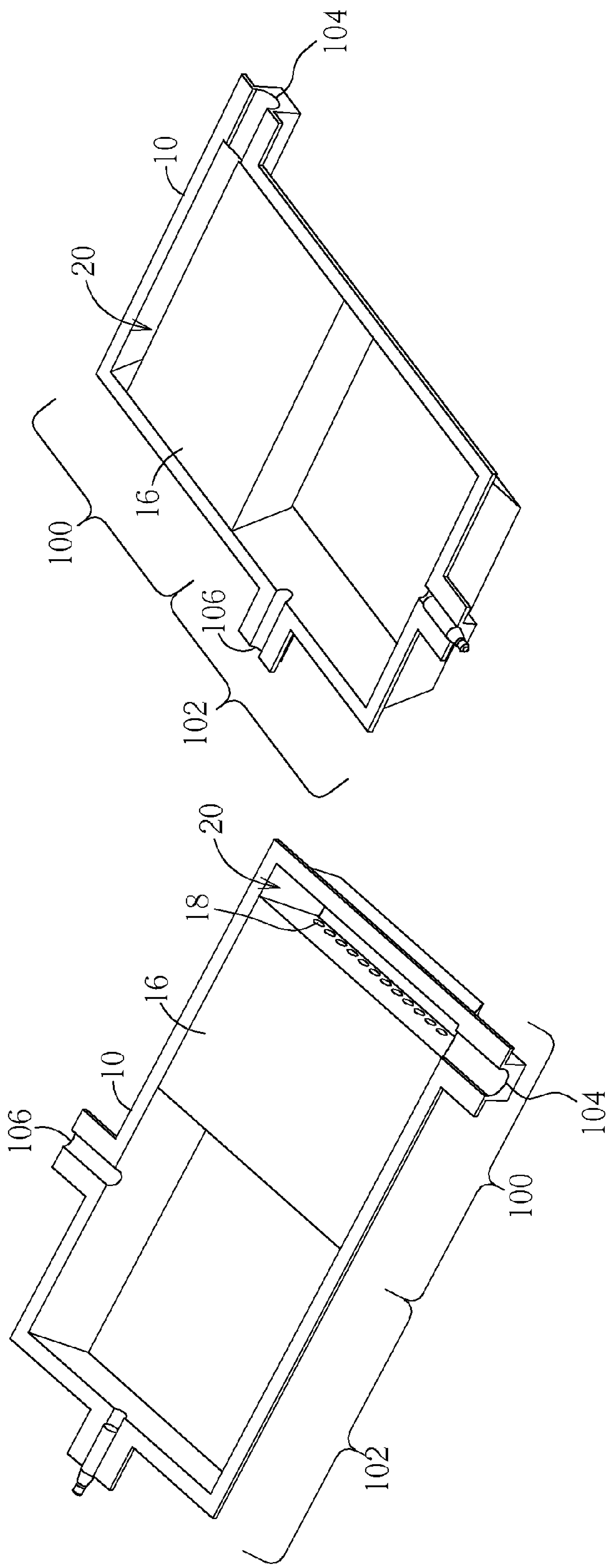


FIG. 3

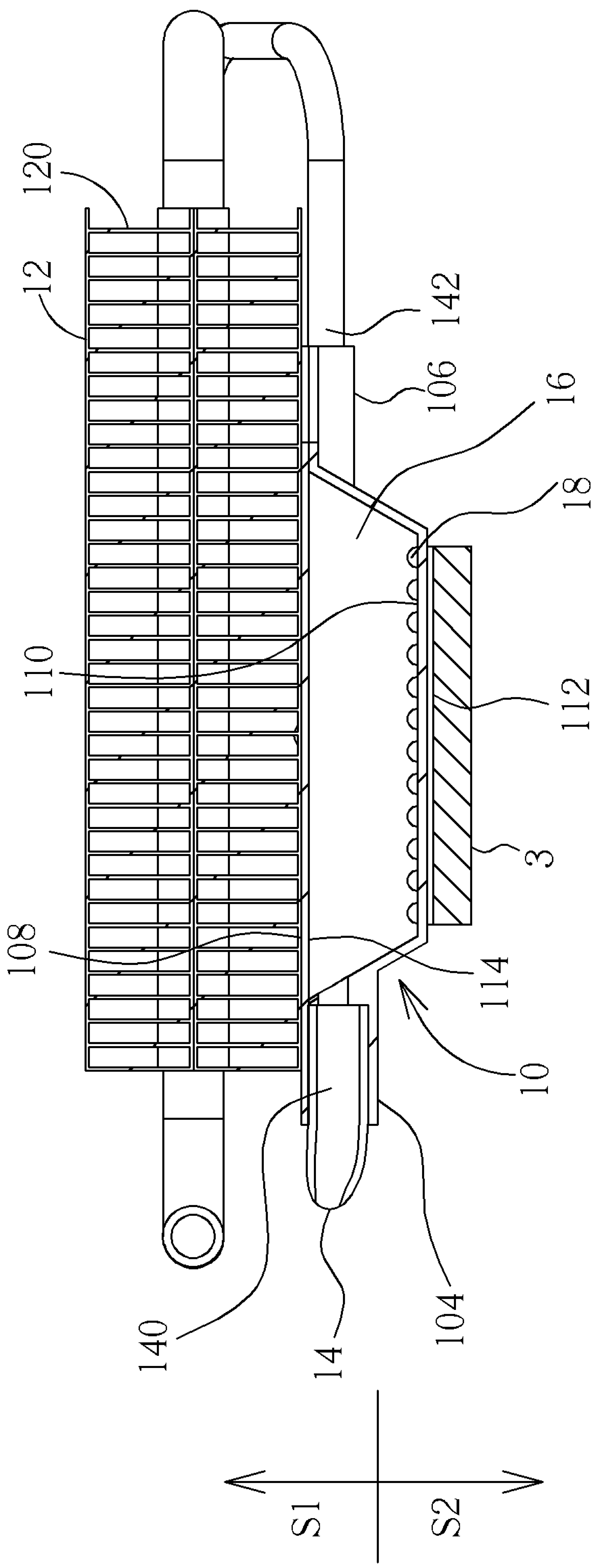


FIG. 4

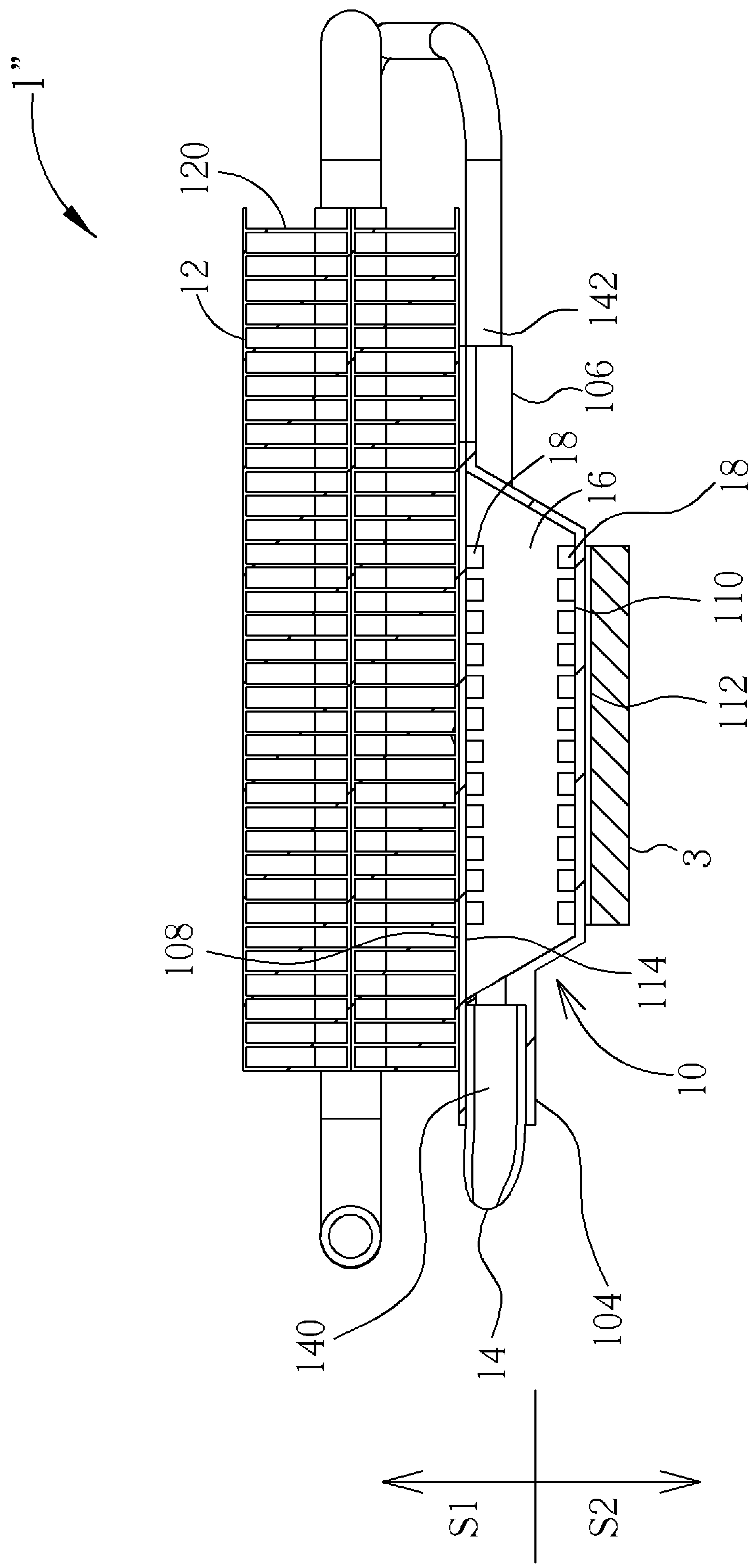


FIG. 5

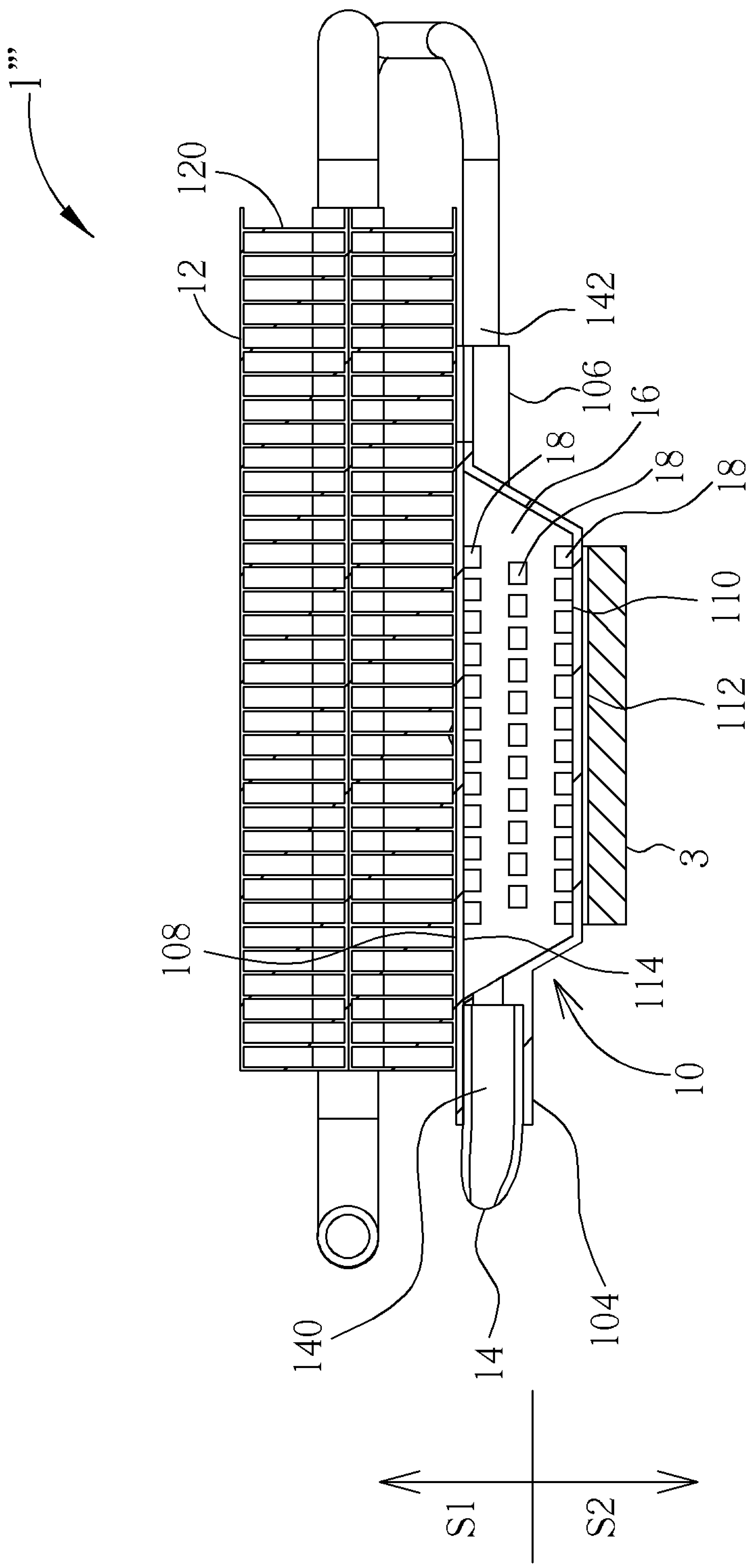


FIG. 6

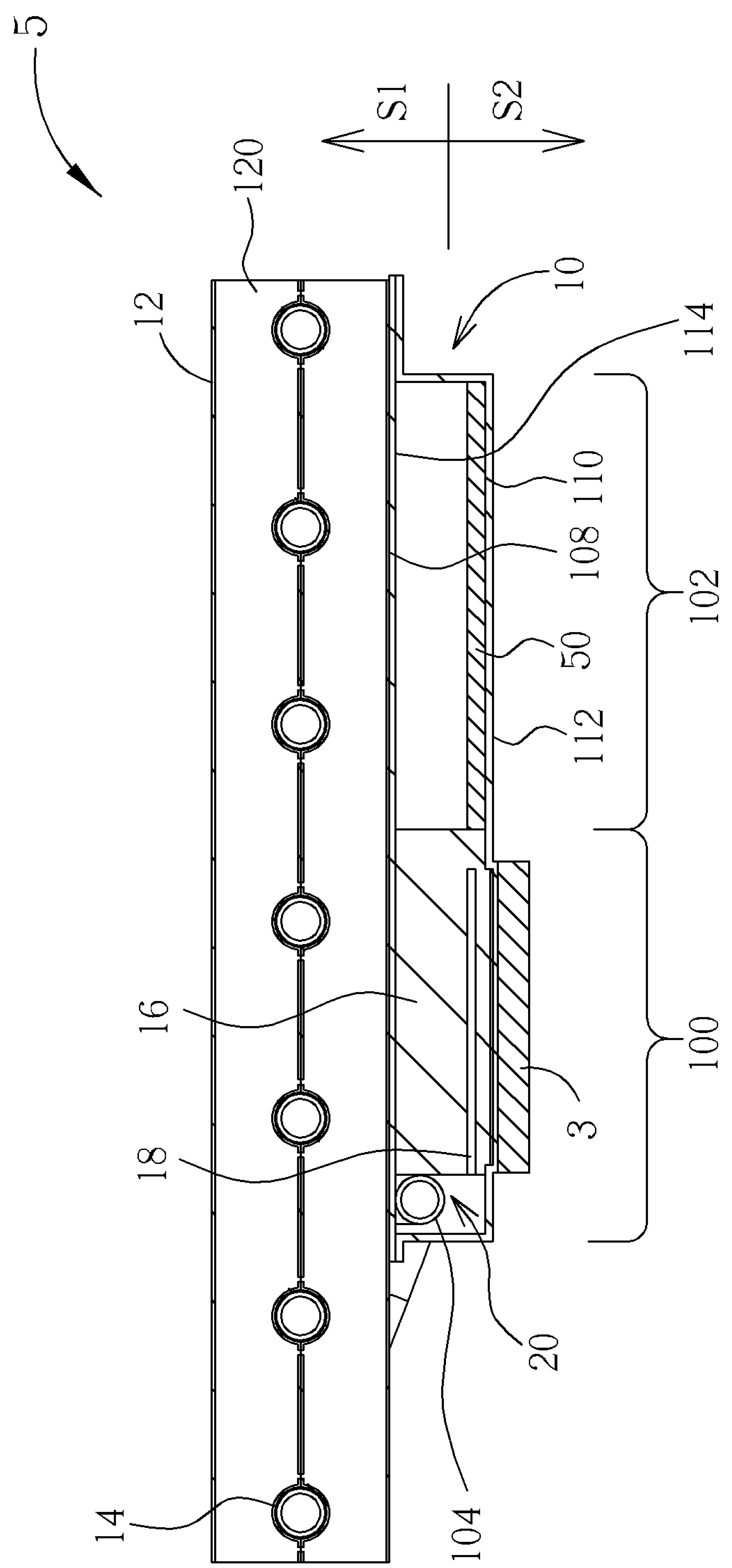


FIG. 7

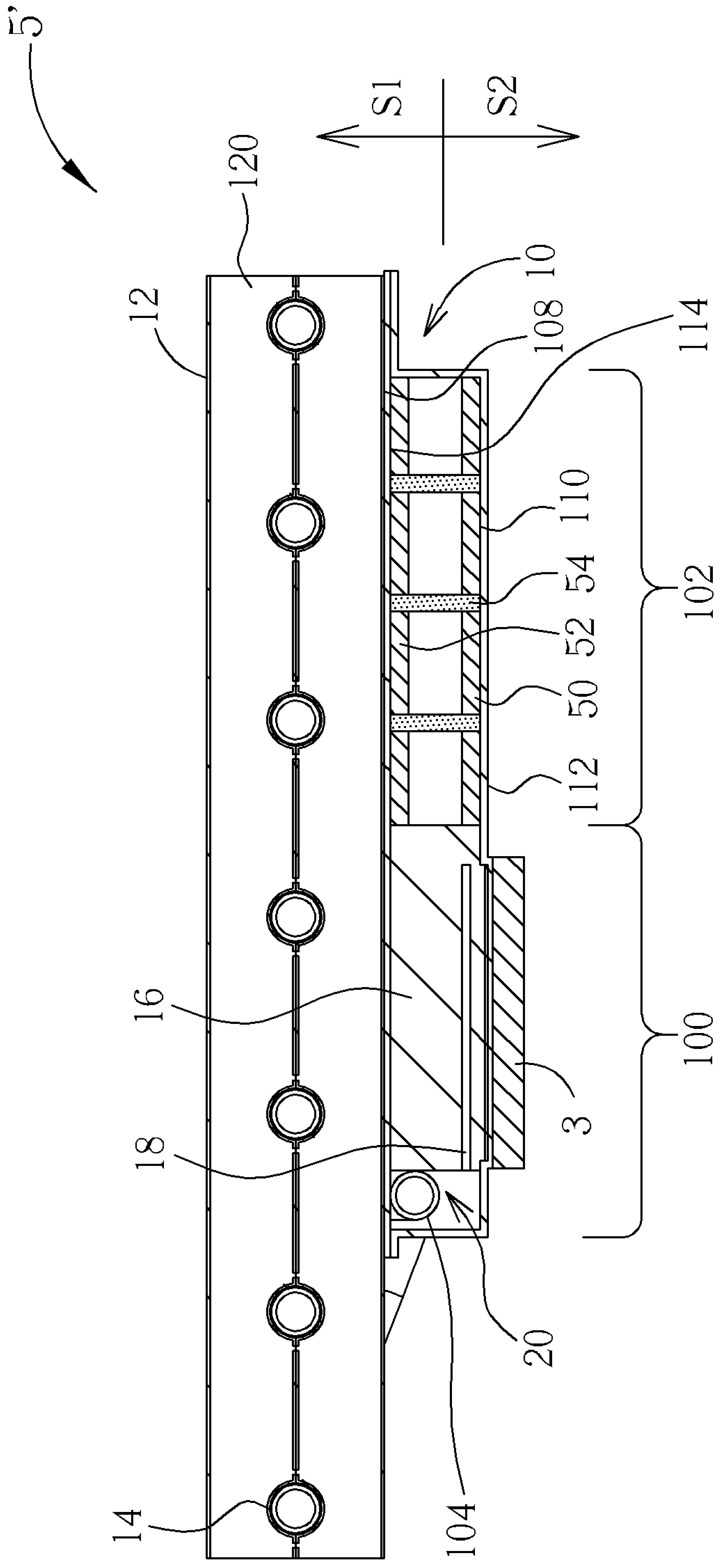
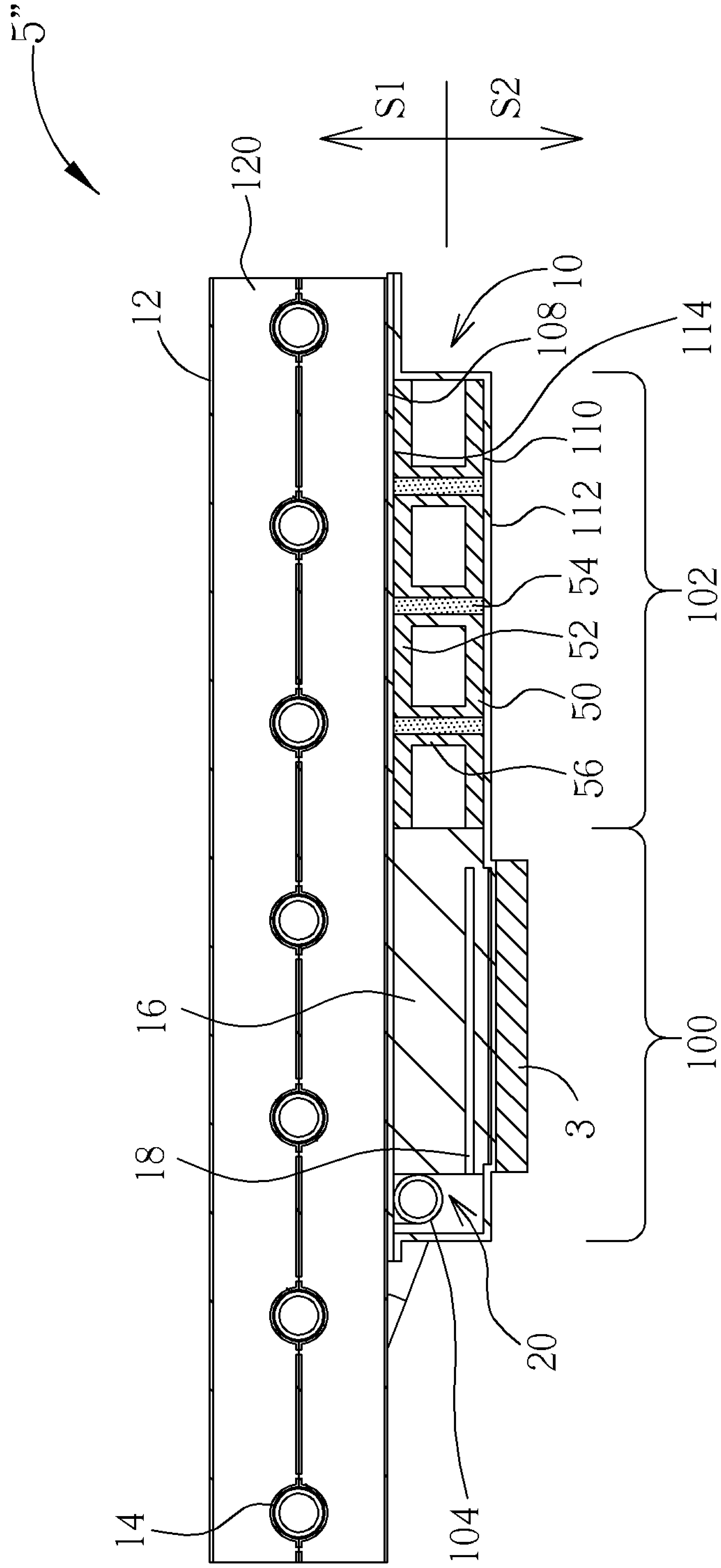


FIG. 8



5"
S1
S2
120
12
10
108
114
110
112
54
52
50
56
102
16
18
3
100
20
104
14

FIG. 9

HEAT DISSIPATING DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to a heat dissipating device and, more particularly, to a loop-heat-pipe type heat dissipating device.

[0003] 2. Description of the Prior Art

[0004] Heat dissipating device is a significant component for electronic products. When an electronic product is operating, the current in circuit will generate unnecessary heat due to impedance. If the heat is accumulated in the electronic components of the electronic product without dissipating immediately, the electronic components may get damage due to the accumulated heat. Therefore, the performance of heat dissipating device is a significant issue for the electronic product.

[0005] So far the heat dissipating device used in the electronic product usually consists of a heat pipe, a heat dissipating fin and a heat dissipating fan, wherein one end of the heat pipe contacts the electronic component, which generates heat during operation, the other end of the heat pipe is connected to the heat dissipating fin, and the heat dissipating fan blows air to the heat dissipating fin so as to dissipate heat. However, since heat generated by the electronic component increases per unit time while calculation speed of the electronic component increase, the conventional heat dissipating device cannot dissipate heat effectively form the electronic component such that heat will be accumulated in the electronic component accordingly. Therefore, how to dissipate heat from the electronic component much more rapidly becomes a significant issue while designing the heat dissipating device.

SUMMARY OF THE INVENTION

[0006] The invention provides a heat dissipating device for solving the aforesaid problems.

[0007] According to an embodiment of the invention, a heat dissipating device comprises a chamber body, a heat sink, a pipe, a first capillary structure and N vapor channels, wherein N is a positive integer. The chamber body has an evaporation chamber and a compensation chamber, wherein the evaporation chamber has a vapor outlet and the compensation chamber has a liquid inlet. The heat sink is disposed on an outer wall of a first side of the chamber body and at least covers the compensation chamber. The pipe is installed within the heat sink, wherein a first end of the pipe is connected to the vapor outlet and a second end of the pipe is connected to the liquid inlet. The first capillary structure is formed in the evaporation chamber. The N vapor channels are formed in the first capillary structure. The N vapor channels and the compensation chamber are isolated by the first capillary structure.

[0008] In this embodiment, the heat dissipating device may further comprise a vapor collecting space formed in the evaporation chamber and communicating with the N vapor channels and the vapor outlet.

[0009] As mentioned in the above, the heat sink of the invention is disposed on the outer wall of the chamber body and at least covers the compensation chamber and the pipe of the invention is installed within the heat sink, such that the heat sink not only can cool vapor within the pipe but also can absorb heat leak within the compensation chamber so as to enhance heat dissipating efficiency of the heat dissipating device. Furthermore, sine the vapor channels and the compensation chamber are isolated by the capillary structure, the vapor generated in the vapor channels cannot flow back to the compensation chamber. Accordingly, pressure difference between the evaporation chamber and the compensation chamber can be maintained so as to prevent the heat dissipating device from failing due to reduced pressure difference. Moreover, the invention utilizes the vapor collecting space to communicate with the vapor channels and the vapor outlet such that vapor generated in all vapor channels can flow into the pipe from the vapor outlet through the vapor collecting space. Accordingly, heat dissipating efficiency of the heat dissipating device can be enhanced effectively.

[0010] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a perspective view illustrating a heat dissipating device according to an embodiment of the invention.

[0012] FIG. **2**A is a top view illustrating the heat dissipating device shown in FIG. **1**.

[0013] FIG. **2**B is cross-sectional view illustrating the heat dissipating device along X-X line shown in FIG. **2**A.

[0014] FIG. **2**C is a cross-sectional view illustrating the heat dissipating device along Y-Y line shown in FIG. **2**A.

[0015] FIG. **3** is an assembly view illustrating the chamber body and the first capillary structure shown in FIG. **2**B from different view angles.

[0016] FIG. **4** is a cross-sectional view illustrating a heat dissipating device according to another embodiment of the invention.

[0017] FIG. **5** is a cross-sectional view illustrating a heat dissipating device according to another embodiment of the invention.

[0018] FIG. **6** is a cross-sectional view illustrating a heat dissipating device according to another embodiment of the invention.

[0019] FIG. **7** is a cross-sectional view illustrating a heat dissipating device according to another embodiment of the invention.

[0020] FIG. **8** is a cross-sectional view illustrating a heat dissipating device according to another embodiment of the invention.

[0021] FIG. **9** is a cross-sectional view illustrating a heat dissipating device according to another embodiment of the invention.

DETAILED DESCRIPTION

[0022] Referring to FIGS. **1** to **3**, FIG. **1** is a perspective view illustrating a heat dissipating device **1** according to an embodiment of the invention, FIG. **2**A is a top view illustrating the heat dissipating device **1** shown in FIG. **1**, FIG. **2**B is cross-sectional view illustrating the heat dissipating device **1** along X-X line shown in FIG. **2**A, FIG. **2**C is a cross-sectional view illustrating the heat dissipating device **1** along Y-Y line shown in FIG. **2**A, and FIG. **3** is an assembly view illustrating the chamber body **10** and the first capillary structure **16** shown in FIG. **2**B from different view angles.

[0023] As shown in FIGS. **1** to **3**, the heat dissipating device **3** comprises a chamber body **10**, a heat sink **12**, a pipe **14**, a first capillary structure **16**, N vapor channels **18** and a vapor collecting space **20**, wherein N is a positive integer. The chamber body **10** has an evaporation chamber **100** and a compensation chamber **102**, wherein the evaporation chamber **100** has a vapor outlet **104** and the compensation chamber **102** has a liquid inlet **106**. The heat sink **12** is disposed on an outer wall **108** of a first side S1 of the chamber body **10** and at least covers the compensation chamber **102**. In this embodiment, the heat sink **12** covers the compensation chamber **102** and the evaporation chamber **100** at the same time. In another embodiment, the heat sink **12** may only cover the compensation chamber **102**. The heat sink **12** and the compensation chamber **102** maybe served as a vapor chamber as long as the heat sink **12** covers the compensation chamber **102**. Accordingly, the heat sink **12** can absorb heat leak within the compensation chamber **102** so as to enhance heat dissipating efficiency of the heat dissipating device **1**. The heat sink **12** may comprise a plurality of heat dissipating fins **120**. In practical applications, a working fluid (not shown), such as water or other fluids with low viscosity, is filled in the chamber body **10**.

[0024] The pipe **14** is installed within the heat sink **12** such that the heat sink **12** can cool vapor within the pipe **14**. A first end **140** of the pipe **14** is connected to the vapor outlet **104** of the evaporation chamber **100** and a second end **142** of the pipe **14** is connected to the liquid inlet **106** of the compensation chamber **102**. Accordingly, when the working fluid is evaporated by heat to be transformed into vapor, the vapor can flow into the pipe **14** from the vapor outlet **104**. Then, the vapor is cooled by the heat sink **12** to be transformed into liquid and the liquid flows into the compensation chamber **102** of the chamber body **10** from the liquid inlet **106**. Since the pipe **14** and the chamber body **10** are configured in a loop type, the heat dissipating device **1** may be called as loop-heat-pipe type heat dissipating device. In this embodiment, a pipe diameter D1 of the first end **140** is larger than a pipe diameter D2 of the second end **142** (as shown in FIG. 2A) so as to ensure that a pressure difference at the first end **140** is smaller than a pressure difference at the second end **142**. Accordingly, the vapor and liquid can circulate in the chamber body **10** well.

[0025] The first capillary structure **16** and the vapor collecting space **20** are formed in the evaporation chamber **100**. The N vapor channels **18** are formed in the first capillary structure **16**. In this embodiment, there are twelve vapor channels **18** formed in the first capillary structure **16** (i.e. N=12), arranged in equal distance and close to an inner wall **110** of a second side S2 of the chamber body **10**, wherein the second side S2 is opposite to the aforesaid first side S1. As shown in FIGS. 2B and 2C, a heat source **3** is attached on an outer wall **112** of the second side S2 of the chamber body **10**. In other words, the vapor channels **18** of the invention are close to the heat source **3**. Thermal resistance is lower while the vapor channels **18** are closer to the heat source **3**. Accordingly, the liquid within the first capillary structure **16** can be evaporated by heat rapidly and then be transformed into vapor in the vapor channels **18** so as to enhance heat dissipating efficiency. It should be noted that the number and arrangement of the vapor channels can be determined based on practical applications and are not limited to the embodiment shown in the figures.

[0026] As shown FIGS. 2B and 3, all of the vapor channels **18** and the compensation chamber **102** are isolate by the first capillary structure **16**. That is to say, each of the vapor channels **18** does not communicate with the compensation chamber **102** such that the vapor generated in each of the vapor channels **18** cannot flow back to the compensation chamber **102**. Accordingly, pressure difference between the evaporation chamber **100** and the compensation chamber **102** can be maintained so as to prevent the heat dissipating device **1** from failing due to reduced pressure difference between the evaporation chamber **100** and the compensation chamber **102**. Furthermore, the vapor collecting space **20** communicates with all of the vapor channels **18** and the vapor outlet **104** such that the vapor generated in each of the vapor channels **18** can flow into the pipe **14** from the vapor outlet **104** through the vapor collecting space **20**, so as to enhance heat dissipating efficiency of the heat dissipating device **1**.

[0027] In this embodiment, a cross-section of each of the vapor channels **18** is circular, as shown in FIG. 2C. In another embodiment, a cross-section of each of the vapor channels **18** may be rectangular, polygonal or arc-shaped.

[0028] Referring to FIG. **4** along with FIG. 2C, FIG. **4** is a cross-sectional view illustrating a heat dissipating device **1'** according to another embodiment of the invention. The difference between the heat dissipating device **1'** and the aforesaid heat dissipating device **1** is that M of the N vapor channels **18** of the heat dissipating device **1'** are located on the inner wall **110** of the second side S2 of the chamber body **10** (i.e. N=12 and M=N). Furthermore, a cross-section of each of the vapor channels **18** is half-circular. Since the vapor channels **18** are located on the inner wall **110** of the second side S2 of the chamber body **10**, the liquid within the first capillary structure **16** can be evaporated by heat rapidly and then be transformed into vapor in the vapor channels **18** so as to enhance heat dissipating efficiency. It should be noted that the same elements in FIG. **4** and FIG. 2C are represented by the same numerals, so the repeated explanation will not be depicted herein again.

[0029] Referring to FIG. **5** along with FIG. 2C, FIG. **5** is a cross-sectional view illustrating a heat dissipating device **1"** according to another embodiment of the invention. The difference between the heat dissipating device **1"** and the aforesaid heat dissipating device **1** is that M of the N vapor channels **18** of the heat dissipating device **1'** are located on the inner wall **110** of the second side S2 of the chamber body **10** and P of the N vapor channels **18** are located on the inner wall **114** of the first side S1, wherein P is a positive integer and a sum of P and M is smaller than or equal to N. In this embodiment, twelve of twenty-four vapor channels **18** are located on the inner wall **110** of the second side S2 of the chamber body **10** and the other twelve of twenty-four vapor channels **18** are located on the inner wall **114** of the first side S1 (i.e. N=24 and P+M=N). Furthermore, a cross-section of each of the vapor channels **18** is rectangular. Since each of the vapor channels **18** is rectangular, the pressure difference of the vapor channel **18** can be reduced so as to enhance heat dissipating efficiency. Moreover, the vapor channels **18** on opposite sides may be arranged symmetrically or interlacedly and it depends on practical applications. It should be noted that the same elements in FIG. **5** and FIG. 2C are represented by the same numerals, so the repeated explanation will not be depicted herein again.

[0030] Referring to FIG. **6** along with FIG. 2C, FIG. **6** is a cross-sectional view illustrating a heat dissipating device **1'"** according to another embodiment of the invention. The difference between the heat dissipating device **1'"** and the aforesaid heat dissipating device **1** is that M of the N vapor channels **18** of the heat dissipating device **1'"** are located on the inner wall **110** of the second side S2 of the chamber body **10**, P of the N vapor channels **18** are located on the inner wall **114**

of the first side S1, and Q of the N vapor channels **18** are located between the M vapor channels **18** and the P vapor channels **18**, wherein Q is a positive integer and a sum of Q, P and M is equal to N. In this embodiment, twelve of thirty-five vapor channels **18** are located on the inner wall **110** of the second side S2 of the chamber body **10**, twelve of thirty-five vapor channels **18** are located on the inner wall **114** of the first side S1, and the other eleven of thirty-five vapor channels **18** are located between the twenty-four vapor channels **18** on opposite sides (i.e. N=35 and Q+P+M=N). Furthermore, a cross-section of each of the vapor channels **18** is rectangular. It should be noted that the same elements in FIG. **6** and FIG. **2**C are represented by the same numerals, so the repeated explanation will not be depicted herein again.

[0031] Referring to FIG. **7** along with FIG. **2**B, FIG. **7** is a cross-sectional view illustrating a heat dissipating device **5** according to another embodiment of the invention. The difference between the heat dissipating device **5** and the aforesaid heat dissipating device **1** is that the heat dissipating device **5** further comprises a second capillary structure **50** formed in the compensation chamber **102** and located on the inner wall **110** of the second side S2 of the chamber body **10**. Once heat leak is generated in the compensation chamber **102**, the liquid within the second capillary structure **50** will be evaporated by heat and then be transformed into vapor. Consequently, heat leak generated in the compensation chamber **102** can be dissipated by the heat sink **102** outside of the compensation chamber **102** so as to enhance heat dissipating efficiency. It should be noted that the same elements in FIG. **7** and FIG. **2**B are represented by the same numerals, so the repeated explanation will not be depicted herein again.

[0032] Referring to FIG. **8** along with FIG. **7**, FIG. **8** is a cross-sectional view illustrating a heat dissipating device **5'** according to another embodiment of the invention. The difference between the heat dissipating device **5'** and the aforesaid heat dissipating device **5** is that the heat dissipating device **5'** further comprises a third capillary structure **52** and a plurality of support pillars **54**. The third capillary structure **52** is formed in the compensation chamber **102** and located on the inner wall **114** of the first side S1. The support pillars **54** are formed in the compensation chamber **102** and connect the second capillary structure **50** and the third capillary structure **52**. The support pillars **54** can prevent the compensation chamber **102** from cracking due to compression. In this embodiment, after the heat sink **12** outside of the compensation chamber **102** takes heat away, the vapor will be congealed to form glob on the third capillary structure **52** and then the glob will flow to the second capillary structure **50** along the support pillars **54** so as to accelerate the cycle of vapor and liquid within the compensation chamber **102**. Accordingly, heat dissipating efficiency can be enhanced. It should be noted that the same elements in FIG. **8** and FIG. **7** are represented by the same numerals, so the repeated explanation will not be depicted herein again.

[0033] Referring to FIG. **9** along with FIG. **8**, FIG. **9** is a cross-sectional view illustrating a heat dissipating device **5"** according to another embodiment of the invention. The difference between the heat dissipating device **5"** and the aforesaid heat dissipating device **5'** is that the heat dissipating device **5"** further comprises a plurality of fourth capillary structures **56**. Each of the fourth capillary structures **56** is formed around one of the support pillars **54** and connects the second capillary structure **50** and the third capillary structure **52**. In this embodiment, after the heat sink **12** outside of the compensation chamber **102** takes heat away, the vapor will be congealed to form glob on the third capillary structure **52** and then the glob will flow to the second capillary structure **50** along the fourth capillary structures **56** so as to accelerate the cycle of vapor and liquid within the compensation chamber **102**. Accordingly, heat dissipating efficiency can be enhanced. It should be noted that the same elements in FIG. **9** and FIG. **8** are represented by the same numerals, so the repeated explanation will not be depicted herein again.

[0034] It should be noted that the aforesaid first capillary structure **16**, second capillary structure **50**, third capillary structure **52** and fourth capillary structures **56** may be formed by, but not limited to, a metal powder sintering process. It depends on practical applications.

[0035] Compared with the prior art, the heat sink of the invention is disposed on the outer wall of the chamber body and at least covers the compensation chamber and the pipe of the invention is installed within the heat sink, such that the heat sink not only can cool vapor within the pipe but also can absorb heat leak within the compensation chamber so as to enhance heat dissipating efficiency of the heat dissipating device. Furthermore, sine the vapor channels and the compensation chamber are isolated by the capillary structure, the vapor generated in the vapor channels cannot flow back to the compensation chamber. Accordingly, pressure difference between the evaporation chamber and the compensation chamber can be maintained so as to prevent the heat dissipating device from failing due to reduced pressure difference. Moreover, the invention utilizes the vapor collecting space to communicate with the vapor channels and the vapor outlet such that vapor generated in all vapor channels can flow into the pipe from the vapor outlet through the vapor collecting space. Accordingly, heat dissipating efficiency of the heat dissipating device can be enhanced effectively. Still further, the invention may form capillary structures in the compensation chamber so as to accelerate the cycle of vapor and liquid within the compensation chamber. Accordingly, heat dissipating efficiency can be enhanced.

[0036] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

What is claimed is:

1. A heat dissipating device comprising:

a chamber body having an evaporation chamber and a compensation chamber, the evaporation chamber having a vapor outlet, the compensation chamber having a liquid inlet;

a heat sink disposed on an outer wall of a first side of the chamber body and at least covering the compensation chamber;

a pipe installed within the heat sink, a first end of the pipe being connected to the vapor outlet, a second end of the pipe being connected to the liquid inlet;

a first capillary structure formed in the evaporation chamber; and

N vapor channels formed in the first capillary structure, the N vapor channels and the compensation chamber being isolated by the first capillary structure, N being a positive integer.

2. The heat dissipating device of claim **1** further comprising a vapor collecting space formed in the evaporation chamber and communicating with the N vapor channels and the vapor outlet.

3. The heat dissipating device of claim **1**, wherein M of the N vapor channels are located on an inner wall of a second side of the chamber body, M is a positive integer smaller than or equal to N, and the second side is opposite to the first side.

4. The heat dissipating device of claim **3**, wherein P of the N vapor channels are located on an inner wall of the first side, P is a positive integer, and a sum of P and M is smaller than or equal to N.

5. The heat dissipating device of claim **4**, wherein Q of the N vapor channels are located between the M vapor channels and the P vapor channels, Q is a positive integer, and a sum of Q, P and M is equal to N.

6. The heat dissipating device of claim **1**, wherein a cross-section of each of the N vapor channels is rectangular, polygonal, circular or arc-shaped.

7. The heat dissipating device of claim **1** further comprising a second capillary structure formed in the compensation chamber and located on an inner wall of a second side of the chamber body, wherein the second side is opposite to the first side.

8. The heat dissipating device of claim **7** further comprising:

a third capillary structure formed in the compensation chamber and located on an inner wall of the first side; and

a plurality of support pillars formed in the compensation chamber and connecting the second capillary structure and the third capillary structure.

9. The heat dissipating device of claim **8** further comprising a plurality of fourth capillary structures, each of the fourth capillary structures being formed around one of the support pillars and connecting the second capillary structure and the third capillary structure.

10. The heat dissipating device of claim **1**, wherein a pipe diameter of the first end is larger than a pipe diameter of the second end.

11. The heat dissipating device of claim **1**, wherein the heat sink comprises a plurality of heat dissipating fins.

* * * * *