FORCED-AIR COOLING HEAT SINK

Inventor: Hideyuki Nishino, Handa-shi (JP)

Correspondence Address:
HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 828
BLOOMFIELD HILLS, MI 48303 (US)

Appl. No.: 10/361,517
Filed: Feb. 10, 2003

Foreign Application Priority Data
Feb. 27, 2002 (JP) 2002-051454

Publication Classification
Int. Cl.° .................................................. F28F 7/00
U.S. Cl. .................................................. 165/185; 165/80.3

ABSTRACT

A forced-air cooling heat sink includes a boxlike body with opened ends to guide the forced-air to flow from one opened end to the other opened end. Two heat sink units, each consisting of a platelike base and a plurality of cooling fins protruding perpendicularly from an inner surface of the platelike base, are fixed at their both sides to two plate members, thereby forming the boxlike body.
FORCED-AIR COOLING HEAT SINK

BACKGROUND OF THE INVENTION

[0001] This invention relates to a forced-air cooling heat sink having a boxlike body which is arranged to cause a forced-air to flow from one opened end to the other opened end.

[0002] The boxlike body of a forced-air cooling heat sink has opened ends for allowing a forced-air to enter or exit and a plurality of cooling fins protruding from the inner surface thereof. As a method for manufacturing the boxlike body of a forced-air cooling heat sink, generally known is a method using an aluminum extrusion molding technique or a method including steps of assembling plate members to form a boxlike body and connecting the cooling fins to the plate member by caulking.

[0003] When the entire boxlike body of a forced-air cooling heat sink is manufactured by the aluminum extrusion molding, it is generally difficult to reduce a heat resistance of a molded body due to restricted fin pitches. Furthermore, once extrusion molding dies are prepared, it is difficult to change the heat radiation properties of the molded body. If such changes are required, it will be necessary to prepare a plurality of or different kinds of extrusion molding dies beforehand so as to allow an operator or a manufacturer to intentional change the heat radiation properties of the molded body. Needless to say, the manufacturing costs will increase.

[0004] On the other hand, according to the method including a step of connecting the cooling fins to a plate member by caulking (refer to Japanese Utility Model No. 3008204), reducing the heat resistance is relatively easy because the fin pitches are not so severely restricted. Thus, controlling or changing the heat radiation properties of the molded body is relatively easy. However, a corrosion-proof surface treatment may be applied on the boxlike body of a forced-air cooling heat sink. In this case, there is the tendency that cracks of a treated surface chiefly appear in a region where the cooling fins are connected to a plate member by caulking. Considering this fact, the surface treatment is unfeasible. Furthermore, according to this method, a large number of parts are required. The manufacturing costs will increase.

SUMMARY OF THE INVENTION

[0005] In view of the above-described problems, the present invention has an object to provide a forced-air cooling heat sink having an arrangement easy to intentionally reduce the heat resistance and also suitable for applying a surface treatment to the surface of a boxlike body.

[0006] In order to accomplish the above and other related objects, the present invention provides a forced-air cooling heat sink including a boxlike body with opened ends so as to guide the forced-air to flow from one opened end to the other opened end. The boxlike body is constituted by at least one heat sink unit and at least one plate member. The heat sink unit has a plate like base and a plurality of cooling fins protruding from an inner surface of the plate like base. The plate like base has an outer surface forming at least one surface of the boxlike body. The plate member forms other surface of the boxlike body.

[0007] According to this arrangement, the extrusion molding is applied to a single heat sink unit which has a simple arrangement. The fin pitches are not so severely restricted. Thus, it becomes possible to reduce the heat resistance of the molded boxlike body even when the heat sink unit is manufactured by the extrusion molding. Furthermore, according to this arrangement, there is no necessity of using a manufacturing method including a step of caulking the cooling fins. Accordingly, the surface treatment is finely performed.

[0008] Preferably, the boxlike body is constituted by two heat sink units positioned in an opposed relationship and two plate members attached to both sides of the platelike bases of the opposed heat sink units so as to accommodate the cooling fins between the two plate members.

[0009] Preferably, the boxlike body is constituted by only one heat sink unit and a U-shaped plate member attached to both sides of the platelike base so as to accommodate the cooling fins of the heat sink unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description which is to be read in conjunction with the accompanying drawings, in which:

[0011] FIG. 1 is a perspective diagram showing a forced-air cooling heat sink in accordance with a first embodiment of the present invention;

[0012] FIG. 2 is an exploded perspective diagram showing the forced-air cooling heat sink in accordance with a first embodiment of the present invention;

[0013] FIG. 3 is a perspective diagram showing a forced-air cooling heat sink in accordance with a second embodiment of the present invention;

[0014] FIG. 4 is an exploded perspective diagram showing the forced-air cooling heat sink in accordance with the second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Preferred embodiments of the present invention will be explained hereinafter with reference to attached drawings. Identical parts are denoted by the same reference numerals throughout the drawings.

[0016] FIGS. 1 and 2 show a forced-air cooling heat sink in accordance with a first embodiment of the present invention. A forced-air cooling heat sink 1 of the first embodiment is, for example, installed in a controller casing (not shown) of an industrial robot (not shown). The forced-air cooling heat sink 1 has a boxlike body 2 which is constituted by two opposed heat sink units 3 and 4 and two rectangular plate members 5 and 6.

[0017] Two opposed heat sink units 3 and 4 have the same configuration and are, for example, manufactured by the aluminum extrusion molding. An upper heat sink unit 3 includes a platelike base 3a and a plurality of cooling fins 3b standing or protruding perpendicularly from an inner surface of the platelike base 3a. The platelike base 3a has an outer surface serving as an upper surface of the boxlike body 2. Similarly, a lower heat sink unit 4 includes a platelike base 4a and a plurality of cooling fins 4b standing or protruding
perpendicularly from an inner surface of the platelike base 4a. The platelike base 4a has an outer surface serving as a lower or bottom surface of the boxlike body 2. The distal ends of cooling fins 3b of the upper heat sink unit 3 are opposed to the distal ends of cooling fins 4b of the lower heat sink unit 4.

[0018] Two rectangular plate members 5 and 6 have the same configuration and are made of the same material, such as a stainless plate, an aluminum plate, a copper plate, an iron plate, or the like. Two plate members 5 and 6 are fixed to both sides of the platelike bases 3a and 4a of the opposed heat sink units 3 and 4 by means of screws 9 or comparable fixing members.

[0019] More specifically, according to the illustration shown in FIG. 2, the upper peripheral edge of the plate member 5 is fixed by a plurality of screws 9 to a right fringe 3c of the platelike base 3a of the upper heat sink unit 3. The lower peripheral edge of the plate member 5 is fixed by a plurality of screws 9 to a right fringe 4c of the platelike base 4a of the lower heat sink unit 4. Similarly, the upper peripheral edge of the plate member 6 is fixed by a plurality of screws 9 to a left fringe 3c of the platelike base 3a of the upper heat sink unit 3. The lower peripheral edge of the plate member 6 is fixed by a plurality of screws 9 to a left fringe 4c of the platelike base 4a of the lower heat sink unit 4.

[0020] Thus, the opposed upper and lower heat sink units 3 and 4 are securely connected by the plate members 5 and 6 positioned at their right and left ends, thereby forming the boxlike body 2 of a forced-air cooling heat sink.

[0021] The boxlike body 2 has front and rear openings (i.e., opposed opened ends). A cooling fan (not shown) supplies fresh and cool air into the boxlike body 2 from its inlet opening (i.e., from one of the front and rear openings). After introduced in the boxlike body 2, the forced cooling air flows along the surfaces of cooling fins 3b and 4b to perform heat exchange (i.e., absorbs the heat generated inside the heat sink 1) and then goes out of the boxlike body 2 from its outlet opening (i.e., from the other of the front and rear openings). For the boxlike body 2 accommodated in a controller casing, it will preferably to attach air filters (not shown) to the inlet and outlet openings of the boxlike body 2.

[0022] According to the above-described arrangement of the forced-air cooling heat sink 1, it is preferable to install or place a heat-generating element of a motor driving circuit or other heat-generating component on the upper surface of the boxlike body 2 (i.e., on the outer surface of the platelike base 3a of the upper heat sink unit 3) or on the bottom surface of the boxlike body 2 (i.e., on the outer surface of the platelike base 4a of the lower heat sink unit 4). Meanwhile, it is preferable to use the plate members 5 and 6 for mounting a component having a relatively small amount of heat generation.

[0023] The above-described first embodiment is characterized in that the boxlike body 2 is constituted by two opposed heat sink units 3 and 4, each consisting of the platelike base 3a or 4a and a plurality of cooling fins 3b or 4b protruding perpendicularly from an inner surface of the platelike base 3a or 4a. The both sides of the opposed heat sink units 3 and 4 are fixed by two plate members 5 and 6.

[0024] According to this arrangement, the fin pitches are not so severely restricted. Thus, it becomes possible to reduce the heat resistance of the molded boxlike body 2 even when each of the heat sink units 3 and 4 is manufactured by the extrusion molding.

[0025] Furthermore, according to this arrangement, there is no necessity of using a manufacturing method including a step of caulking the cooling fins. Accordingly, the surface treatment is finely performed. According to the above-described embodiment, it is preferable to apply an alumite treatment on the surfaces of the heat sink units 3 and 4 so that the boxlike body 2 has sufficient corrosive durability.

[0026] Furthermore, according to the above-described first embodiment, two heat sink units 3 and 4 can sufficiently absorb a great amount of heat from upper and lower directions of the boxlike body 2. The heat radiation properties of the boxlike body 2 can be enhanced appropriately.

[0027] Furthermore, according to the above-described first embodiment, two heat sink units 3 and 4 have the same configuration which is simple and not expensive to manufacture. Two plate members 5 and 6 are simple, too. Thus, it becomes possible to reduce the manufacturing costs of the boxlike body 2. Moreover, for the purpose of intentionally changing or controlling the heat radiation properties, it is possible to use a set of different heat sink units which are differentiated in the heat radiation properties (for example, in the fin pitches or fin height).

[0028] FIGS. 3 and 4 show a forced-air cooling heat sink in accordance with a second embodiment of the present invention. A forced-air cooling heat sink 1r of the second embodiment is characterized in that a boxlike body 8 is constituted by a single heat sink unit 3 and a single U-shaped plate member 7. The U-shaped plate member 7 is, for example, made of a stainless plate. The U-shaped plate member 7 consists of a bottom portion 7a and opposed side walls portions 7b and 7c. The right wall portion 7b is continuous and bent perpendicularly from the bottom portion 7a. Similarly, the left wall portion 7c is continuous and bent perpendicularly from the bottom portion 7a. A pair of small attachment flanges 7d (although only one flange 7d is shown in FIG. 4) are provided at the front and rear edges of the bottom portion 7a. Instead of using a stainless plate, it is possible to form the plate member 7 by using other metallic material, such as an aluminum plate, a copper plate, an iron plate, or the like.

[0029] According to the illustration shown in FIG. 3, the upper peripheral edge of the right wall portion 7b of plate member 7 is fixed by a plurality of screws 9 to the right fringe 3c1 of the platelike base 3r of the heat sink unit 3. Similarly, the upper peripheral edge of left wall portion 7c of plate member 7 is fixed by a plurality of screws 9 to the left fringe 3c2 of the platelike base 3r of the heat sink unit 3. Thus, the heat sink unit 3 is securely connected with the U-shaped plate member 7, so as to form the boxlike body 2 of a forced-air cooling heat sink.

[0030] The rest of the arrangement of the second embodiment is the same as that of the first embodiment. Thus, the second embodiment brings the same functions and effects as those of the first embodiment. Especially, using only one heat sink unit 3 is preferable in a case where the heat radiation properties are not so severely required. In this case, the manufacturing costs can be suppressed to a lower level.

[0031] Although the above-described first or second embodiment uses only one or two heat sink units, the
number of heat sink units is not limited to a specific number. Therefore, it is possible to use three or more heat sink units. Although the above-described first or second embodiment uses the screws to connect each plate member to a heat sink unit, a welding (brazing) or bonding (adhesive) materials can be also used for this purpose.

What is claimed is:

1. A forced-air cooling heat sink comprising:

   a boxlike body with opened ends so as to guide the forced-air to flow from one opened end to the other opened end,

   wherein the boxlike body is constituted by at least one heat sink unit and at least one plate member,

   said at least one heat sink unit has a platelike base and a plurality of cooling fins protruding from an inner surface of said platelike base, said platelike base having an outer surface serving as at least one surface of said boxlike body; and

   said at least one plate member serves as other surface of said boxlike body.

2. The forced-air cooling heat sink according to claim 1, wherein said boxlike body is constituted by two heat sink units positioned in an opposed relationship and two plate members attached to both sides of said platelike bases of said opposed heat sink units so as to accommodate said cooling fins between said two plate members.

3. The forced-air cooling heat sink according to claim 1, wherein said boxlike body is constituted by only one heat sink unit and a U-shaped plate member attached to both sides of said platelike base so as to accommodate said cooling fins of said heat sink unit.

   * * * * *