



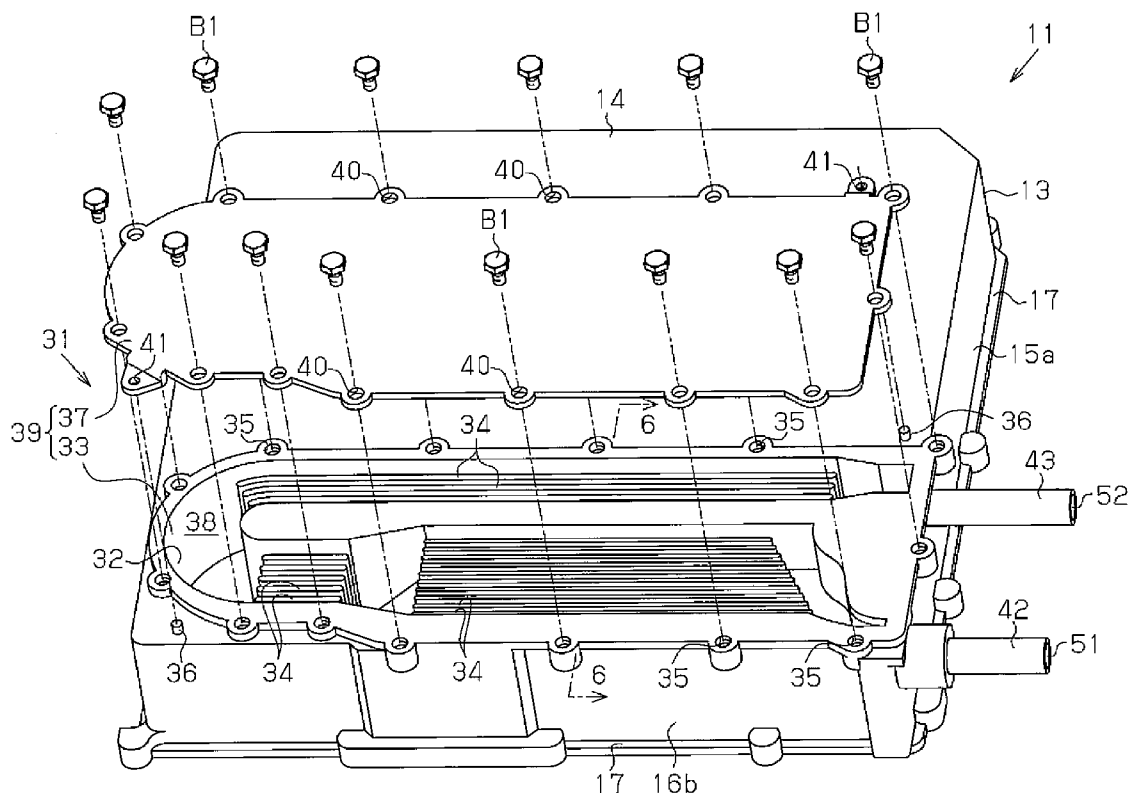
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KOJIMA et al.(10) **Pub. No.: US 2014/0096938 A1**(43) **Pub. Date: Apr. 10, 2014**(54) **HEAT DISSIPATION DEVICE**(30) **Foreign Application Priority Data**(71) Applicants: **TOKAISEIKI CO., LTD.**, Iwata-shi
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USPC **165/104.19**(57) **ABSTRACT**(73) Assignees: **TOKAISEIKI CO., LTD.**, Iwata-shi
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The heat dissipation device is provided with a body portion, to which a heating element is thermally coupled. A coolant passage through which the coolant, which dissipates heat of the heating element, flows is provided in the body portion. A passage forming portion, which forms at least one of an inflow passage and an outflow passage, is molded integrally with the body portion.

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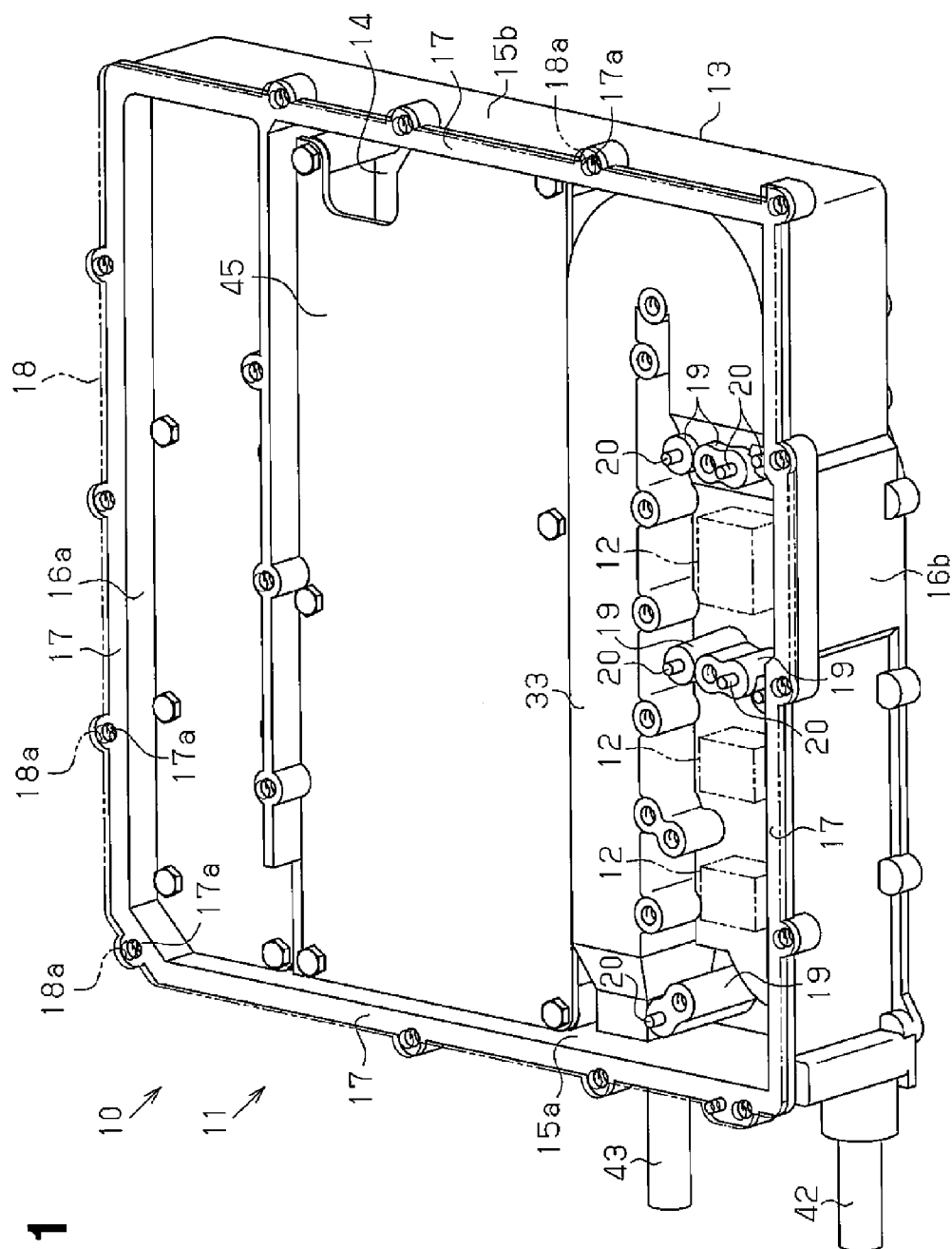


Fig. 1

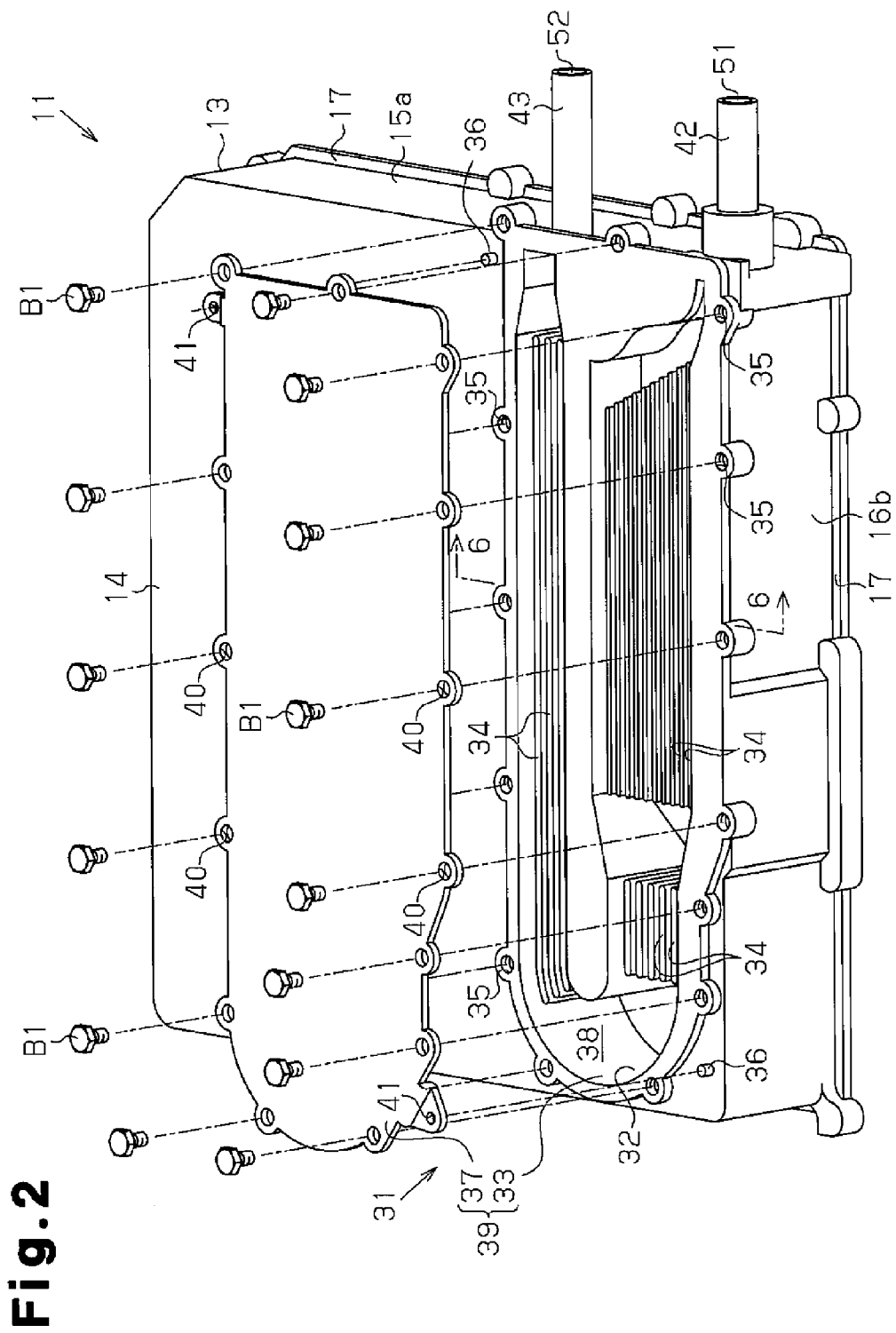


Fig.3A

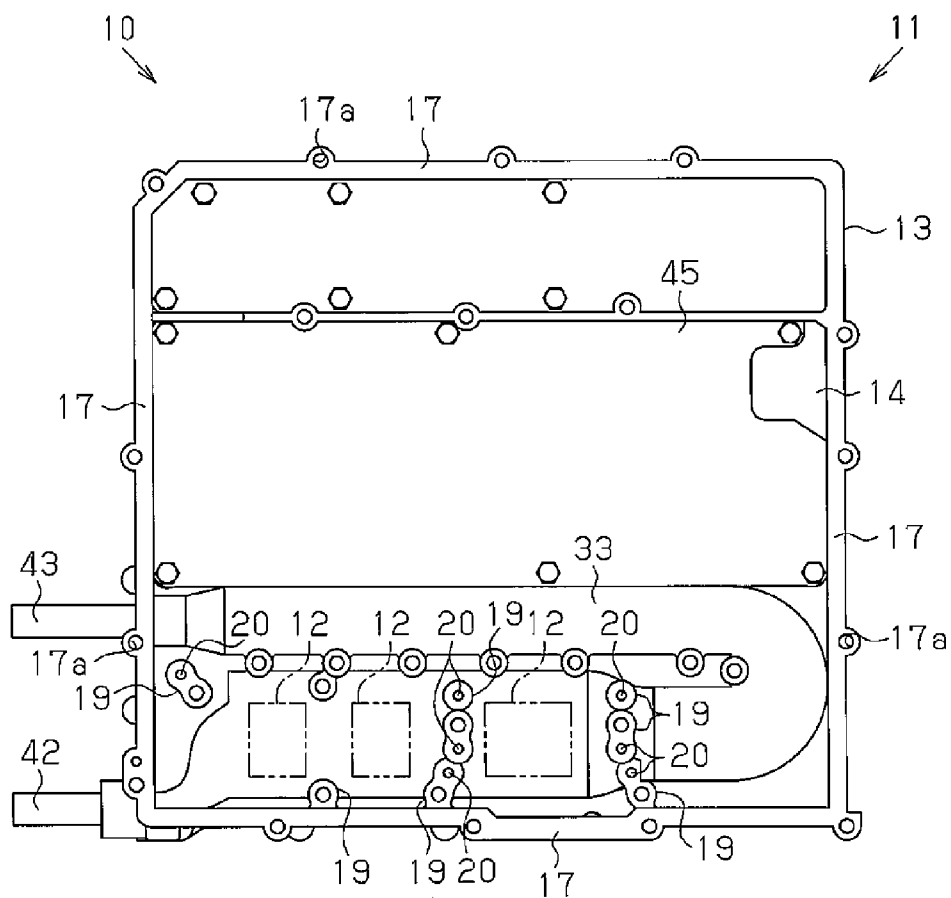


Fig.3B

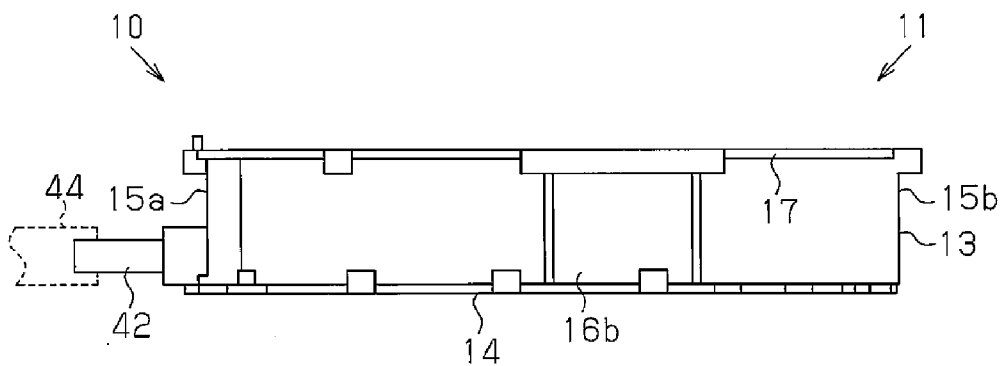


Fig. 4

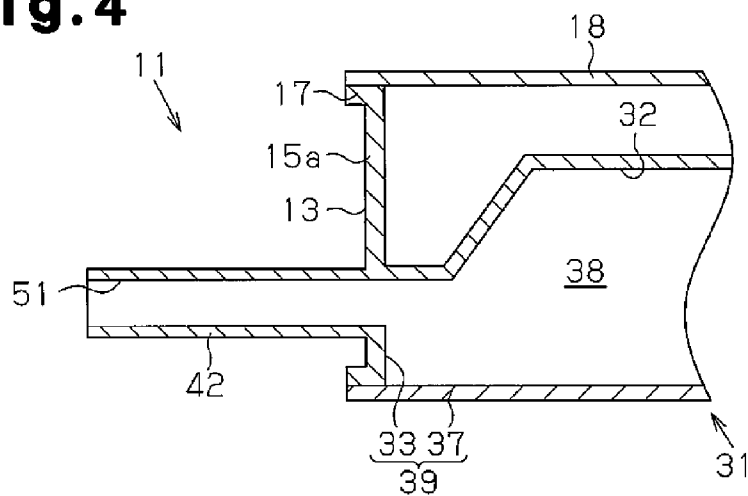


Fig. 5A

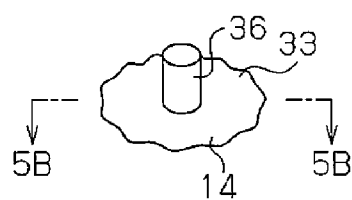


Fig. 5B

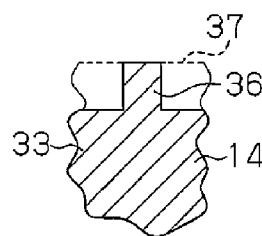
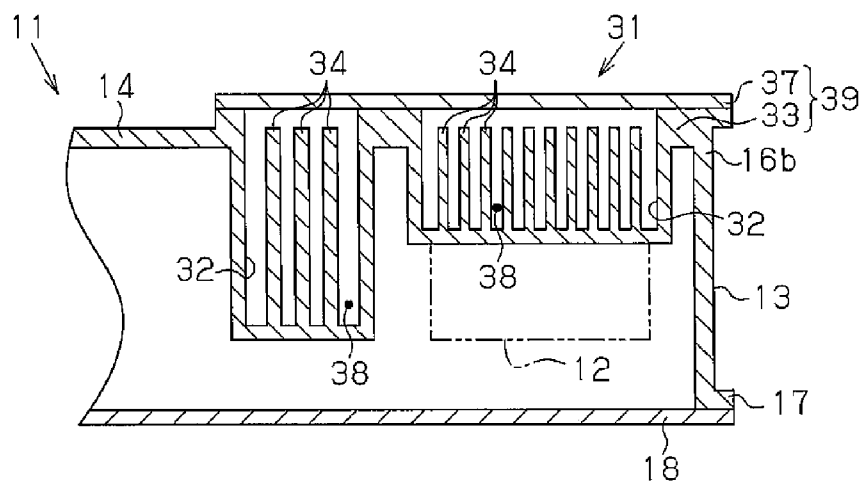


Fig. 6



HEAT DISSIPATION DEVICE

BACKGROUND OF THE INVENTION

[0001] The art of the present disclosure relates to a heat dissipation device with a coolant passage through which coolant, which dissipates heat of a heating element, flows.

[0002] A heat exchanger disclosed in Japanese Laid-Open Patent Publication No. 2008-211147 is an example of the heat exchanger, which cools electronic parts such as a semiconductor device that generates heat when driven.

[0003] The heat exchanger disclosed in Japanese Laid-Open Patent Publication No. 2008-211147 has a pair of plates. A recessed portion is formed in the entire portion of each plate except for peripheral edge portions thereof. A groove portion with a semicircular cross section, which communicates the recessed portion with the edge of each plate, is formed in a part of the peripheral portion of each of the pair of plates. The pair of plates is stacked such that the groove portions face each other, and an inlet-outlet pipe, through which the coolant flows, fits into the groove portions therebetween. The groove portions and the inlet-outlet pipe are brazed to each other.

SUMMARY OF THE INVENTION

[0004] Reduction of the number of components of the heat exchanger is desired.

[0005] An object of the present disclosure is to provide a heat dissipation device that reduces the number of components.

[0006] To achieve the foregoing object, a heat dissipation device including a body portion thermally coupled with a heating element, an inflow passage, an outflow passage, and a flow passage forming portion formed integrally with the body portion is provided. The body portion includes therein a coolant passage through which coolant, which dissipates heat of the heating element, flows. The inflow passage admits the coolant into the coolant passage. The outflow passage allows the coolant to flow out of the coolant passage. The flow passage forming portion forms at least one of the inflow passage and the outflow passage.

[0007] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

[0009] FIG. 1 is a perspective view illustrating an inverter device according to an embodiment;

[0010] FIG. 2 is an exploded perspective view illustrating a heat dissipation device according to an embodiment provided in the inverter device of FIG. 1;

[0011] FIG. 3A is a plan view illustrating the inverter device of FIG. 1;

[0012] FIG. 3B is a lateral view illustrating the inverter device of FIG. 1;

[0013] FIG. 4 is a cross-sectional view illustrating the inverter case of FIG. 1;

[0014] FIG. 5A is an enlarged view illustrating a position determining pin in the heat dissipation device of FIG. 2;

[0015] FIG. 5B is a cross-sectional view taken along line 5B-5B of FIG. 5A, illustrating the position determining pin; and

[0016] FIG. 6 is a cross-sectional view taken along line 6-6 of FIG. 2, illustrating the inverter case of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] A heat dissipation device provided in an inverter device according to an embodiment of the present disclosure will be described with reference to FIGS. 1 to 6.

[0018] As shown in FIG. 1, an inverter device 10 is configured such that electronic parts 12 such as a semiconductor device (a switching element and a diode) as a component of an inverter are accommodated in an inverter case 11.

[0019] As shown in FIGS. 1 and 2, a case body 13 of the inverter case 11 is provided with a rectangular bottom plate 14, lateral walls 15a and 15b, and lateral walls 16a and 16b. The lateral walls 15a and 15b are set up on a pair of shorter sides facing each other on the bottom plate 14. The lateral walls 16a and 16b are set up on a pair of longer sides facing each other on the bottom plate 14. A flange 17 is formed on the distal ends of the lateral walls 15a, 15b, 16a, and 16b. The inverter case 11 is formed by attaching a top plate 18 to the flange 17. A plurality of threaded portions 17a, into which bolts that are not illustrated are threaded for fixing the top plate 18 to a case body 13, are formed in the flange 17. A plurality of through-holes 18a, into which the bolts are inserted, is formed in a peripheral portion of the top plate 18. Pillar-like support portions 19, which extend vertically from the bottom plate 14, are formed at a plurality of positions of the bottom plate 14. A columnar pin 20, which extends vertically from a distal end surface of each support portion 19, is formed on the distal end surface of each support portion 19. Each pin 20 is inserted into a corresponding recessed portion formed in the internal surface of the top plate 18, which is not illustrated. The pins 20 are inserted into the corresponding recessed portions of the top plate 18 so that the position of the top plate 18 is determined, and the bolts inserted into the through-holes 18a are threaded into the threaded portions 17a so that the top plate 18 is fixed to the case body 13.

[0020] As shown in FIG. 2, a heat dissipation device 31 for cooling the electronic parts 12 accommodated in the inverter case 11 is formed on the bottom plate 14. In the present embodiment, the heat dissipation device 31 is formed integrally with the case body 13. Hereinafter, explanation will be made in detail.

[0021] A case 33, which is U-shaped in the plan view, is set up on the bottom plate 14. A U-shaped recessed portion 32 is formed in the inside of the case 33. The case 33 of the heat dissipation device 31 is formed on a part of the case body 13 (bottom plate 14), and the case body 13 serves as the case 33 of the heat dissipation device 31.

[0022] The recessed portion 32 is formed such that it extends from one of the pair of lateral walls 15a and 15b facing each other, namely the lateral wall 15a to the other one of the pair of lateral walls 15a and 15b, namely the lateral wall 15b, and turns toward the lateral wall 15a before reaching the lateral wall 15b. A plurality of plate fins 34, which extend vertically from the bottom plate 14, are formed in the recessed portion 32. The fins 34 extend in a direction in which the lateral walls 15a and 15b face each other.

[0023] As shown in FIG. 6, the fins 34 are molded integrally with the case 33 of the heat dissipation device 31.

[0024] As shown in FIG. 2, threaded portions 35, into which bolts B1 are threaded, are formed at a plurality of positions of a peripheral portion of the recessed portion 32 in the bottom plate 14. Further, pins 36, which extend vertically from an outer surface of the bottom plate 14, are formed at two positions of the peripheral portion of the recessed portion 32 in the bottom plate 14.

[0025] A plate lid member 37, which covers the recessed portion 32, is attached to the bottom plate 14. A coolant passage 38, through which coolant flows, is formed by the case 33 and the lid member 37. A body portion 39 of the heat dissipation device 31 in the present embodiment is provided with the case 33 and the lid member 37.

[0026] Through-holes 40, into which the bolts B1 for fixing the lid member 37 to the bottom plate 14 are inserted, are formed at a plurality of positions of a peripheral portion of the lid member 37. Further, through-holes 41, into which the pins 36 are inserted, are formed at two positions of the peripheral portion of the lid member 37. The lid member 37 is attached to the bottom plate 14 by inserting the pins 36 into the through-holes 41 formed in the lid member 37 and threading the bolts B1 into the threaded portions 35. Accordingly, the pins 36 serve as position determining pins for determining the position of the lid member 37 for the bottom plate 14, namely the case 33.

[0027] As shown in FIGS. 5A and 5B, the pins 36, which determine the position of the lid member 37 when the lid member 37 is attached to the case 33 of the heat dissipation device 31, are molded integrally with the case 33 of the heat dissipation device 31. Similarly, the position determining pins 20, which determine the position of the top plate 18 when the top plate 18 is attached to the case body 13, are molded integrally with the case body 13.

[0028] As shown in FIG. 2, a cylindrical inflow passage forming portion 42 as a flow passage forming portion is molded integrally with the lateral wall 15a. An inflow passage 51 is formed in the inflow passage forming portion 42. The inflow passage 51 is in communication with an inlet of the coolant passage 38. Similarly, an outflow passage forming portion 43 as a flow passage forming portion is molded integrally with the lateral wall 15a. An outflow passage 52 is formed in the outflow passage forming portion 43. The outflow passage 52 is in communication with an outlet of the coolant passage 38.

[0029] As shown in FIGS. 3A and 3B, a coolant supply source is connected through a tubular member 44 such as a hose to the inflow passage forming portion 42 and the outflow passage forming portion 43. The coolant supplied from the coolant supply source flows through the inflow passage 51 to the coolant passage 38, and discharged through the outflow passage 52 from the coolant passage 38.

[0030] As shown in FIG. 4, the inflow passage forming portion 42 is molded integrally with the case 33 of the heat dissipation device 31. Similarly, the outflow passage forming portion 43 is molded integrally with the case 33 (case body 13) of the heat dissipation device 31.

[0031] As described above, the case 33 of the heat dissipation device 31, the inflow passage forming portion 42, the outflow passage forming portion 43, the pins 20 and 36, and the fins 34 are integrally molded in the case body 13.

[0032] The case body 13 is an integrally molded cast. That is, the case body 13 is manufactured by flowing melted metal materials (such as aluminum) into a mold formed in accordance with the shape of the case body 13, and solidifying the

metal materials. The case body 13, in which the case 33, the inflow passage forming portion 42, the outflow passage forming portion 43, the pins 20 and 36, and the fins 34 of the heat dissipation device 31 are integrally formed, is obtained by drawing out the case body 13 from the mold. The phrase “integrally molded” refers to a fact that the body portion 39, the inflow passage forming portion 42, and the outflow passage forming portion 43 of the heat dissipation device 31 are the same member. The phrase does not include a plurality of members integrally joined by a brazing material, for example.

[0033] As shown in FIG. 3A, the top of the coolant passage 38 corresponds to a mounting region for the electronic parts 12 as heat generators in the case 33. The electronic parts 12 are mounted on the region. Each electronic part 12 is signally connected to a control board 45 accommodated in the case body 13. The electronic parts 12 are controlled by the control board 45, in which a control device is formed, which is not illustrated.

[0034] Next, an operation of the heat dissipation device 31 according to the present embodiment will be described.

[0035] When the electronic parts 12 generate heat and the coolant flows from the inflow passage 51 to the coolant passage 38, the electronic parts 12 transfer heat to the coolant via the body portion 39. The electronic parts 12 are cooled by the coolant. The coolant that has passed through the coolant passage 38 is discharged from the coolant passage 38 through the outflow passage 52.

[0036] The above described embodiment has the following advantages.

[0037] (1) The case 33 of the heat dissipation device 31 is molded integrally with the inflow passage forming portion 42 and the outflow passage forming portion 43. Accordingly, since the inflow passage forming portion 42 and the outflow passage forming portion 43 are formed simultaneously with the body portion 39 (case 33), it is not necessary to separately prepare a member for forming the inflow passage 51 and the outflow passage 52. Therefore, the number of components of the heat dissipation device 31 is reduced.

[0038] (2) The pins 36, which determine the position of the lid member 37 attached to the case 33 of the heat dissipation device 31, are molded integrally with the case 33 of the heat dissipation device 31. Accordingly, it is not necessary to prepare the position determining pins 36 separately from the case 33. Therefore, the number of components of the heat dissipation device 31 is reduced.

[0039] (3) The fins 34, which protrude in the inside of the coolant passage 38, are molded integrally with the case 33 of the heat dissipation device 31. Accordingly, it is not necessary to prepare the fins 34 separately from the case 33. Therefore, the number of components of the heat dissipation device 31 is reduced.

[0040] (4) The case body 13 is manufactured by casting. Since the casting is a method in which the melted metal materials are flowed into the mold, it excels in mass production of the case body 13.

[0041] (5) The pins 20, which determine the position of the top plate 18 attached to the case body 13, are molded integrally with the case body 13. Accordingly, it is not necessary to prepare the pins 20 separately from the case body 13 so that the number of components is reduced.

[0042] (6) For example, as in the heat exchanger disclosed in Japanese Laid-Open Patent Publication No. 2008-21147, when the heat dissipation device is configured by brazing the inlet-outlet pipe on between the pair of plates, a sealing mem-

ber is intervened at an interface between the inlet-outlet pipe and the pair of plates to ensure the sealing property between the inlet-outlet pipe and the pair of plates. In the heat dissipation device 31 of the present embodiment, since the case 33 of the heat dissipation device 31 is molded integrally with the inflow passage forming portion 42 and the outflow passage forming portion 43, the interface between the case 33, and the inflow passage forming portion 42 and the outflow passage forming portion 43 is absent. Accordingly, it is not necessary to provide a sealing member between the case 33 of the heat dissipation device 31, and the inflow passage forming portion 42 and the outflow passage forming portion 43 to ensure the sealing property therebetween so that the number of components is reduced.

[0043] (7) As in the heat exchanger disclosed in Japanese Laid-Open Patent Publication No. 2008-211147, when the inlet-outlet pipe is brazed to the pair of plates, positional shifting of the inlet-outlet pipe may be caused in the steps of arranging the inlet-outlet pipe on the recessed portion of the pair of plates, and melting the brazing material after the inlet-outlet pipe is arranged on the recessed portion of the pair of plates. When the brazing is performed in the state where the positional shifting of the inlet-outlet pipe is caused, inferior joint is likely to be caused so that the joint reliability of the heat exchanger is reduced. In the heat dissipation device 31 of the present embodiment, because the inflow passage forming portion 42 and the outflow passage forming portion 43 are molded integrally with the case 33, the positional shifting of the inflow passage forming portion 42 and the outflow passage forming portion 43 is not caused.

[0044] (8) Since it is not necessary to braze the inlet-outlet pipe to the plates unlike the heat exchanger disclosed in Japanese Laid-Open Patent Publication No. 2008-211147, the step of brazing the inflow passage forming portion 42 and the outflow passage forming portion 43 is omitted.

[0045] (9) When the pins 20 are not integrally molded, the pins are press fit into the holes formed in the support portions 19 to be provided in the case body 13. In the heat dissipation device 31 of the present embodiment, since the pins 20 are molded integrally with the case body 13, the step of press fitting the pins becomes unnecessary.

[0046] The embodiment may be modified as follows.

[0047] In the embodiment, the heat dissipation device 31 molded integrally with the case body 13 of the inverter case 11 is used as the heat dissipation device 31. The heat dissipation device 31 is not limited to this. The body portion 39 of the heat dissipation device 31, the inflow passage forming portion 42, and the outflow passage forming portion 43 may be integrally molded. It is not necessary to mold these elements integrally with other members such as the case body 13.

[0048] The case body 13 (the case 33 of the heat dissipation device 31, the inflow passage forming portion 42, and the outflow passage forming portion 43) may be articles manufactured by cutting. In this case, unlike the case of casting, it is not necessary to draw out the case body 13 from the mold. Accordingly, the case body 13 is manufactured even if the case body 13 includes a complicated shape. For example, the

inflow passage forming portion 42 and the outflow passage forming portion 43 may be of a flexed shape.

[0049] The case body 13 (the case 33 of the heat dissipation device 31, the inflow passage forming portion 42, and the outflow passage forming portion 43) may be a forging manufactured by forging.

[0050] Only one of the inflow passage forming portion 42 and the outflow passage forming portion 43 may be molded integrally with the case 33 of the heat dissipation device 31.

[0051] It is not necessary to mold the position determining pins 36 integrally with the case body 13.

[0052] It is not necessary to mold the fins 34 integrally with the case body 13.

[0053] The fins 34 may be molded integrally with the lid member 37.

[0054] Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

What is claimed is:

1. A heat dissipation device comprising:

a body portion thermally coupled with a heating element, wherein the body portion includes therein a coolant passage through which coolant, which dissipates heat of the heating element, flows;

an inflow passage, which admits the coolant into the coolant passage;

an outflow passage, which allows the coolant to flow out of the coolant passage; and

a flow passage forming portion formed integrally with the body portion, wherein the flow passage forming portion forms at least one of the inflow passage and the outflow passage.

2. The heat dissipation device according to claim 1, wherein

the body portion includes a case, including a recessed portion, and a lid member, which is attached to the case in a state in which it covers the recessed portion to form the coolant passage with the case, and

the heat dissipation device further includes a position determining pin formed integrally with the case to determine a position of the lid member with respect to the case.

3. The heat dissipation device according to claim 1, further comprising a fin molded integrally with the body portion and arranged inside the coolant passage.

4. The heat dissipation device according to claim 1, wherein the body portion and the flow passage forming portion are casts.

5. The heat dissipation device according to claim 1, wherein the body portion and the flow passage forming portion are articles formed by cutting.

6. The heat dissipation device according to claim 1, the body portion and the flow passage forming portion are forgings.

* * * * *