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18 ATS Automation Tooling Systems, Inc. and Thermal Form &
19 Function, LLC

20 UNITED STATES DISTRICT COURT
21 NORTHERN DISTRICT OF CALIFORNIA
22 SAN FRANCISCO DIVISION

23 ATS Automation Tooling Systems, Inc. and
24 Thermal Form & Function, LLC,

25 Plaintiffs,

26 v.

27 Foxconn Electronics, Inc., Hon Hai Precision
28 Industry Co. Ltd., Foxconn Precision
Components Co., Ltd., and DOES 2 through
10

11 Defendants.

12 **Case No. C03-2648 PJH**

13 **SECOND AMENDED COMPLAINT FOR
14 PATENT INFRINGEMENT**

15 **JURY DEMAND**

16 **INTRODUCTION**

17 Pursuant to Rule 15 of the Federal Rules of Civil Procedure, the Order of this Court dated
18 May 25, 2004, and taking into account information obtained during discovery since the Court's
19 May 25, 2004 Order, the plaintiffs hereby set forth the amended allegations:

20 **THE PARTIES**

21 1. Plaintiff ATS Automation Tooling Systems, Inc. ("ATS") is an Ontario

ORIGINAL FILED

JUN 15 2004

RICHARD W. WIEKING
CLERK U.S. DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA

1 corporation with its principal office at 250 Royal Oak Road, Box 32100, Preston Center,
2 Cambridge, Ontario N3H 5M2.

3 2. Plaintiff Thermal Form & Function, LLC (“TFF”) is an Ohio company with its
4 principal place of business at 48 Central Street, Manchester By the Sea, Massachusetts 01944.

5 3. This action arises under the patent laws of the United States, as set forth in Title 35
6 of the United States Code.

7 4. Upon information and belief, defendant Foxconn Electronics, Inc. (“Foxconn
8 Electronics”) is a corporation organized under the laws of the State of California, having its
9 principal place of business in Cypress, California.

10 5. Upon information and belief, defendant Hon Hai Precision Industry Co., Ltd.
11 (“Hon Hai”) is a corporation organized under the laws of Taiwan, having its principal place of
12 business at No. 2, Tzuo Yu Street, Tu-Cheng Taipei Hsien, Taiwan.

13 6. Upon information and belief, defendant Foxconn Precision Components Co., Ltd.
14 (“Foxconn Precision”) is a corporation organized under the laws of Taiwan, having its principal
15 place of business at 66-1 Chung Shan Road, Tu-Cheng Industrial District, Taipei Hsien, Taiwan.

16 7. Upon information and belief, Foxconn International, Inc. (“Foxconn
17 International”) is a corporation organized under the laws of the State of California, having its
18 principal place of business in Santa Clara, California.

19 8. The true names or capacities, whether individual, corporate, associate, or
20 otherwise, of defendants named as DOES 2 through 10 inclusive, are unknown to ATS and TFF
21 (“Plaintiffs”), and Plaintiffs therefore sue these defendants by fictitious names. Plaintiffs will
22 seek leave to amend this complaint to include the true names and capacities of the DOE
23 defendants when ascertained.

24 9. Plaintiffs are informed and believe and thereon allege that DOES 2 through 10,
25 inclusive, are in some manner responsible for and/or involved in the acts and omissions set forth
26 below, and Plaintiffs will amend this complaint to state the exact grounds of responsibility and
27 involvement when discovered.

28 **JURISDICTION AND VENUE**

1 behalf of Hon Hai, its subsidiaries, and affiliates, of the infringement of the '098 Patent and
2 offered to discuss reasonable licensing terms.

3 19. Foxconn International, on behalf of Hon Hai, its subsidiaries, and affiliates, denied
4 infringement of the '098 Patent and has refused to take a license. Foxconn International only
5 provided TFF with an illustration and photograph of what it states is an "example of the product
6 at issue." Foxconn International has not provided TFF with any samples or any adequate
7 illustrations, photographs, or descriptions of its various heat sink products necessary to confirm
8 the full extent of infringement.

9 20. Upon information and belief, one or more of Defendants' other heat sink devices
10 (i.e., devices for which information is not readily available and has not been provided by the
11 Defendants) infringe the '098 Patent.

12 **COUNT I — PATENT INFRINGEMENT**

13 21. Plaintiffs reallege and incorporate herein by this reference paragraphs 1 through 19
14 of this Complaint as though fully set forth herein.

15 22. Defendants have been and are directly infringing, contributorily infringing, and
16 inducing others to infringe, one or more claims of the '098 Patent by making, using, selling,
17 offering to sell, and/or importing infringing products that are covered by the '098 Patent, and/or
18 inducing and/or contributing to others' making, using, selling, offering to sell, and/or importing
19 infringing products that are covered by the one or more claims of the '098 Patent.

20 23. Defendants' infringement of the '098 Patent is and has been willful and deliberate,
21 has caused and will continue to cause TFF and ATS to suffer substantial damages, and has caused
22 and will continue to cause TFF and ATS to suffer irreparable harm for which there is no adequate
23 remedy at law.

24 **REQUEST FOR RELIEF**

25 **WHEREFORE**, Plaintiffs request that the Court:

- 26 A. Adjudge that the '098 Patent is valid and enforceable;
27 B. Adjudge that Defendants are liable for infringement of the '098 Patent;
28 C. Adjudge that such infringement by Defendants has been willful and deliberate;

1 D. Preliminarily enjoin Defendants, the affiliates, subsidiaries, officers, directors,
2 employees, agents, representatives, licensees, successors, and assigns of any of Defendants, and
3 all those acting for or in concert with any of Defendants, from any further infringement of the
4 '098 Patent, as provided by law;

5 E. Permanently enjoin Defendants, the affiliates, subsidiaries, officers, directors,
6 employees, agents, representatives, licensees, successors, and assigns of any of Defendants, and
7 all those acting for or in concert with any of Defendants, from any further infringement of the
8 '098 Patent, as provided by law;

9 F. Award compensatory damages to Plaintiffs, together with interest, as provided by
10 law;

11 G. Award treble damages to Plaintiffs for Defendants' willful infringement of the
12 '098 Patent, as provided by law;

13 H. Award Plaintiffs their costs and reasonable attorneys' fees under 35 U.S.C. § 285,
14 and as otherwise provided by law; and

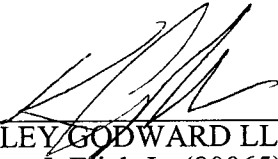
15 I. Award Plaintiffs such other relief as the Court deems just and proper.

16
17 **DEMAND FOR JURY TRIAL**

18 Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Plaintiffs hereby demand
19 trial by jury on all issues presented by this Action.
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1 Dated: June 14, 2004

ATS AUTOMATION TOOLING SYSTEMS, INC. and
THERMAL FORM & FUNCTION, LLC

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EXHIBIT A



US005494098A

United States Patent [19]

[11] Patent Number: 5,494,098

Morosas

[45] Date of Patent: Feb. 27, 1996

- [54] FAN DRIVEN HEAT SINK
- [75] Inventor: Christopher G. Morosas, Sutton, Mass.
- [73] Assignee: Wakefield Engineering, Inc., Wakefield, Mass.

- 5,287,249 2/1994 Chen .
- 5,297,617 3/1994 Herbert .
- 5,299,632 4/1994 Lee .
- 5,309,983 5/1994 Bailey .
- 5,368,094 11/1994 Hung 165/80.3

Primary Examiner—Allen J. Flanigan
Attorney, Agent, or Firm—Blodgett & Blodgett

- [21] Appl. No.: 261,678
- [22] Filed: Jun. 17, 1994
- [51] Int. CL⁶ H01L 23/36
- [52] U.S. Cl. 165/121; 165/80.3; 165/185; 361/697; 29/890.035
- [58] Field of Search 165/80.3, 122, 165/121, 185; 361/697, 709; 29/890.035

[57] ABSTRACT

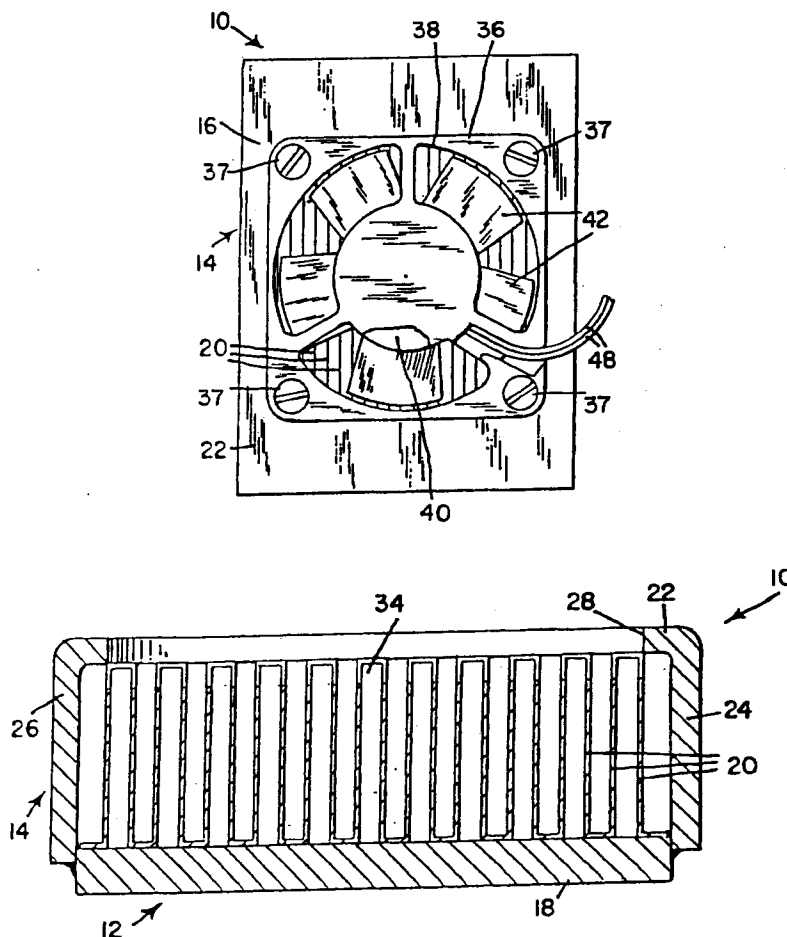
A fan driven heat sink assembly which includes a fan assembly mounted on a heat sink for mounting on a micro-processor unit. The heat sink has a solid flat base, a plurality of spaced cooling fins and a housing which is fixed to the base. The cooling fins are fixed to the base and extend from one flat surface of the base to a top wall of the housing. The top wall of the housing has an aperture which is aligned with an outlet opening of the fan assembly. The fins extend from a first end opening at one end of the housing to a second end opening at the opposite end of the housing. Airflow from the fan assembly extends from the opening in the top wall of the housing along the spaces between the fins and out through both end openings of the housing.

[56] References Cited

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12 Claims, 2 Drawing Sheets



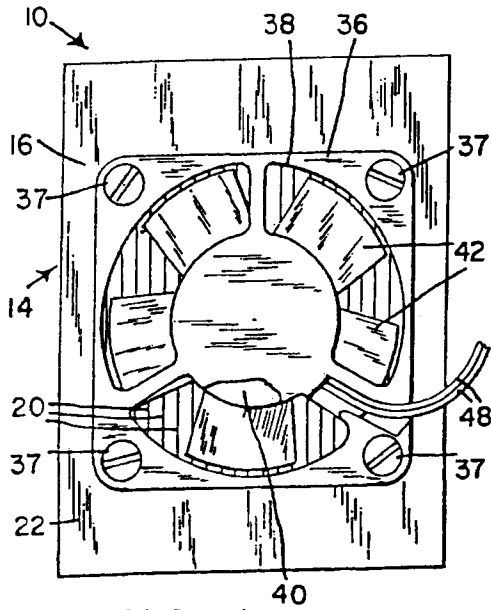


FIG. 1

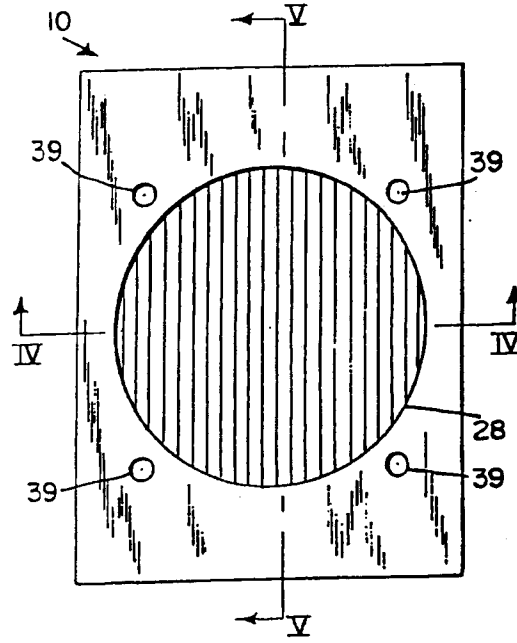


FIG. 3

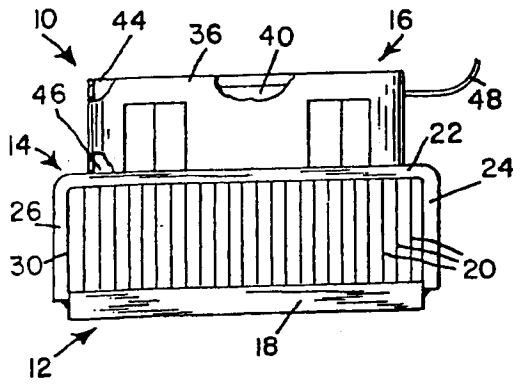


FIG. 2

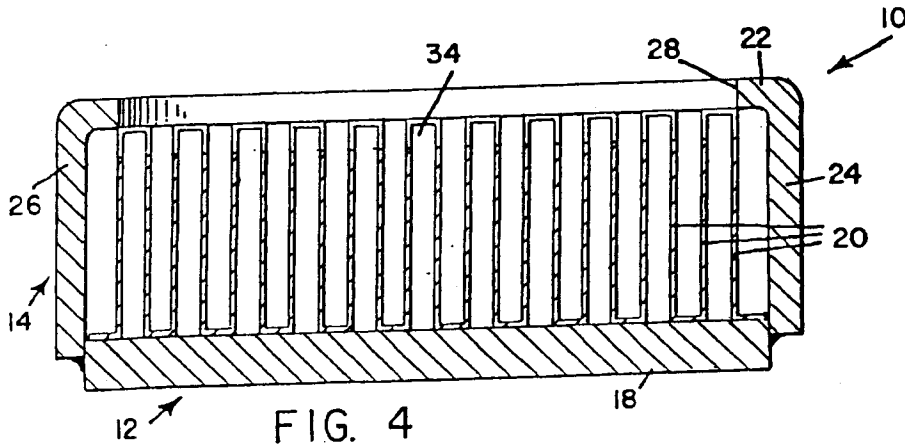
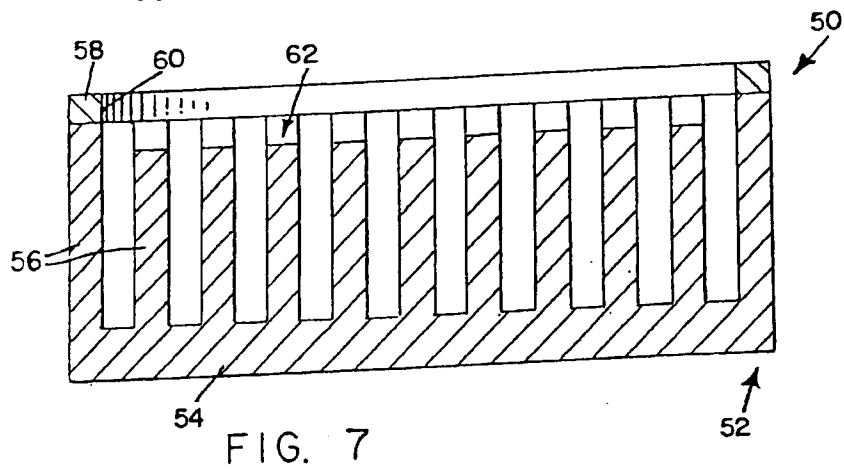
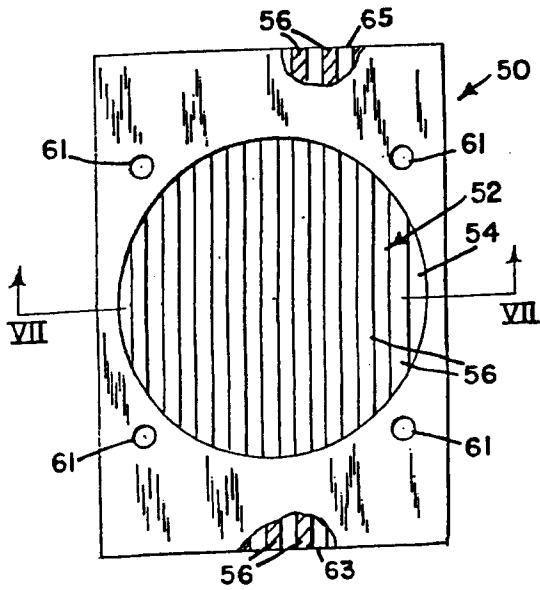
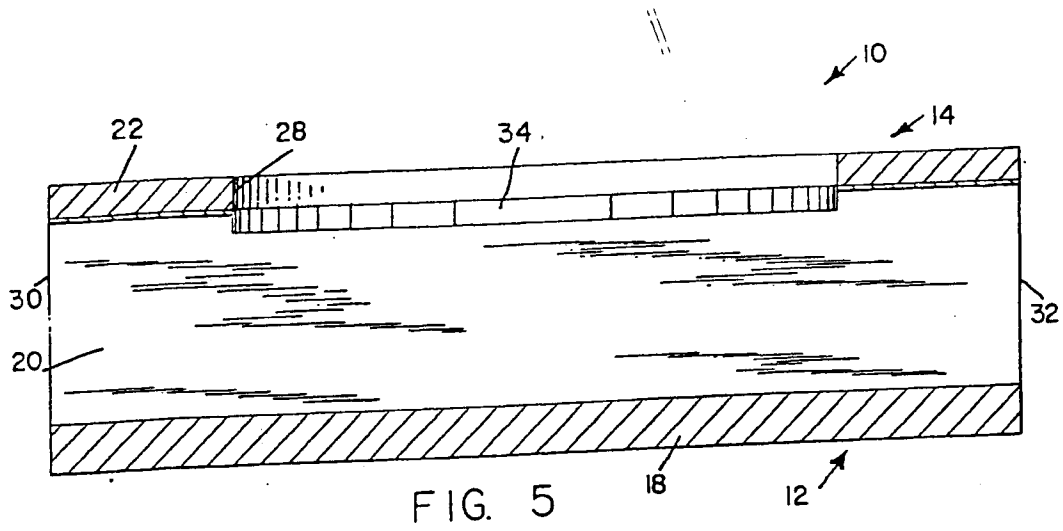


FIG. 4



FAN DRIVEN HEAT SINK

BACKGROUND OF THE INVENTION

The present invention is generally directed to a heat sink assembly for the removal of heat from a heat generating electronic device such as a microprocessor. The present invention is directed more specifically to a heat sink assembly which includes a small electric fan for creating an airflow along and through the heat transfer surface area of the heat sink.

A typical heat sink includes a solid base and a plurality of fins or pins which extend from the base. Heat is dissipated from the heat sink by free convection. The surface heat transfer characteristics of the heat sink are further enhanced by forced convection. In forced convection, an airflow is directed along and through the heat transfer surface element of the heat sink. Initially, forced convection was achieved by the implementation of blowers or fans within the cabinet or housing of a computer system. The advent of more powerful and high heat generating microprocessors rendered a general forced convection system obsolete. In order to cool the new microprocessors adequately, more sophisticated multiple level fan systems were required. This creates additional noise and consumption of space at the expense of electronic components. Also, the new systems were no longer reliable. These problems were solved to some degree by the development of fan driven heat sink packages. Such a package includes a fan which is mounted directly to a heat sink which, in turn, is mounted to a microprocessor. In one type of fan driven heat sink package, some of the fins or portions of the fins are removed to create a space for the fan. This saves space and enables the fan to be positioned close to the base of the heat sink. However, the loss of fin area and the limitation of airflow to the base and to the lower portions of the fins results in a substantial loss in cooling efficiency. For other fan driven heat sink assemblies, the fan is mounted directly on top of the fins or pins of the heat sink. In this type of assembly, air from the fan is directed to the pins or fins which are located below the fan at an initial air velocity. Air from the fan can exit the assembly quite readily through the spaces between the fins or pins just outside of the fan housing. Very little airflow is developed along the fins or pins and the airflow has very little velocity. The prior art fan driven heat sink assemblies have provided minimal improvement in cooling efficiency over general fan driven forced convection systems. These and other difficulties experienced with the prior art devices have been obviated by the present invention.

It is, therefore, a principle object of the present invention to provide a fan driven heat sink assembly which is capable of developing a substantial air pressure between the fan and the heat sink and capable of developing a high uniform velocity airflow along the surfaces of the fins of the heat sink to provide substantial improvement in heat dissipation efficiency.

Another object of the invention is to provide fan driven heat sink assembly which has a substantially higher fin surface area, which enhances the heat dissipation efficiency which is created by the positive or forced convection airflow along the surfaces of the fins.

A further object of the invention is the provision of a method of making a fan driven heat sink assembly which results in a higher cooling fin density and increased fin surface area.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

SUMMARY OF THE INVENTION

In general, the invention consists of a fan driven heat sink assembly which includes a fan assembly which is mounted on a heat sink which is adapted to be mounted on a microprocessor unit. The heat sink has a solid flat base and a housing which is fixed to the base and which has a top wall that is spaced from the base. A plurality of spaced parallel fins are fixed to the base and extend from the upper flat surface of the base to the top wall of the housing. The top wall of the housing has an aperture which is aligned with an outlet opening of the fan assembly. The fins extend from a first end opening at one end of the housing to a second end opening at the opposite end of the housing. Airflow from the fan assembly extends from the opening in the top wall of the housing along the spaces between the fins and out through both end openings of the housing. More specifically, the portions of the upper ends of the fins which are just below the aperture are spaced from the top wall of the housing to define a plenum chamber beneath the fan assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

The character of the invention, however, may best be understood by reference to one of its structural forms, as illustrated by the accompany drawings, in which:

FIG. 1 is a top plan view of a heat sink assembly embodying the principles of the present invention,

FIG. 2 is a front elevation of the heat sink assembly,

FIG. 3 is a top plan view of the heat sink assembly without the fan assembly which is one of the components of the heat sink assembly,

FIG. 4 is a vertical cross-sectional view on an enlarged scale of the heat sink assembly taken along the line IV—IV of FIG. 3,

FIG. 5 is a vertical cross-sectional view on an enlarged scale of the heat sink assembly taken along the line V—V of FIG. 3,

FIG. 6 is a top plan view of a modified heat sink assembly without the fan assembly, and

FIG. 7 is a vertical cross-sectional view on an enlarged scale taken along the line VII—VII of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the heat sink assembly of the present invention is generally indicated by the reference numeral 10. The assembly 10 includes a heat sink which is generally indicated by the reference numeral 12, a housing which is generally indicated by the reference numeral 14 and a fan assembly which is generally indicated by the reference numeral 16.

The heat sink comprises a solid generally rectangular base 18 and a plurality of spaced parallel fins 20 which are fixed to the top surface of the base and which extend upwardly from the base.

The housing 14 has an inverted U-shaped cross-sectional configuration and includes a top wall 22 and a pair of side walls 24 and 26. The lower ends of the side walls 24 and 26 are fixed to the base 18 of the heat sink. The top wall 22 has

a circular opening or aperture 28. The top wall 22 and the base 18 and the side walls 24 and 26 define a generally rectangular first end opening 30 and a generally rectangular second end opening 32, see FIG. 5. The fins 20 are fixed at their lower ends to the base 18 and at their upper ends to the top wall 22, except for the circular opening 28. In addition, the upper ends of the portions of the fins 20 which are vertically aligned with the opening 28 are spaced from the top wall 22 and define a plenum chamber 34 below the opening 28. The fins 20 are preferably made from a single continuous sheet of heat conductive and heat dissipating material which is bent into a sinuous or serpentine configuration as shown in FIG. 4. The bottom loops of the material are fixed to the upper surface of the base 18. The upper loops of the material are fixed to the bottom surface of the top wall 22 of the housing. The portions of the top loops of the fin material which are located directly below the opening 28 are severed. The upper ends of the severed portions of the fins are located in a horizontal plane which is spaced below the horizontal plane of the bottom surface of the top wall 22, as shown in FIGS. 4 and 5, to form the plenum chamber 34.

The fan assembly 16 includes a fan housing 36 which is fixed to the wall 22 by screws 37. The screws 37 are threaded into threaded holes 39 in the top wall 22. The fan housing 36 has a circular bore 38 which has a circular top opening 44 and a circular bottom opening 46. The bore 38 and the openings 44 and 46 are vertically aligned with the top opening 28 in the top wall 22. A rotor 40 is located within the bore 38 and is supported by the housing 36 for rotation about a vertical axis. A plurality of fan blades 42 are fixed to the rotor 40 and extend radially from the rotor within the bore 38. The rotor 40 is electrically driven and is operatively connected to a source of electrical power, not shown, by a pair of wires 48. The bottom opening 46 is at the top surface of the top wall 22 and fan blades 42 are very close to the bottom opening 46. During operation of the invention, the rotor 40 is rotated so that the blades 42 draw ambient air into the bore 38 through the top opening 44. The air is forced against the tops of the exposed fins 20 which are located below the opening 28. Pressurized air from the fan enters plenum chamber 34 which helps to distribute the pressurized air evenly in all of the spaces between the fins 20 and a high velocity air flow is created in the spaces between the fins 20. Air flows from the plenum chamber 34 to the first and second end openings 30 and 32, respectively. The combination of high fin surface area and high airflow velocity is very effective in removing heat by active convection from the heat sink 12.

The heat sink assembly 10 is constructed by folding a predetermined length of thermally conductive material such as aluminum, aluminum alloy or copper strip into the serpentine configuration shown in FIG. 4 to form the fins 20. The fins 20 are positioned on a solid block of aluminum or aluminum alloy which serves as the base 18. A section of U-shaped aluminum or aluminum alloy channel material is placed on top of the fins in an inverted position so that the legs of the channel member overlap the side edges of the base 18 as shown in FIG. 4 to define the housing 14. The opening 28 and the tapped holes 39 can be formed prior to assembly or after. After housing 14 and the fins 20 have been positioned relative to the base 18 as shown in FIG. 4, these elements are brazed or otherwise bonded, i.e. epoxy, together to form an integral unit. The top portions of the fins 20 which are vertically aligned with the opening 28 are then milled to form the plenum chamber 34. Thereafter, the fan assembly is attached to the top wall 22 to complete the heat sink assembly 10.

Referring to FIGS. 6 and 7, there is shown a modified fan driven heat sink assembly which is generally indicated by the reference numeral 50. The assembly 50 includes a conventional heat sink which is generally indicated by the reference numeral 52 and a flat top plate 58. The heat sink 52 includes a solid base portion 54 and a plurality of spaced parallel fins 56 which extend upwardly from the upper surface of the base 54. The top plate 58 is brazed to the top edges of the fins 56 so that it is spaced from the base 54. The top plate 58 has a central circular opening or aperture 60 and a plurality of threaded apertures 61 for receiving the screws 37 of the fan assembly 16. The upper portions of the fins 56 which lie beneath the circular opening 60 are milled to a level which is below the bottom surface of the top plate 58. This creates a plenum chamber 62 beneath the top plate 58. The assembly 50 functions in the same manner as the assembly 10. Air from the fan assembly 12 enters the plenum chamber 62 through the opening 60. Super atmospheric air from the fan enters plenum chamber 62 and air flows uniformly from the chamber 62 at a substantial velocity along the channels which are defined by the spaced fins 56 to first and second end openings 63 and 65, respectively, at the outer ends of the fins 56.

Clearly, minor changes may be made in the form and construction of this invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

1. A heat sink assembly for use in removal of heat from a heat generating electronic device, said heat sink assembly comprising:

- (a) a solid flat base;
 - (b) a housing which is fixed relative to said base, said housing having a top wall which is spaced from said base, and side walls which extend from said base to said top wall, a first end opening at a first end of said base which is defined by said base, side walls and top wall, a second end opening which is defined by said base, side walls and top wall at a second end of said base which is opposite said first end opening, and an aperture in said top wall which is spaced from said first and second end openings;
 - (c) a plurality of parallel spaced fins which are fixed to said base, said fins extending from said base to said top wall, said fins defining with said base and said top wall a plurality of channels which extends from said first end opening to said second end opening, the portions of said channels which lie beneath said aperture being open to said aperture; and
 - (d) a fan assembly which is fixed to said top wall above said aperture for blowing air through said aperture and creating an airflow through said channels from said aperture to each of said first and second end openings.
2. A heat sink assembly as recited in claim 1, wherein said fan assembly comprises:

- (a) a fan housing which is fixed to said top wall, said fan housing having a bottom opening at said aperture and a top opening; and
 - (b) a rotor which has at least one fan blade, said rotor being rotatably mounted within said fan housing between said bottom and top openings.
3. A method of forming a fan driven heat sink assembly comprising the following steps:

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- (a) folding a length of sheet metal into a continuous serpentine configuration to define a fin assembly which has a plurality of spaced parallel fins, each of said fins being connected to a first adjacent fin by a first end loop at a first end of said fins and connected to a second adjacent fin by a second end loop at a second end of said fins which is opposite said first end;
- (b) positioning said fin assembly on the upper surface of a flat metal base so that the first end loops rest on said upper surface and said fins extend vertically from said base;
- (c) positioning an inverted U-shaped metal housing on top of the second loops of said fin assembly, said housing having a flat horizontal top wall which rests on said second loop and a pair of vertical legs which lie outside of said pin assembly and which abut said base;
- (d) fixing the fin assembly to the top wall of the housing and to the base and fixing the legs of the housing to the base;
- (e) forming an aperture in the top wall of the housing to expose portions of said second loops;
- (f) severing the exposed portions of said second loops which are below said apertures to expose the spaces between the fins which are below the severed portions of said second loops to said aperture; and
- (g) attaching a fan assembly to said top wall above said aperture for blowing air through said aperture against said fins and creating an airflow in the spaces between said fins.

4. A method of forming a fan driven heat sink assembly as recited in claim 3, wherein said fins are fixed to said top wall and to said base by brazing and the legs of said housing are fixed to said base by brazing.

5. A method of forming a fan driven heat sink assembly as recited in claim 3, wherein said housing, said fin assembly and said base are formed essentially of aluminum.

6. A method of forming a fan driven heat sink assembly as recited in claim 3, wherein the upper end portions of said fins are severed are located in a horizontal plane which is spaced from the top wall of said housing to define a plenum chamber below said aperture.

7. A heat sink assembly for use in removal of heat from a heat generating electronic device, said heat sink assembly comprising:

- (a) a flat base wall;
- (b) a housing which is fixed relative to said base wall, said housing having a top wall which is spaced from said base wall, and side walls which extend from said base wall to said top wall, a first end opening at a first end of said base wall which is defined by said base wall, said side walls and said top wall, a second end opening which is defined by said base wall, said side walls and said top wall at a second end of said base wall which is opposite said first end, and an aperture in said top wall which is spaced from said first and second end openings;
- (c) a plurality of parallel spaced fins which are fixed to said base wall, said fins extending from said base wall to said top wall, said fins defining with said base and said top wall a plurality of channels which extends from said first end opening to said second end opening, the portions of said channels which lie beneath said aperture being open to said aperture; and
- (d) a fan assembly which is fixed to said top wall above said aperture for blowing air through said aperture and

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creating an airflow through said channels from said aperture to each of said first and second end openings, said fan assembly comprising:

(1) a fan housing which is fixed to said top wall, said fan housing having a bottom opening at said aperture and a top opening; and

(2) a rotor which has at least one fan blade, said rotor being rotatably mounted within said fan housing between said bottom and top openings, said fan blade being spaced from the fins so as to define a plenum chamber between said blade and said fins.

8. A heat sink assembly as recited in claim 7, wherein the portions of said fins which are directly below said aperture are below the level of said top wall and are vertically spaced from said aperture.

9. A heat sink assembly for use in removal of heat from a heat generating electronic device, said heat sink assembly comprising:

(a) a flat base wall;

(b) a housing which is fixed relative to said base wall, said housing having a top wall which is spaced from said base wall, and side walls which extend from said base wall to said top wall, a first end opening at a first end of said base wall which is defined by said base wall, said side walls and said top wall, a second end opening which is defined by said base wall, said side walls and said top wall at a second end of said base wall which is opposite said first end, and an aperture in said top wall which is spaced from said first and second end openings;

(c) a plurality of parallel spaced fins which are fixed to said base wall, said fins extending from said base wall to said top wall, said fins defining with said base wall and said top wall a plurality of channels which extends from said first end opening to said second end opening, the portions of said channels which lie beneath said aperture being open to said aperture, said fins being a single continuous length of material which extends transversely of said channels, each of said fins having an upper end which is connected to the upper end of an adjacent fin and a lower end which is connected to the lower end of a different adjacent fin, the portions of said fins which are vertically aligned with said aperture being unconnected at their upper ends so that all of said channels are operatively connected to said aperture; and

(d) a fan assembly which is fixed to said top wall above said aperture for blowing air through said aperture and creating an airflow through said channels from said aperture to each of said first and second end openings.

10. A method of forming a fan driven heat sink assembly comprising the following steps:

(a) forming a heat sink body having a solid base which has a flat horizontal upper surface, said heat sink body having a plurality of spaced parallel fins which are fixed to the base and which extend vertically from said upper surface to upper free ends;

(b) fixing a flat plate to the upper free ends of said fins to form airflow channels which extend from a first end of said plate to a second end of said plate;

(c) forming an aperture in said plate which is spaced from said first and second ends to expose portions of the upper ends of said fins so that portions of said airflow channels are open to said aperture;

(d) reducing the height of the portions of said fins which are vertically aligned with said aperture relative to the

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remaining portions of said fins to form a plenum chamber below said aperture; and

(e) attaching a fan assembly to said plate, said fan assembly having an outlet opening for airflow which is created by said fan assembly, said outlet opening being operatively connected to said aperture so that air flow from said fan assembly enters said airflow channels from said aperture and proceeds along said airflow channels to each of said first and second ends.

11. A heat sink assembly for use in removal of heat from a heat generating electronic device, said heat sink assembly comprising:

- (a) a solid flat base;
- (b) a plurality of spaced substantially parallel fins which extends vertically from said base to define a plurality of channels between said fins, each of said fins having a lower end which is fixed to said base and an upper end, each of said fins extending horizontally from a first end to a second end, each of said channels having a first end opening at said first end and a second end opening at said second end;

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(c) a flat top wall which is fixed relative to said fins and said flat base and abuts the upper ends of said fins, said top wall being parallel to the base and extending from said first end opening to said second end opening, said top wall having an aperture for providing an inlet opening to each of said channels, said aperture being spaced substantially from each of said first and second end openings so that the portions of each of said channels which extends from each of said first and second end openings to said aperture is a tubular duct which is defined by two adjacent fins, said bottom wall and said top wall; and

(d) a fan assembly which is operatively connected to said aperture for blowing air through said aperture and for creating an airflow within said channels from said aperture to each of said first and second openings.

12. A heat sink as recited in claim 11, wherein each of said first and second outlet openings is defined by said first and last of said plurality of fins, said base and said top wall.

* * * * *

ASSIGNMENT

For good and valuable consideration, the receipt of which is hereby acknowledged, Robinson Fin Machines, Inc. (the "Assignor"), an Indiana corporation having a place of business at 13670 Highway 68 South, Kenton, Ohio 43326, hereby assigns and transfers to Thermal Form & Function, LLC (the "Assignee"), an Ohio limited liability company having a place of business at 74A Summer Street, Manchester, Massachusetts 01944, its successors and assigns all of the Assignor's right, title and interest in and to U.S. Patent No. 5,494,098 (the "'098 Patent") including, without limitation, all rights to sue at law or in equity for any and all past, present or future infringement of the '098 Patent, and to receive all income, royalties, damages, and other payments therefrom, the same to be held and enjoyed by the Assignee, its successors and assigns, as fully as the same would have been held and enjoyed by the Assignor had this assignment not been made. Assignor agrees to authorize and request any official whose duty it is to issue patents to record this subsequent assignment document for the '098 Patent, and agrees that on request and without further consideration, but at the expense of Assignor, Assignor will communicate to the Assignee or its representatives or nominees any facts known to Assignor respecting the '098 Patent, testify in any legal proceedings, sign all lawful papers, execute all reissue applications, make all rightful oaths and generally do everything possible to aid the Assignee, its successors, assigns and nominees to obtain and enforce proper patent protection of the '098 Patent.

Robinson Fin Machines, Inc.

Mark Haushalter

Signature

Mark Haushalter

Printed Name

VP Eng / Mfg

Title

4/9/03

Date

The foregoing instrument was acknowledged before me this 9th day of April, 2003

by Sheryl A. Haushalter Herron

Sheryl A. Haushalter Herron
NOTARY PUBLIC

My Commission Expires: October 19, 2005

EXHIBIT B

Form PTO-1595
(Rev. 6-93)
OMB No. 0652-0011 (exp



RECORDATION FORM COVER SHEET
PATENTS ONLY

U.S. Department of Commerce
Patent and Trademark Office

48 10/581 AD

To the Honorable Commissioner of Patents and Trademarks. Please record the attached original documents or copy thereof.

1. Name of conveying party(ies):
Christopher G. Morozas

Additional name(s) of conveying party(ies) attached? Yes No

2. Name and address of receiving party(ies):
Name: WAKEFIELD ENGINEERING, INC.
Internal Address: _____
Street Address: 60 Ardson Road
City Wakefield State Massachusetts ZIP 01880
Country U.S.A.
Additional name(s) & address(es) attached? Yes No

RECEIVED
SEP 10 10 18 AM '94
ASSIGNMENT BRANCH

3. Nature of Conveyance:
 Assignment Merger
 Security Agreement Change of Name
 Other _____
Execution Date: August 11, 1994

RECEIVED
SEP 08 1994
APPLICATION BRANCH

4. Application number(s) or patent number(s):
If this document is being filed together with a new application, the execution date of the application is: _____
A. Patent Application No(s) U.S. Serial No. 08/261,678
B. Patent No(s) _____

5. Name and address of party to whom correspondence concerning document should be mailed:
Name: Garry J. Madgett, Esquire
Internal Address: MADGETT & MADGETT, P.C.
Street Address: 43 Highland Street
City: Worcester State MA Zip 01609-2797

6. Total number of applications and patents involved: _____
7. Total fee (37 CFR 3.41): \$ 40.00
 Enclosed
 Authorized to be charged to deposit account
8. Deposit Account number: 02-2138
(Attach duplicate copy of this page if paying by deposit account)

DO NOT USE THIS SPACE

9. Statement and signature:
I, Wilfred F. DeRosier, Reg. No. 25,531, do hereby certify that the foregoing information is true and correct and any attached copy is a true copy of the original document.
Signature: Wilfred F. DeRosier Date: 17 Aug 1994
Total number of pages including cover sheet, attachments, and documents: 2

Mail documents to be recorded with required cover sheet information to:
Commissioner of Patents & Trademarks, Box Assignments
Washington, D.C. 20231
93711917

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SEP 10 10 18 AM '94
ASSIGNMENT BRANCH

ASSIGNMENT

In consideration of the sum of One Dollar (\$1.00) or equivalent and other good and valuable consideration paid to each of the undersigned: Christopher G. Morosas the undersigned hereby sell(s) and assign(s) to Wakefield Engineering, Inc. (the Assignee) the entire right, title and interest

check applicable box(es) for the United States of America (as defined in 35 U.S.C. § 100), and throughout the world,

in the invention(s) known as FAN DRIVEN HEAT SINK for which application(s) for patent in the United States of America has (have) been executed by the undersigned on June 17, 1994 (also known as United States Application Serial No. 08/261,678, filed June 17, 1994), in any and all applications thereon, in any and all Letters Patent(s) therefor, and in any and all reissues, extensions, renewals, reexaminations, divisions and continuations of such applications or Letters Patent(s) to the full end of the term or terms for which such Letters Patent(s) issue, such entire right, title and interest to be held and enjoyed by the above-named Assignee in the same as they would have been held and enjoyed by the undersigned had this assignment and sale not been made.

The undersigned agree(s) to execute all papers necessary in connection with the application(s) and any continuing, divisional, reissue, reexamination or corresponding application(s) thereof and also to execute separate assignments in connection with such applications as the Assignee may deem necessary or expedient.

The undersigned agree(s) to execute all papers necessary in connection with any interference which may be declared concerning the application(s) or any continuation, division, reissue or reexamination thereof and to cooperate with the Assignee in every way possible in obtaining evidence and going forward with such interference.

The undersigned hereby covenant(s) that he has (they have) full right to convey the entire interest herein assigned, and that he has (they have) not executed, and will not execute, any agreement in conflict therewith.

The undersigned hereby grant(s) Gerry A. Blodgett, Esquire, Registration No. 26,090 and Wilfred F. DesRosiers, Patent Agent, Registration No. 35,531 of BLODGETT & BLODGETT, P.C., 43 Highland Street, Worcester, Massachusetts 01609, power to insert on this assignment any further identification which may be necessary or desirable in order to comply with the rules of the United States Patent and Trademark Office for recordation of this document.

IN WITNESS WHEREOF, executed by the undersigned on the date(s) opposite the undersigned name(s).

Date: 8-11-94 Signature of Inventor: [Signature]
Christopher G. Morosas

Date: _____ Signature of Inventor: _____
RECORDED
PATENT & TRADEMARK OFFICE

Date: _____ Signature of Inventor: _____
AUG 19 94

Date: _____ Signature of Inventor: _____

BLODGETT & BLODGETT, P.C.
43 Highland Street
Worcester, MA 01609-2797
(508) 753-5533

REC-7181-RMS927

EXHIBIT C

1100 5-27-99
RFM113PA-ASG

FORM PTO-1590 (Modified)
(Rev. 6-93)
OMB No. 0651-0011 (exp. 4/94)
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POBA/REV02

RECORDA
PA

06-03-1999

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office



101053561

Tab settings → → → ▼ ▼ ▼
To the Honorable Commissioner of Patents and Trademarks: Please record the attached original documents or copy thereof.

1. Name of conveying party(ies):
Wakefield Engineering, Inc.
by **James Polakiewicz, Vice-President Finance**

Additional names(s) of conveying party(ies) Yes No

2. Name and address of receiving party(ies):
Name: **Robinson Fin Machines, Inc.**
Address: **13670 Hwy 68 South**

City: **Kenton** State/Prov.: **OH**
Country: **USA** ZIP: **43311**

Additional name(s) & address(es) Yes No

3. Nature of conveyance:
 Assignment Merger
 Security Agreement Change of Name
 Other _____

Execution Date: **March 4, 1999**

4. Application number(s) or registration numbers(s):
If this document is being filed together with a new application, the execution date of the application is: _____

Patent Application No.	Filing date	B. Patent No.(s)
		5,494,098

Additional numbers Yes No

5. Name and address of party to whom correspondence concerning document should be mailed:
Name: **Barbara Joan Haushalter**
Registration No. **33,598**
Address: **Law Office**
228 Bent Pines Court

City: **Bellefontaine** State/Prov.: **OH**
Country: **USA** ZIP: **43311**

6. Total number of applications and patents involved: **1**

7. Total fee (37 CFR 3.41):.....\$ **40.00**
 Enclosed - Any excess or insufficiency should be credited or debited to deposit account
 Authorized to be charged to deposit account

8. Deposit account number: _____

06/01/1999 BUDYEN 00000002 5494098 DO NOT USE THIS SPACE
04-FC-501 40.00 00

9. Statement and signature.
To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.
Barbara Joan Haushalter *Barbara Joan Haushalter* **May 18, 1999**
Name of Person Signing Signature Date

Total number of pages including cover sheet, attachments, and **2**

PATENT

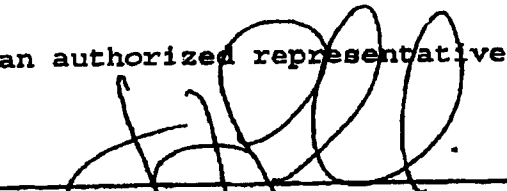
REEL: 009987 FRAME: 0088

ASSIGNMENT

In consideration of One Dollar and other good and valuable consideration, of which we acknowledge receipt, **Wakefield Engineering, Inc.**, a corporation of the United States having a place of business at 100 Cummings Center, Beverly, Massachusetts, 09015, does hereby sell and assign to **Robinson Fin Machines, Inc.**, a corporation of the United States having a place of business at 13670 highway 68 South, Kenton, Ohio 43326, its successors and assigns the entire right, title and interest in and to U.S. Patent No. 5,494,098, owned by Wakefield via an assignment document recorded in the United States Patent and Trademark Office, and authorize and request any official whose duty it is to issue patents, to record this subsequent assignment document for that patent, and agree that on request and without further consideration, but at the expense of Wakefield, we will communicate to Robinson Fin Machines or its representatives or nominees any facts known to us respecting said patent, testify in any legal proceeding, sign all lawful papers, execute all reissue applications, make all rightful oaths and generally do everything possible to aid Robinson Fin Machines, its successors, assigns, and nominees to obtain and enforce proper patent protection for said patent.

I hereby set my hand and seal, as an authorized representative of Wakefield Engineering, Inc., on

MARCH 4 1999


 (Signature)
VP FINANCE
 (Title)

State of: Massachusetts

County of: Middlesex

This 4th day of March, 1999, before me personally came the above-named James Polakiewicz, to me personally known as the individual who executed the foregoing assignment on behalf of Wakefield Engineering, Inc., who acknowledged to me that he/she executed the same of his/her own free will for the purpose therein set forth.


 My Commission Expires Jan. 21, 2005

(SEAL)

EXHIBIT D

ASSIGNMENT

For good and valuable consideration, the receipt of which is hereby acknowledged, Robinson Fin Machines, Inc. (the "Assignor"), an Indiana corporation having a place of business at 13670 Highway 68 South, Kenton, Ohio 43326, hereby assigns and transfers to Thermal Form & Function, LLC (the "Assignee"), an Ohio limited liability company having a place of business at 74A Summer Street, Manchester, Massachusetts 01944, its successors and assigns all of the Assignor's right, title and interest in and to U.S. Patent No. 5,494,098 (the "'098 Patent") including, without limitation, all rights to sue at law or in equity for any and all past, present or future infringement of the '098 Patent, and to receive all income, royalties, damages, and other payments therefrom, the same to be held and enjoyed by the Assignee, its successors and assigns, as fully as the same would have been held and enjoyed by the Assignor had this assignment not been made. Assignor agrees to authorize and request any official whose duty it is to issue patents to record this subsequent assignment document for the '098 Patent, and agrees that on request and without further consideration, but at the expense of Assignor, Assignor will communicate to the Assignee or its representatives or nominees any facts known to Assignor respecting the '098 Patent, testify in any legal proceedings, sign all lawful papers, execute all reissue applications, make all rightful oaths and generally do everything possible to aid the Assignee, its successors, assigns and nominees to obtain and enforce proper patent protection of the '098 Patent.

Robinson Fin Machines, Inc.

Mark Haushalter

Signature

Mark Haushalter

Printed Name

VP Eng / Mfg

Title

4/9/03

Date

The foregoing instrument was acknowledged before me this 9th day of April, 2003

by Sheryl A. Haushalter Herron

Sheryl A. Haushalter Herron
NOTARY PUBLIC

My Commission Expires: October 19, 2005