A HEATSINK AND A METHOD AND AN ASSEMBLY FOR FORMING THE SAME

The present invention relates to a heatsink and to a method and an assembly for forming the same. It is envisaged that a heatsink according to the invention will be incorporated into an electrical/electronic apparatus to provide a means for dissipating thermal energy generated by electrical/electronic devices comprising the apparatus.

Heatsinks employed in electrical/electronic apparatuses are provided in many different forms and sizes. However, such heatsinks can normally be separated into two groups. A first group comprises relatively small heatsinks. These are generally formed by die cutting blanks from thin sheet metal material and bending the edges of the blanks to form fins, etc. Such heatsinks have limited heat dissipating characteristics, but are inexpensive to manufacture.

A second group comprises relatively large heatsinks designed to have optimum heat dissipating characteristics. These are employed where space considerations are critical and thus heat dissipation efficiency must be optimised. Such heatsinks are generally formed from an extruded metal member having integrally formed fin members. The fin members can be machined to provide heatsinks with more complex arrangements of fins, etc. than that possible with sheet metal heatsinks. However,

the cost of the extruded member often accounts for a sizeable proportion of the total cost of a heatsink manufactured in this manner.

One object of the present invention is to provide a method of forming inexpensive heatsinks.

Another object of the invention is to provide heatsinks having good heat dissipating characteristics.

A further object of the invention is to provide heatsinks which are more easily recyclable.

According to a first aspect of the present invention, there is provided a heatsink assembled from a generally planar base member and at least one fin member, said fin member consisting of at least one fin portion and a base portion extending at an angle therefrom, wherein said fin member is fixed by its base portion to said base member such that the base portion is coplanar with the base member and the fin portion extends generally outwardly therefrom and the base member and the fin member are made of thermally conductive material.

Preferably, the base member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

Preferably, the base member and the fin member are made of the same thermally conductive material.

Preferably, the thermally conductive material is a metallic material.

Preferably further, the metallic material is aluminium.

Preferably, the fin member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

The heatsink may include a plurality of spaced apart fin members.

The fin members may be spaced apart on a same side of the base member.

The fin members may be fixed to the base member by swaging or riveting the base portions thereof to the base member.

The heatsink may include means formed integrally with the base member and/or a fin member to enable it to be mounted on a printed circuit board (pcb) or attached to an electronic device.

Alternatively, the heatsink may be provided with detachable clip means which attach to the base member and/or a fin member to enable the heatsink to be mounted on a pcb or attached to an electronic device.

The clip means may be formed of a solderable material which is a different material to the thermally conductive material of the heatsink.

The base member may be formed by press-cutting from a sheet material or may comprise a cut-off section of an extruded member.

The fin members may be formed by press-cutting from a sheet material or may comprise cut-off sections of an extruded member.

At least one fin member/portion may comprise a plurality of spaced apart pin fin portions.

The pin fin portions may be twisted to lie in respective planes angled with respect to a plane in which the fin member/portion lies.

The heatsink may be assembled such that corresponding pin fin portions of adjacent fin members/portions are aligned in a transverse direction.

Alternatively, the corresponding pin fin portions of adjacent fin members/portions may be staggered.

According to a second aspect of the present invention, there is provided a method of assembling a heatsink comprising fixing at least one fin member to a generally planar base member such that a base portion of the fin member lies coplanar with the base member and a fin portion of the fin member extends outwardly from the base member, wherein the base member and the fin member are made of thermally conductive material.

Preferably, the base member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

Preferably, the method includes using a base member and a fin member made of the same thermally conductive material.

Other features of the method of assembling a heatsink according to the second aspect of the invention correspond to dependent features of the heatsink according to the first aspect of the invention.

According to a third aspect of the present invention, there is provided an assembly for forming a heatsink, said assembly comprising a generally planar base member and at least one fin member, said fin member consisting of at least one fin portion and a base portion extending at an angle therefrom, wherein the base member and the fin member are made of thermally conductive material.

Preferably, the base member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

Preferably, the base member and the fin member are made of the same thermally conductive material.

Other features of the heatsink assembly according to the third aspect of the invention correspond to dependent features of the heatsink according to the first aspect of the invention.

The foregoing and further features of the present invention will be more readily understood from the following description of preferred

embodiments, by way of example thereof, with reference to the accompanying drawings, of which:

Figure 1 is a plan view of a first embodiment of a heatsink in accordance with the invention;

Figure 2 is a section on line A-A of figure 1;

Figure 3 is a transverse sectional view of a second embodiment of the invention;

Figure 4 is a transverse sectional view of another embodiment of the invention;

Figure 5 is a transverse sectional view of a further embodiment of the invention;

Figure 6 is a partial view of a heatsink showing an integrally formed attachment means;

Figure 7 is a partial view of a heatsink showing a detachable clip means;

Figure 8 is a plan view of a yet another embodiment of a heatsink according to the invention showing a pin fin arrangement;

Figure 9 is a section on line B-B of figure 8;

Figure 10 is a yet further embodiment of a heatsink according to the invention showing an alternative pin fin arrangement to that of figure 9;

Figure 11 is a sectional view on line C-C on figure 10;

Figure 12 is a plan view of a fin member showing a twisted pin fin structure; and

Figure 13 is a sectional view on line D-D of figure 12.

A first embodiment of a heatsink 1 according to the present invention is illustrated in figures 1 and 2. This comprises a base plate 10 made of a thermally conductive material to which are fixed a plurality of "U"-shaped fin members 12 also made of a thermally conductive material. Each fin member 12 comprises two coplanar fin portions 12a joined by a base portion 12b. The fin members 12 are fixed to the base plate 10 by their base portions 12b. The fin members 12 can be fixed to the base plate 10 by any suitable means including swaging and riveting. The preferred means of fixing the fin members 12 to the base plate 10 is by means of "self-riveting" whereby, at predetermined points along the base portion 12b of each fin member 12, a punch tool displaces a part of said base portion 12b to extend into a corresponding depression or hole formed previously in the base plate 10.

The use of "U"-shaped fin members 12 rather than "L"-shaped or "Z"-shaped members, for example, is advantageous insofar that it minimises the punching operations required to fix said fin members 12 to said base plate 10 for a given number of upwardly extending fin portions 12a. However, the heatsink 1 may be assembled using "U"-shaped, "L"-shaped or

"Z"-shaped fin members 12 (not shown), or any combination of these, thus enabling a heatsink 1 having an odd number of fin portions 12a to be formed.

Preferably, the base plate 10 and the fin members 12 are made of the same thermally conductive material. By making the base plate 10 and the fin members 12 of the same thermally conductive material, for example aluminium, a heatsink 1 is provided which exhibits an enhanced thermal energy dissipating performance over relatively small heatsinks of known constructions. This is, in part, due to the better thermal conductivity of the aluminium fin members 12, but also due to the good thermal contact between the fin members 12 and the base plate 10 being of the same metallic material.

A heatsink 1 such as this is more readily recyclable since there is no requirement to disassemble the fin members 12 from the base plate 10. This is a particular advantage in countries where legislation exists requiring products of this type to be capable of recycling. Where the base plate 10 and the fin members 12 are not made of the same thermally conductive material, it is necessary to disassemble the fin members 12 from the base plate 10. This requires labour and is expensive.

The labour cost may be greater than the value of the recovered material.

Surprisingly, however, other distinct advantages have followed the formation of the heatsink 1 from fin members 12 and a base plate 10 of the same metallic material. The heatsink 1 has greater corrosion resistance over a heatsink utilising different metals, for example steel and aluminium. A further unexpected advantage is the elimination of bi-metallic bending on heating of the heatsink which, in a heatsink utilising different metals, can result in reduced thermal contact between the fin members and the base plate and even parting of the fin member from said base plate.

In the following description of other embodiments, like numerals are used to denote like parts.

Figures 3 to 5 show a number of other embodiments of a heatsink 1 according to the present invention which are each characterised in that the base plate 10 respectively has an "L"-shaped, a "U"-shaped and a "Z"-shaped transverse cross-section. The form of the base plate 10 is such that it provides at least one additional fin portion 12d which is integral with the base plate 10. The additional fin portion 12d is provided without the penalty of an additional thermal joint and provides

a simplified assembly of fin members 12 with base plate 10. More importantly, the at least one integral fin portion 12d improves the rigidity of the heatsink 1 so formed. The fin members 12 may comprise "L"-shaped members or "Z"-shaped or, as shown in the figures, "U"-shaped members.

In these embodiments, the base plate 10 and assembled fin members 12 are preferably made of the same metallic material (aluminium) to provide the advantages hereinbefore described with respect to the first embodiment (figures 1 and 2). However, for some applications, it may be sufficient that the base plate 10 is formed of aluminium and the assembled fin members 12 formed of less expensive steel.

The heatsink 1 may be adapted for mounting on a pcb (not shown) or for attachment to an electrical/electronic device (not shown). The heatsink 1 may include means to enable it to form a friction fit with a pcb. Figure 6 shows a partial view of a heatsink 1 including a tag or pin 14 formed integrally with a fin member 12 to enable the heatsink to be mounted on a pcb. The pin 14 makes a friction fit with an aperture in the pcb and thus the heatsink can be readily recovered for recycling.

Alternatively, the heatsink can be mounted by soldering the pin 14 in the aperture in the pcb. It

will be appreciated that the heatsink 1 may have more than one pin 14 for mounting and that the pin(s) may be formed integrally with the fin members 12 and/or base plate 10.

In the case where the material of the fin members 12 and/or base plate 10 are not solderable, it is still possible to mount the heatsink 1 on a pcb by soldering. This can be achieved by means of a clip member 16 which engages with a fin member 12 and/or the base plate. Figure 7 shows a partial view of a heatsink in which a clip member 16 is inserted into a slot 18 formed in an edge 10a of the base plate 10. Thus the heatsink 1 can be detached from the clip member 16. This arrangement also allows the heatsink 1 to be readily recovered for recycling. It will be appreciated that the clip member 16 must be made of a solderable material. It will also be appreciated that the clip member 10 can be adapted to be engageable with a fin member 12 for mounting the heatsink 10.

Figures 8 and 9 show a further embodiment of a heatsink 1 in accordance with the invention in which the fin portions 12a of the fin members 12 each comprise a plurality of spaced apart pin fin portions 12c. These are formed by removing sections from each fin portion 12a. Where the fin members 12 are formed from press-cut blanks of sheet material,

the pin fin portions 12c are formed at the blank cutting stage. This provides very wide design freedom in arranging the pattern of pin fin portions 12c across the width of the heatsink 1. Thus, heatsinks can be designed with a pin fin formation which optimises the heat dissipating characteristics of a heatsink for a given application. This design freedom is achieved at little extra cost contrary to the situation encountered with known heatsink designs. In the embodiment illustrated in figures 8 and 9 the pin fin portions 12c are arranged in alignment across the width of the heatsink 1.

Figures 9 and 10 show a further embodiment of a heatsink 1 according to the invention in which adjacent rows of pin fin portions 12c are staggered across the width of the heatsink 1.

A fin member 12 for forming yet another embodiment of the invention is illustrated in figures 12 and 13. The pin fin portions 12c are twisted such that they lie in planes at an angle to a plane along a central axis of the fin member 12. Whilst the pin fin portions 12c shown in figures 12 and 13 are shown spaced apart having been formed by removal of material from the fin portions 12a of the fin members 12, it will be appreciated that said pin fin portions 12c can be formed by making spaced apart cuts in the fin portions 12a and then twisting

the pin fin portions 12c so formed. This also illustrates the wide design freedom available with the present invention.

The present invention thus provides a heatsink having a structure and performance similar to that of the large size expensive heatsinks machined from extruded members, but at a cost not substantially greater than the inexpensive small size sheet material heatsinks.

CLAIMS

1. A heatsink assembled from a generally planar base member and at least one fin member, said fin member consisting of at least one fin portion and a base portion extending at an angle therefrom, wherein said fin member is fixed by its base portion to said base member such that the base portion is coplanar with the base member and the fin portion extends generally outwardly therefrom and the base member and the fin member are made of thermally conductive material.

2. A heatsink as claimed in claim 1, wherein the base member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

3. A heatsink as claimed in claim 1 or claim 2, wherein the base member and the fin member are made of the same thermally conductive material.

4. A heatsink as claimed in claim 3, wherein the thermally conductive material is a metallic material.

5. A heatsink as claimed in claim 4, wherein the metallic material is aluminium.

6. A heatsink as claimed in any preceding claim, wherein the fin member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

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7. A heatsink as claimed in any preceding claim, wherein it includes a plurality of spaced apart fin members.

8. A heatsink as claimed in claim 7, wherein the fin members are spaced apart on a same side of the base member.

9. A heatsink as claimed in claim 7 or claim 8, wherein the fin members are fixed to the base member by swaging or riveting the base portions thereof to the base member.

10. A heatsink as claimed in any preceding claim, wherein it includes means formed integrally with the base member and/or a fin member to enable it to be mounted on a printed circuit board (pcb) or attached to an electronic device.

11. A heatsink as claimed in any one of claims 1 to 9, wherein the heatsink is provided with detachable clip means which attach to the base member and/or a fin member to enable the heatsink to be mounted on a pcb or attached to an electronic device.

12. A heatsink as claimed in claim 11, wherein the clip means is formed of a solderable material which is a different material to the thermally conductive material of the heatsink.

13. A heatsink as claimed in any preceding claim, wherein the base member is formed by press-

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cutting from a sheet material or comprises a cut-off section of an extruded member.

14. A heatsink as claimed in any one of claims 7 to 12, wherein the fin members are formed by press-cutting from a sheet material or comprise cut-off sections of an extruded member.

15. A heatsink as claimed in any one of claims 7 to 14, wherein at least one fin member/portion comprises a plurality of spaced apart pin fin portions.

16. A heatsink as claimed in claim 15, wherein the pin fin portions are twisted to lie in respective planes angled with respect to a plane in which the fin member/portion lies.

17. A heatsink as claimed in claim 15, wherein the heatsink is assembled such that corresponding pin fin portions of adjacent fin members/portions are aligned in a transverse direction.

18. A heatsink as claimed in claim 16, wherein the corresponding pin fin portions of adjacent fin members/portions are staggered.

19. A method of assembling a heatsink comprising fixing at least one fin member to a generally planar base member such that a base portion of the fin member lies coplanar with the base member and a fin portion of the fin member extends outwardly from the base member, wherein the

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base member and the fin member are made of thermally conductive material.

20. A method as claimed in claim 16, wherein the base member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

21. A method as claimed in claim 19 or claim 20, wherein the method includes using a base member and a fin member made of the same thermally conductive material.

22. An assembly for forming a heatsink, said assembly comprising a generally planar base member and at least one fin member, said fin member consisting of at least one fin portion and a base portion extending at an angle therefrom, wherein the base member and the fin member are made of thermally conductive material.

23. An assembly as claimed in claim 22, wherein the base member has a generally "L"-shaped, "U"-shaped or "Z"-shaped transverse section.

24. An assembly as claimed in claim 22 or claim 23, wherein the base member and the fin member are made of the same thermally conductive material.

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