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(54) HEAT SINK FOR ELECTRONIC PARTS AND MANUFACTURE THEREOF

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(57) **ABSTRACT**

Heat dissipation fins **12** provided on a metal flat plate **10** with a predetermined distance and a metal base plate provided with a plurality of bottom-expanded recesses **15** on the flat surface **14** with a predetermined distance are prepared and pressing portions corresponding to the bottom-expanded recesses on the flat plate between fins to press down protrusions provided on the back side of the flat plate into the bottom-expanded recesses to fix the heat dissipation fins and the base plate securely. Number of components of the heat sink is reduced and construction has become simple. The manufacturing cost is reduced.

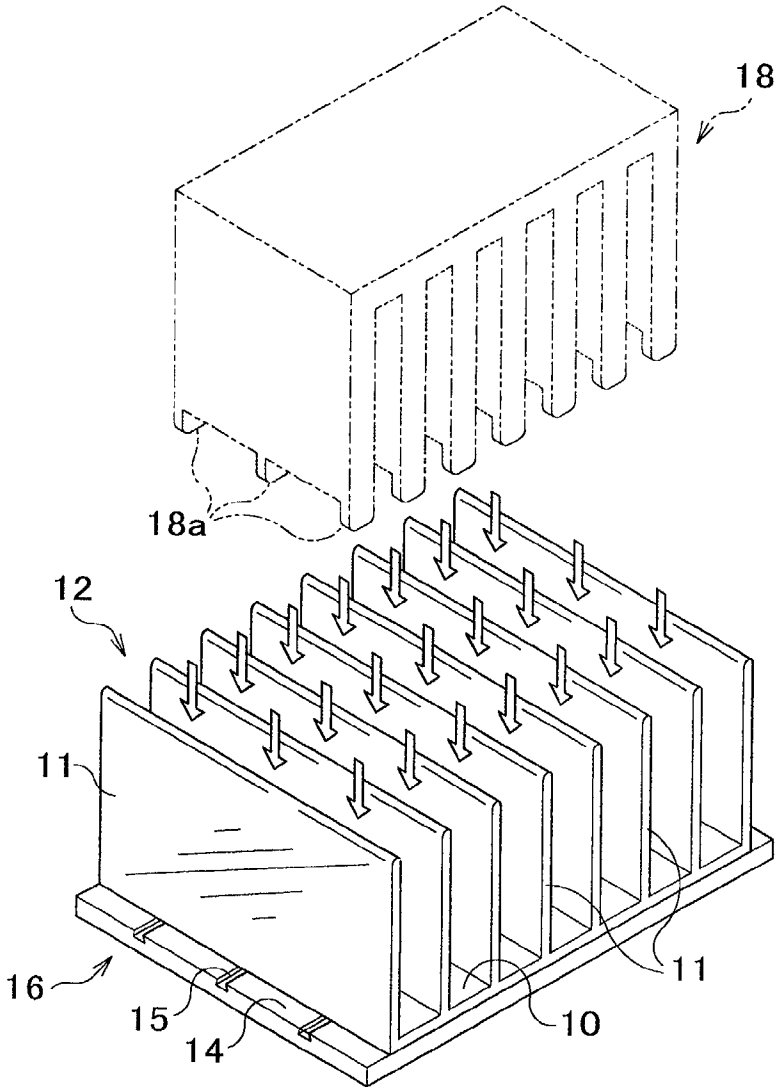


FIG. 1
PRIOR ART

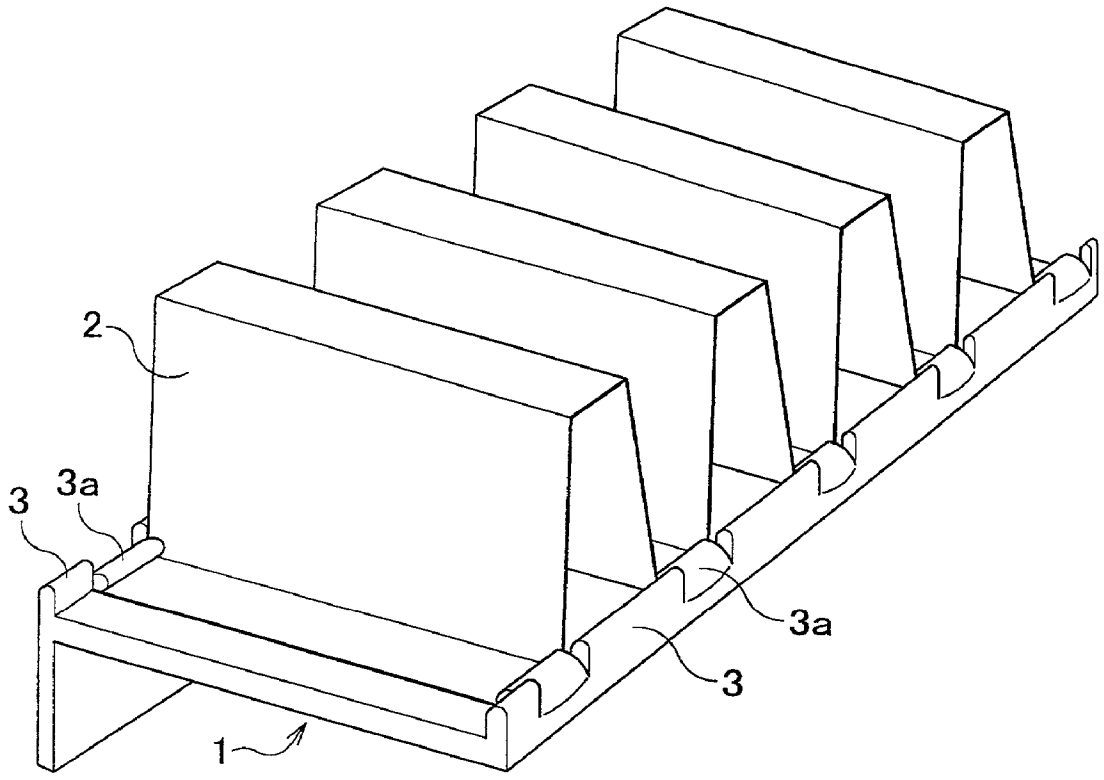


FIG.2C

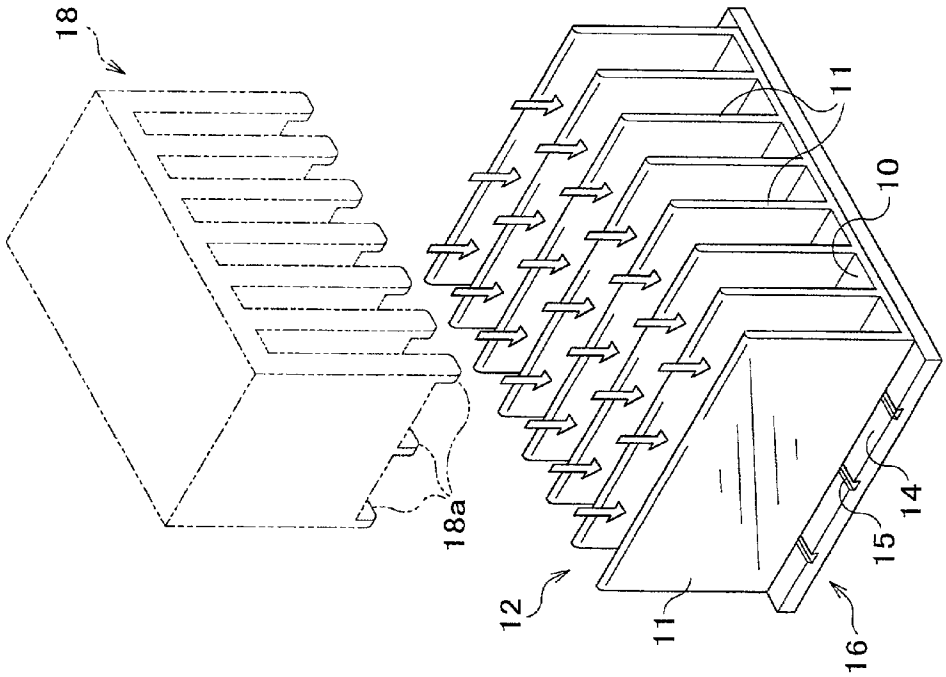


FIG.2A

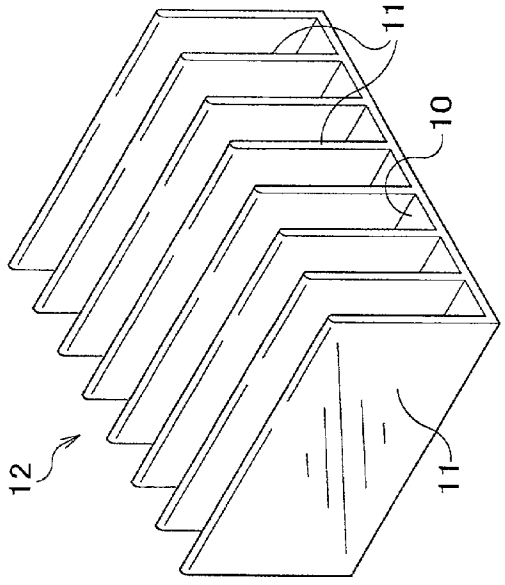
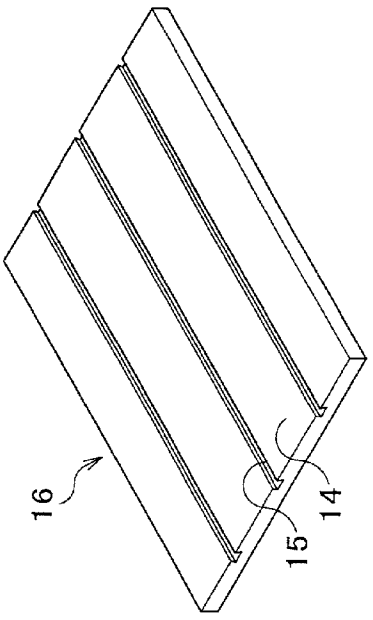


FIG.2B



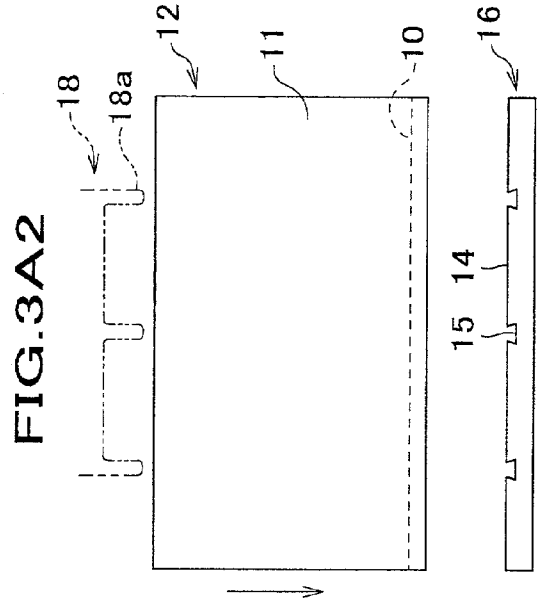


FIG.3A2

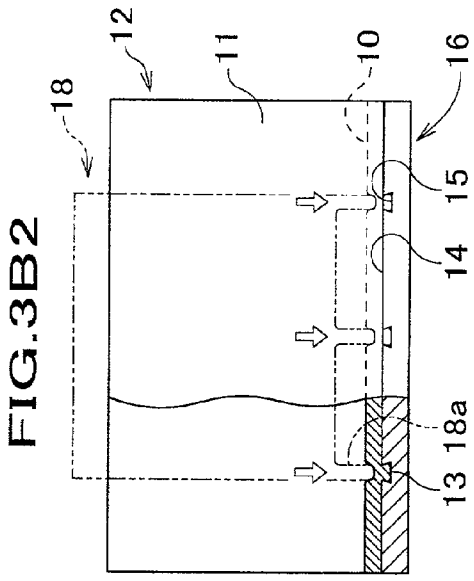


FIG.3B2

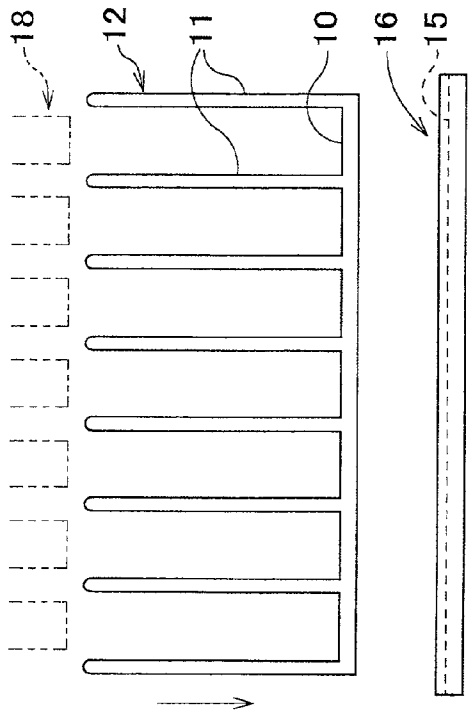


FIG.3A1

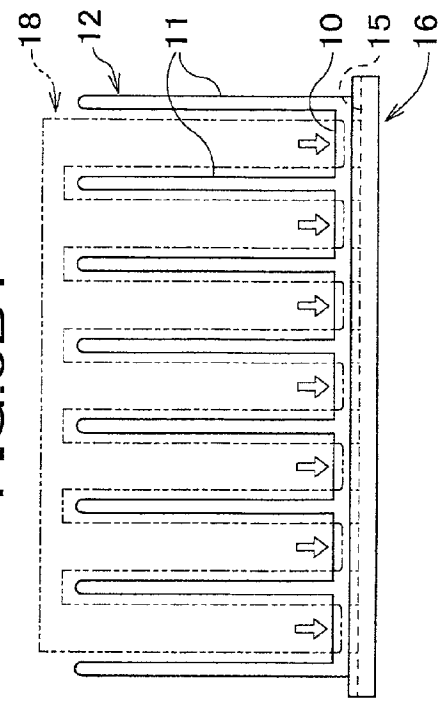


FIG.3B1

FIG.4C

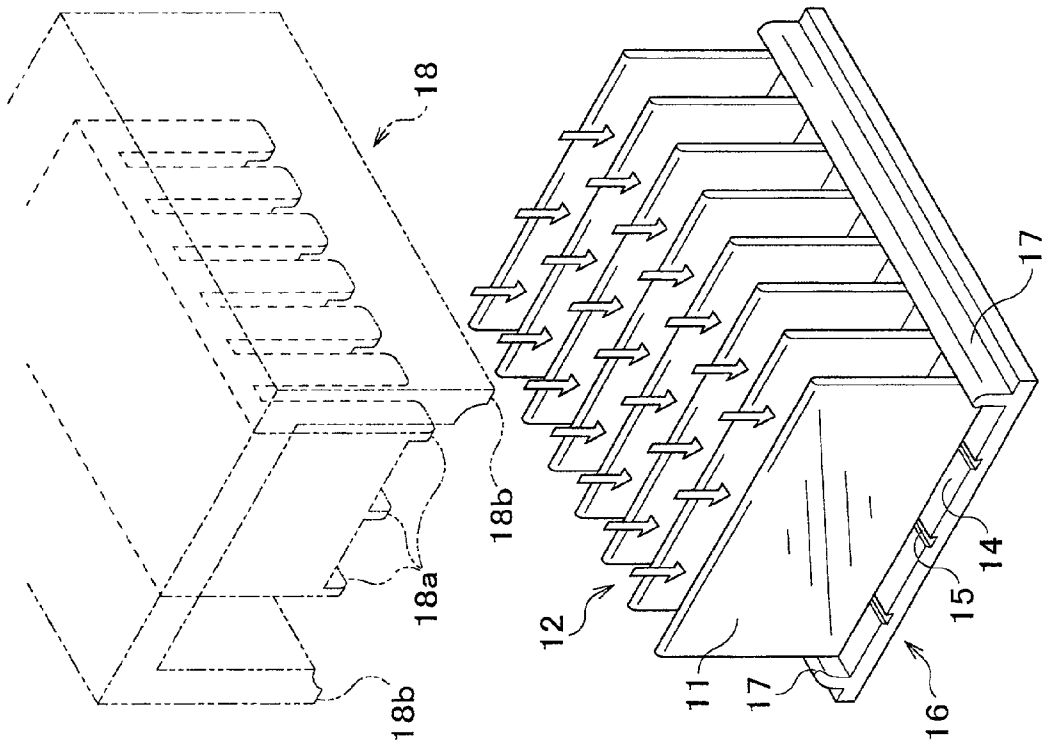


FIG.4A

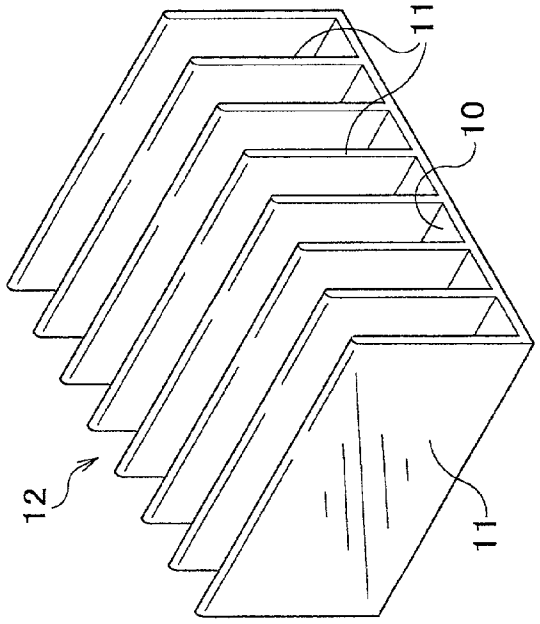


FIG.4B

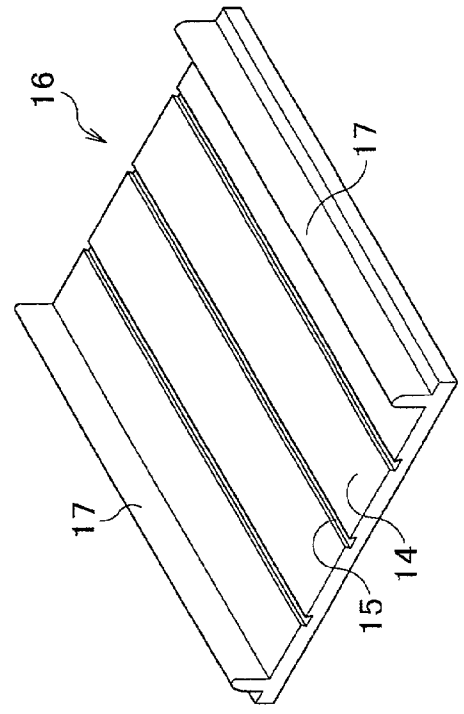


FIG.5A2

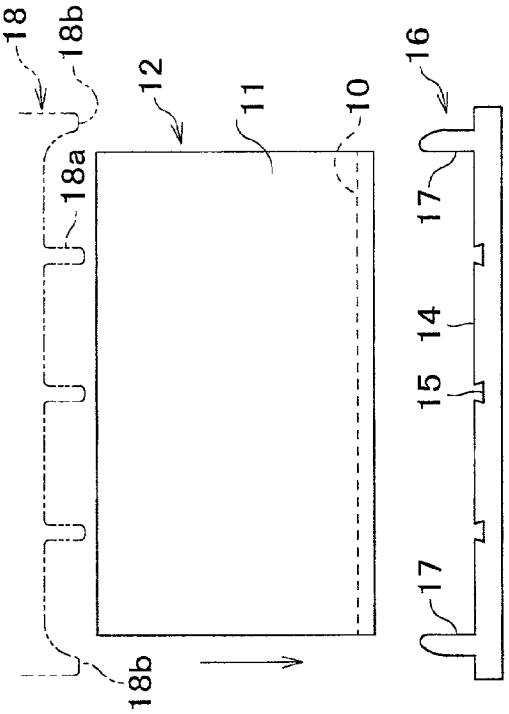


FIG.5B2

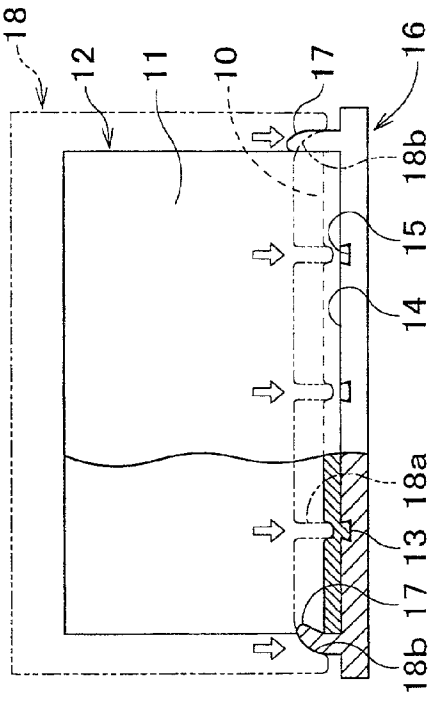


FIG.5A1

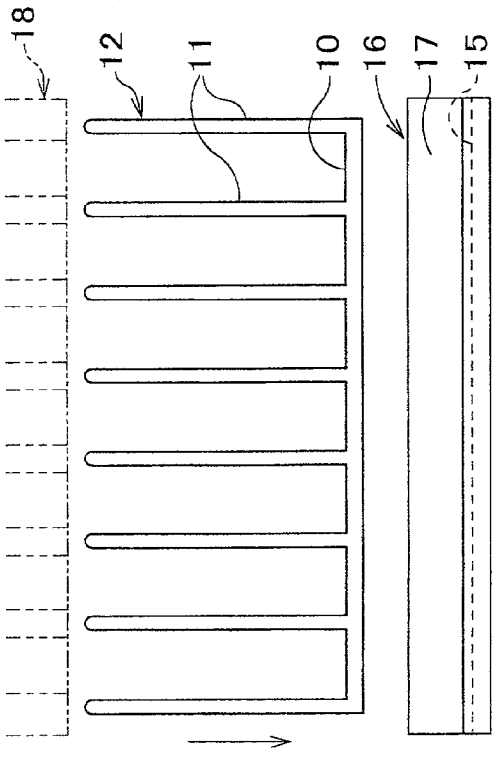
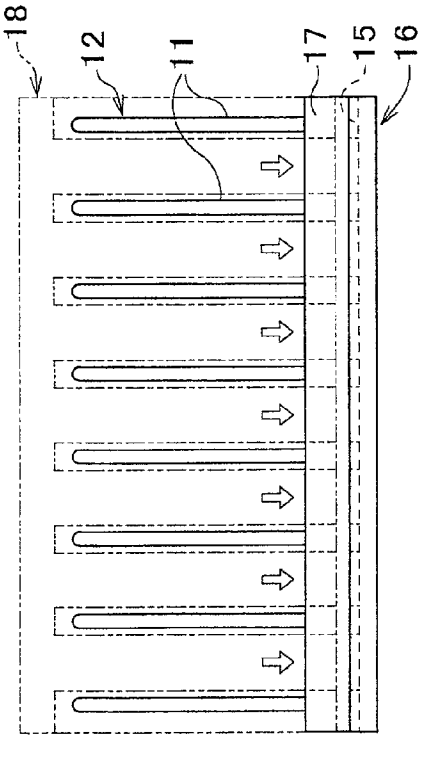


FIG.5B1



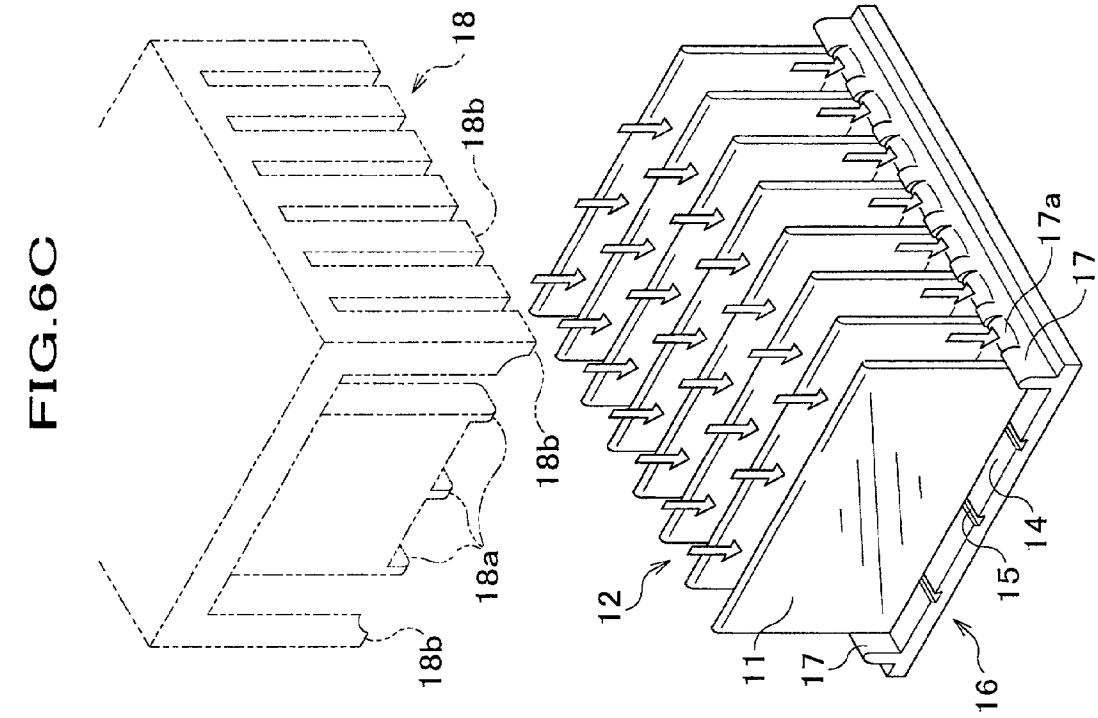


FIG.6C

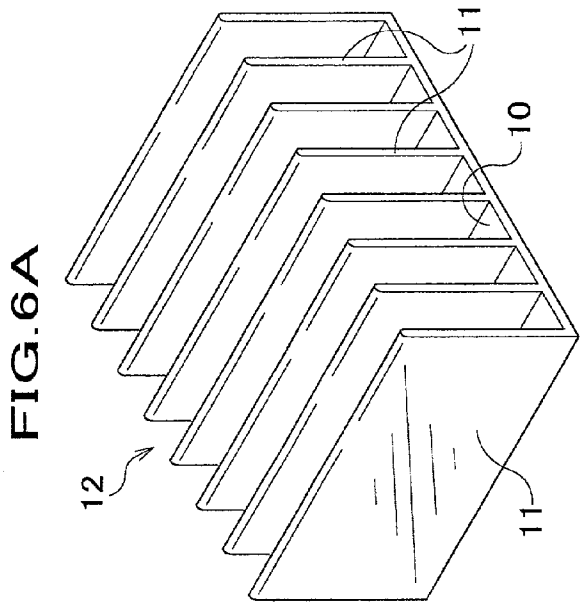


FIG.6A

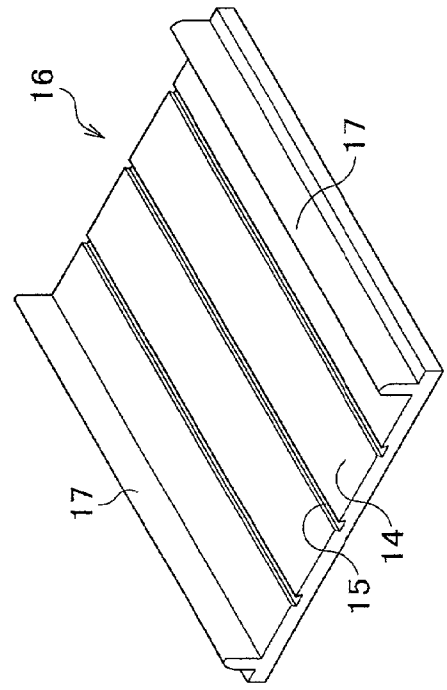
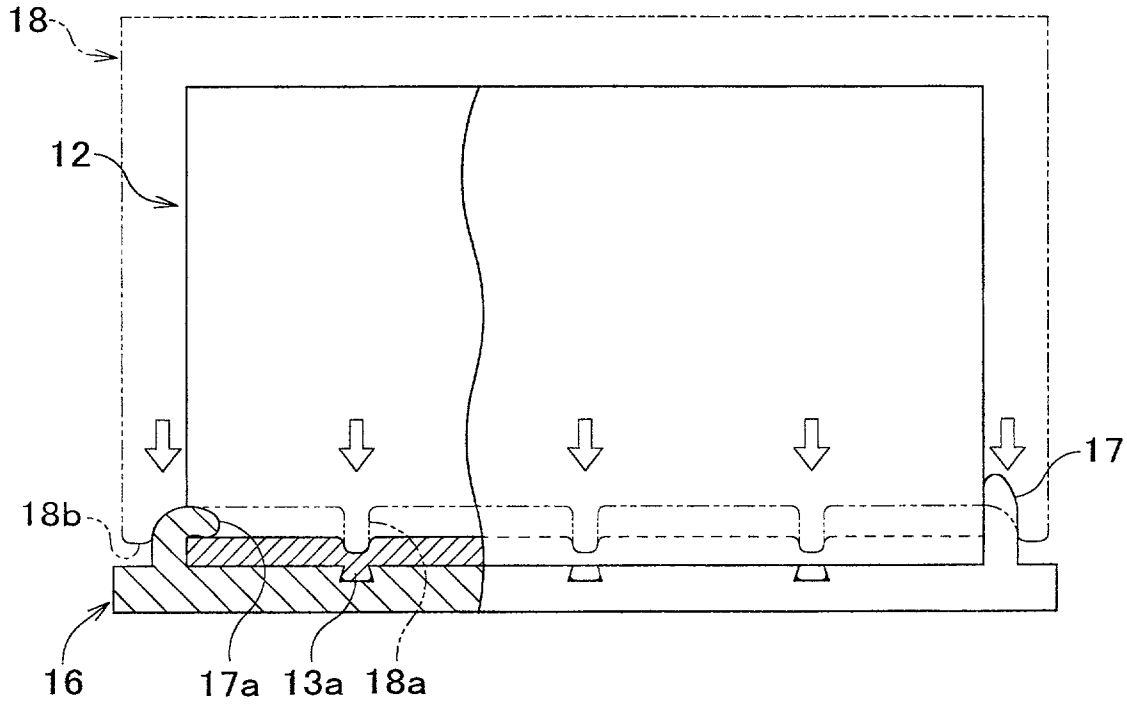


FIG.6B

FIG.7



HEAT SINK FOR ELECTRONIC PARTS AND MANUFACTURE THEREOF

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a heat sink for electronic parts and more particularly relates to a heat sink for electronic parts made of Transistor, IC, LSI, Diode or Thyristor to cause heat during practical operation, the heat being conducted and dissipated from the heat sink fins.

[0003] 2. Prior Art

[0004] Conventional heat sink made of aluminum has been disclosed in the Japanese Patent Publication No. 3-40506. Reference is made with **FIG. 1** to explain such conventional heat sink. A substrate **1** made of aluminum and heat dissipation fins **2** formed by bending aluminum band sheets into the rectangular corrugated plate are soldered to prepare a heat sink. In the process of manufacturing heat sink, two vertically protruded edge frames **3**, **3** provided in parallel with each other at each edge of the substrate **1** respectively are formed on the substrate **1** with a predetermined distance. The heat dissipation fins are placed between said oppositely faced protruded edge frames **3**, **3**. As shown in **FIG. 1**, the heat dissipation fins extend to a full width between the protruded edge frames **3**, **3** provided on the substrate **1** in parallel with each other, and a portion of the protruded edge frame **3** where the heat dissipation fins **2** and said protruded edge frame **3** come into contact with each other is pressed by means of a mold to stretch out said portion toward inside the substrate **1**. Reference numeral **3***a* indicates the portion stretched out inside the substrate **1** in **FIG. 1**. The portions **3***a*, **3***a* secure the heat dissipation fins **2** to the substrate **1**. Next, the substrate **1** and the heat dissipation fins **2** are soldered together.

[0005] It has been pointed out in the conventional method that the heat dissipation fins **2** and the substrate **1** are to be soldered because if the heat dissipation fins **2** are secured to the substrate **1** only by means of the aforementioned portions **3***a*, **3***a*, the heat dissipation fins **2** will not perfectly contact the substrate **1** and the heat generated in the substrate **1** is not perfectly conducted to the heat dissipation fins **2**.

[0006] It is, therefore, required in the conventional manufacturing method of heat sink to solder the heat dissipation fins **2** to the substrate **1**. However, in order to proceed the soldering process some soldering installments are inevitably required. This is a problem in conventional method.

[0007] Further, as bending the aluminum band sheet into a rectangular corrugated sheet makes the heat dissipation fins, plate thickness of the heat dissipation fins is limited to be thinner taking into consideration of easy handling. Accordingly, if the heat dissipation fins made of thinner plate should collide other materials such as electronic parts or housings or the like, the fins are easily distorted.

[0008] The present invention has been made with the foregoing background in mind. The object of the present invention is to offer an easy processing method and yet most durable heat sinks for electronic parts and manufacture thereof.

SUMMARY OF THE INVENTION

[0009] In order to achieve the aforementioned object the present invention offers a heat sink disclosed in claim **1** and illustrated in **FIG. 2A and 2B**. The heat sink according to the present invention comprises a plurality of heat dissipation fins **12** and a base plate **16**. The heat sink includes heat dissipation fins **12** provided with a plurality of fins **11** placed on the upper surface of a metal plate **10** with a predetermined distance, and the metal base plate **16** provided with a plurality of bottom-expanded recesses **15** on the upper surface of a flat plate **14** with a predetermined distance. Portions corresponding to the bottom-expanded recesses **15** of the flat plate **14** between the fins **11** are pressed by means of a mold **18** so that protrusions **13** (refer to **FIG. 3**B2) provided on the back side of the metal plate **10** are pressed into the bottom-expanded recesses **15** to fix the heat dissipation fins **12** and the base plate **16** together.

[0010] The invention disclosed in claim **2** comprises, as briefly illustrated the overall construction in **FIG. 4A, 4B,** 4C, heat dissipation fins **12** provided with a plurality of fins **11** placed on the upper surface of the flat plate **10** with a predetermined distance and a metal base plate **16** provided with a plurality of bottom-expanded recesses **15** on the upper surface of a flat plate **14** with a predetermined distance and protrusions **17**, **17** to hold the side edges of said heat dissipation fins **12** to secure said heat dissipation fins **12** on the upper surface of a flat plate **14**. Portions of the flat plate **10** corresponding to the bottom-expanded recesses **15** between said two fins **11** are pressed by the mold **18** to press down protrusions **13** (refer to **FIG. 3**B2) provided on the back side of said flat plate **10** into said bottom-expanded recesses **15** and the protrusions **17**, **17** formed on the base plate **16** are pressed and distorted toward the side of the heat dissipation fins **12** to fix said heat dissipation fins **12** to the base plate **16**.

[0011] The invention disclosed in claim **3** comprises heat dissipation fins **12** provided with a plurality of fins **11** placed on the upper surface of the metal plate **10** with a predetermined distance and a metal base plate **16** provided with a plurality of bottom-expanded recesses **15** on the upper surface **14** with a predetermined distance, and the portions of the flat plate **10** corresponding to the bottom-expanded recesses **15** between said two fins **11** are pressed by the mold **18** to press down protrusions **13** (refer to **FIG. 3**B2) provided on the back side of said flat plate **10** into said bottom-expanded recesses **15** to fix the dissipation fins **12** and the base plate **16** together. This is the manufacturing process of the heat sink disclosed in claim **1**.

[0012] The invention disclosed in claim **4** comprises the heat dissipation fins **12** provided with a plurality of fins **11** placed on the upper surface of the metal plate **10** with a predetermined distance and a metal base plate **16** provided with a plurality of bottom-expanded recesses **15** provided on the upper surface **14** with a predetermined distance and protrusions **17**, **17** to hold the side edges of the heat dissipation fins **12** to secure said heat dissipation fins **12** on the upper surface of a flat plate **14**. Portions of the flat plate **10** corresponding to the bottom- expanded recesses **15** between said two fins **11** are pressed by the mold **18** to press down protrusions **13** provided on the back side of said flat plate **10** into said bottom-expanded recesses **15** and the protrusions **17**, **17** formed on the base plate **16** are pressed and distorted toward the side of the heat dissipated fins **12** to fix said heat dissipated fins **12** to the base plate **16**. This is the manufacturing process of the heat sink disclosed in claim **2**.

BRIEF EXPLANATION OF THE DRAWINGS

[0013] **FIG. 1** is a perspective view of the conventional aluminum heat sink.

[0014] **FIG. 2** indicates a heat sink for electronic parts disclosed in claim **1** according to the present invention.

[0015] **FIG. 3** illustrates a manufacturing process for the heat sink for the electronic parts disclosed in claim **3** according to the present invention.

[0016] **FIG. 4** indicates a heat sink for the electronic parts disclosed in claim **2** according to the present invention.

[0017] **FIG. 5** illustrates a manufacturing process for the heat sink for the electronic parts disclosed in claim **4** according to the present invention.

[0018] **FIG. 6** indicates another example of the preferred embodiments for the heat sink for the electronic parts disclosed in claim **2** according to the present invention.

[0019] **FIG. 7** indicates a cross-section partly cut the heat sink for the electronic parts disclosed in claim **2** according to the present invention.

DETAILED EXPLANATION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

[0020] Now an example of the preferred embodiments of the heat sink disclosed in claim **1** according to the present invention is explained with reference to the accompanying drawing **FIG. 2A, 2B** and **2**C.

[0021] **FIG. 2A** indicates a perspective view of the heat sink according to the present invention. **FIG. 2B** indicates a perspective view of the base plate. **FIG. 2C** indicates a perspective view of the heat sink for the electronic parts comprising the heat dissipation fins are pressed by the mold to fix the heat dissipation fins to the base plate. The heat sink according to the present invention is prepared by extruding a metal of good heat conduction such as aluminum or the like. The heat sink comprises heat dissipation fins **12** provided with a plurality of fins **11** formed on the flat metal plate **10** with a predetermined distance and a base plate **16** provided with a plurality of bottom-expanded recesses **15** formed on the flat plate **14** with a predetermined distance. As shown in **FIG. 2**C, the portions corresponding to the bottom expanded recesses **15** on the flat surface **14** between the fins **11** are pressed down by means of the mold **18** to press down protrusions **13** (refer to **FIG. 3**B2) provided on the back side of said flat metal plate **10** into said bottom-expanded recesses **15** to fix said plurality of heat dissipation fins **12** and the base plate together. The bottom-expanded recesses **15** are made like dovetail grooves in the embodiments of the present invention. It is of course possible to form a recessed hole of dovetail groove. The recessed hole of dovetail groove configuration is not made by means of press extrusion but other extrusion method is applied. Reference numeral **18***a* indicates protrusions to press and distort the flat metal plate **10** provided on the mold

[0022] As aforementioned, the heat sink according to the present invention is made by pressing down the protrusions **18***a* provided in the mold **18** to press the corresponding portions to the bottom-expanded recesses **15** of the flat metal plate **10** between the fins **11** to press down said protrusions **13** into the bottom-expanded recesses **15** to fix the heat dissipation fins **12** to the base plate **16**. The soldering installation is not required. Thus, manufacturing cost is reduced.

[0023] The heat sink for electronic parts disclosed in claim **2** of the present invention is explained with reference to the drawings **FIG. 4A, 4B** and **4**C. **FIG. 4A** is a perspective view of the heat sink. **FIG. 4B** is a perspective view of the base plate. **FIG. 4C** is a perspective view of the heat sink for electronic parts prepared by pressing the heat sink to the base plate by means of the mold. The heat sink for electronic parts comprises a heat sink provided with a plurality of heat dissipation fins **12** formed on the surface of the flat metal plate **10** with a predetermined distance and the base plate **16** provided with the protrusions **17, 17** to hold the both ends of said heat dissipation fins **12** on the surface of the flat plate **14** with a predetermined distance to hold together with the plurality of bottom-expanded recesses **15**. The corresponding portion to the bottom-expanded recesses **15** on the flat plate **10** between the fins **11** is pressed down by means of the mold **18** to press the protrusions **13** provided on the back side of the flat metal plate **10** into said recesses **15** (refer to **FIG. 5**B2). The holding protrusions **17, 17** formed on the edge plate **16** are pressed and distorted toward the side of the heat dissipation fins **12** to fix said heat dissipation fins **12** and the base plate **16** tightly to prepare heat sink for electronic parts according to the present invention.

[0024] Reference numeral **18***b* indicates a press protrusion to press and distort the holding protrusions **17**. It is possible to construct the heat dissipation fins **12** and the base plate **16** simply and perfectly fixed together without soldering. Both edges of the heat dissipation fins **12** are held firmly by being held with the protrusions **17, 17**. The heat dissipation fins **12** and the base plate **16** are fixed tightly. A durable construction is obtained.

[0025] In this embodiment, two protrusions **17, 17** are formed to hold the both ends of the heat dissipation fins **12** facing with each other. It goes without saying that holding another both ends of the heat dissipation fins **12** by additional protrusions **17, 17** provided crossing at right angle to the edge side protrusions **17, 17** can offer more durable structure of heat dissipation fins (not shown in figure).

[0026] The manufacturing process of the heat dissipation fins disclosed in claim **3** according to the present invention is explained with reference to the accompany drawing **FIG. 3A1, 3A2, 3B1** and **3B2**. Firstly, the heat sink is prepared by extruding a metal of good heat transmission such as aluminum or the like. The heat sink comprises heat dissipation fins **12** provided with a plurality of fins **11** formed on the plate **10** with a predetermined distance and a base plate **16** provided with a plurality of bottom-expanded recesses **15** formed on the flat plate **14** with a predetermined distance. As shown in front view of **FIG. 3A1** and right side view of **FIG. 3A2**, a plurality of heat dissipation fins **12** are provided on the base plate **16**. Next, as shown in front view of **FIG. 3B1** and right side view of **FIG. 3B2**, the corresponding portion of the flat plate **10** to a plurality of bottom-expanded recesses **15** between the fins **11** are pressed down by means of the mold **18** to press insert the protrusions **13** provided on the back side of the flat plate **10** into the bottom-expanded recesses **16** to fix said heat dissipation fins **12** and said base plate **15** securely.

[0027] In accordance with this manufacturing process of the heat sink for electronic parts, said heat dissipation fins **12** and the base plate **16** are perfectly fixed without soldering. The manufacturing process is simple but securely fixed construction is obtained. The manufacturing cost is reduced. The manufacturing process of the heat sink for electronic parts disclosed in claim **4** is explained with reference to **FIG. 5**A1 and **5**A2. At first, the heat dissipation fins **12** provided with a plurality of fins **11** on the flat plate **10** with a predetermined distance and the base plate **16** provided with a plurality of the bottom expanded recesses **15** formed on the plate surface **14** with a predetermined distance and further provided with the holding protrusions **17**, **17** to hold the edges of said heat dissipation fins **12** are prepared by extruding a metal of good heat conduction such as aluminum. Next, as shown in front view of **FIG. 5**A1 and right side view of **FIG. 5**A2, the corresponding portions on the flat plate **10** between the fins **11** to the bottom-expanded recesses **15** are pressed down by means of the mold **18** to press insert said protrusions provided on the back side of said flat plate **10** into the bottom-expanded recesses **15** and at the same time the holding protrusions **17**, **17** provided on the base plate **16** to press and distort said protrusions **17**, **17** toward the side of the heat dissipation fins **12**.

[0028] The heat dissipation fins **12** and the base plate **16** are fixed as aforementioned. The heat sink for electronic parts according to the present invention is prepared without soldering. The heat dissipation fins **12** and the base plate **16** are fixed together. A durable construction is obtained. If holding protrusions **17**, **17** are pressed to distort toward the side of the heat dissipation fins **12**, the fins **11** are strongly supported and the heat dissipation fins **12** are tightly held to the base plate **16**.

[0029] **FIG. 6A, 6B** and **6**C indicate another example of the preferred embodiments of the present invention. **FIG. 6A** is a perspective view of the heat dissipation fins **12**. **FIG. 6B** is a perspective view of the base plate **16**. **FIG. 6C** is a perspective view of the heat sink for electronic parts prepared by pressing the heat dissipation fins **12** toward the base plate **16**. **FIG. 7** is a partly vertical cross-section of the heat sink shown in **FIG. 6**. In this embodiment, the heat sink is pressed at the portions corresponding to said bottom expanded recesses **15** of the flat plate **10** between fins **11**, **11** by means of the mold **18** to press down the protrusions provided on the back side of the flat plate **10** into the bottom expanded recesses **15** and the holding protrusions **17**, **17** provided on the base plate **16** are slightly bent toward the side of the heat dissipation fins **12**. The portion **17***a* is pressed down to cover the edges of the flat plate **10** of the heat dissipation fins **12**. As shown in **FIG. 6**C, the press mold **18** is devised to press down the portion **17***a* between the fins **11** of the holding protrusion **17** to cover the flat plate **10** of the heat dissipation fins **12** (e.g. dividing the press protrusion **18***b* of the mold **18**).

Effect of the Invention

[0030] As aforementioned, claim **1** (heat sink) and claim **3** (manufacturing method of the heat sink) present a heat sink by pressing the portion corresponding to the bottom-expanded recesses of the flat plate between the fins by means of the mold to press the protrusions provided on the back side of the flat plate toward the base plate to press down the protrusions into the bottom-expanded recesses. The perfectly fixed construction of the heat dissipation fins and the base plate is obtained. The manufacturing process is done without soldering installation. The manufacturing cost is greatly reduced.

[0031] As aforementioned, claim **2** (heat sink) and claim **4** (manufacturing method of the heat sink) present a heat sink by fixing the heat dissipation fins and the base plate without soldering. The heat dissipation fins are fixed at its ends to the base plate with the holding protrusions. Construction of the heat dissipation fins with the base plate is firm.

What is claimed is:

1. A heat sink for electronic parts comprising:

a plurality of heat dissipation fins provided on a metal flat plate with a predetermined distance,

a metal base plate provided with a plurality of bottom expanded recesses on the flat surface with a predetermined distance,

pressing a portion corresponding to the bottom-expanded recesses provided on the flat surface between the fins to press down protrusions provided on the back side of the metal flat plate to press into the bottom-expanded recesses to fix the heat dissipation fins and the base plate securely.

2. A heat sink for electronic parts comprising:

a plurality of heat dissipation fins provided on a metal flat plate with a predetermined distance,

a metal base plate provided with a plurality of bottom-expanded recesses on the flat surface with a predetermined distance, and the base plate provided with a holding protrusions to hold both ends of the heat dissipation fins.

pressing the portion corresponding to the bottom-expanded recesses of the metal flat plate between fins and to press the protrusions provided on the back side of said flat plate to press into said bottom-expanded recesses and to press the holding protrusions provided on the edges of the base plate toward the side of the heat dissipation fins to fix said heat dissipation fins and the base plate securely.

3. A manufacturing process of a heat sink for electronic parts comprising:

a plurality of heat dissipation fins provided on a metal flat plate with a predetermined distance and a metal base plate provided with a plurality of bottom-expanded recesses on the flat surface with a predetermined distance are prepared, and

pressing a portion corresponding to the bottom-expanded recesses of the flat plate between the fins to press down protrusions provided on the back side of the flat surface plate to press into the bottom-expanded recesses to fix the heat dissipation fins and the base plate securely.

4. A manufacturing process of a heat sink for electronic parts comprising:

a plurality of heat dissipation fins provided on a metal flat plate with a predetermined distance,

a metal base plate provided with a plurality of bottom-expanded recesses provided on the metal flat surface

with a predetermined distance, and the base plate provided with a holding protrusions to hold at both ends of the plate,

pressing the portions corresponding to the bottom-expanded recesses of the flat plate between fins and to press down the protrusions provided on the back side of said flat plate into said bottom-expanded recesses and to press the holding protrusions provided on the base plate toward the side of the fins to fix the heat dissipation fins and the base plate securely.

* * * * *