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(54) HEAT-DISSIPATING MODULE, FAN STRUCTURE AND IMPELLER THEREOF

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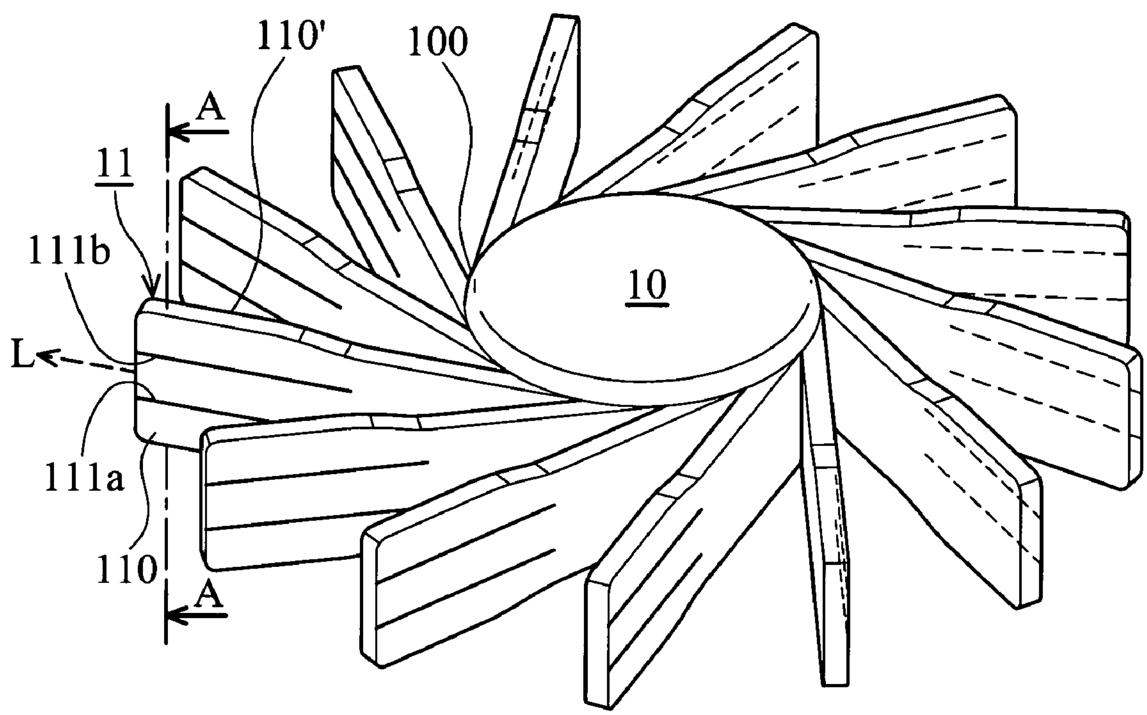
(52) **U.S. Cl.** .... **416/236 R**

(57) **ABSTRACT**

A heat-dissipating module, a fan structure and an impeller. The heat-dissipating module comprises a fan structure providing the impeller to expel heat from a heat source. The impeller comprises a main body and a plurality of blade units. The main body has abase surface, and the blade units extending from the base surface of the main body. Each blade unit comprises a blade surface and a plurality of guiding portions disposed on the blade surface. The pattern of the guiding portions can be linear, curved, parallel or symmetrical, indented on or protruded from the blade units.

F1



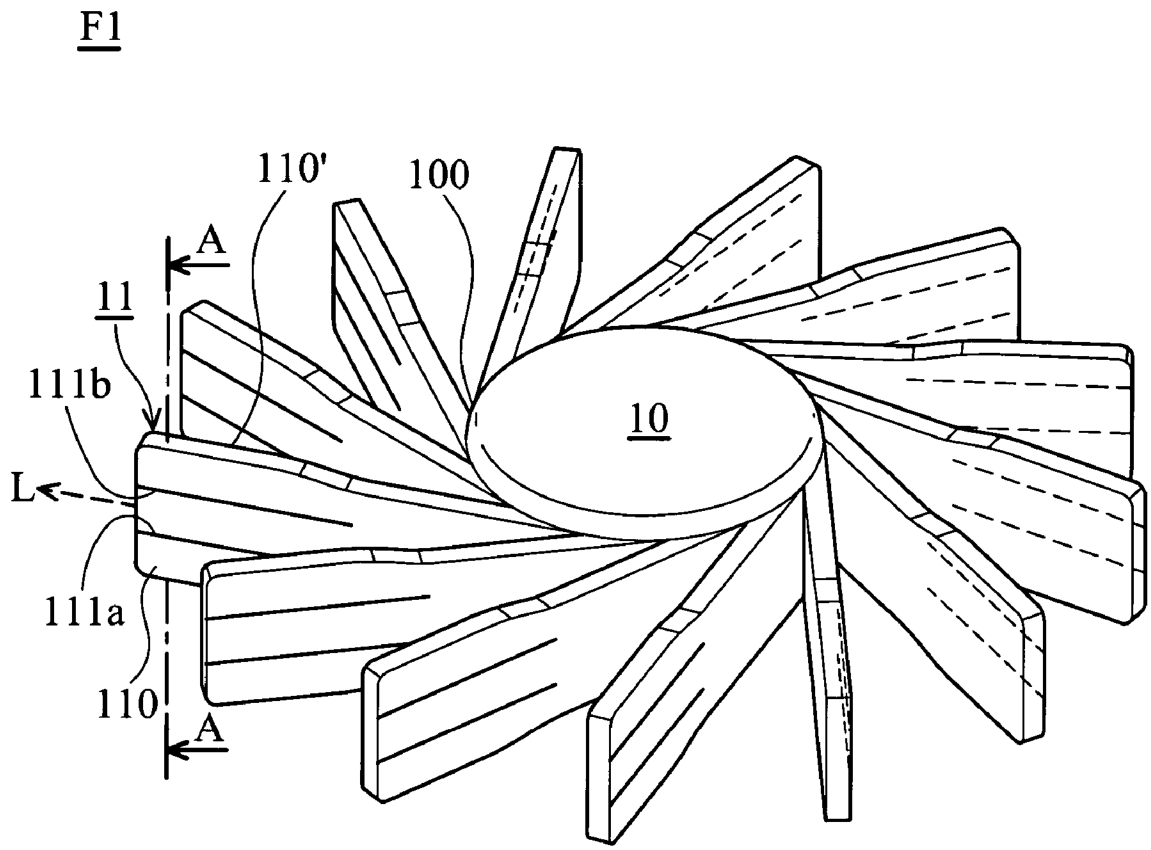


FIG. 1

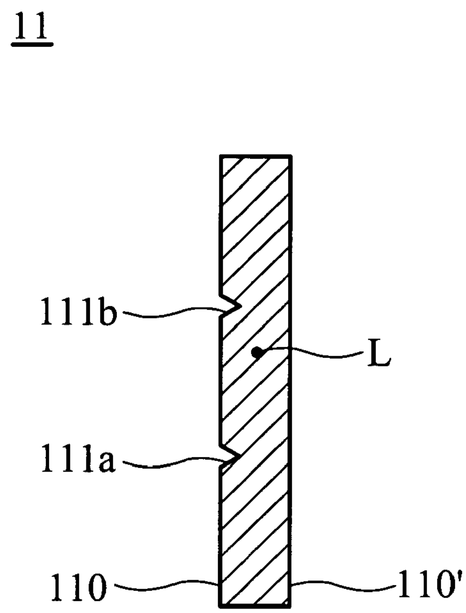


FIG. 2A

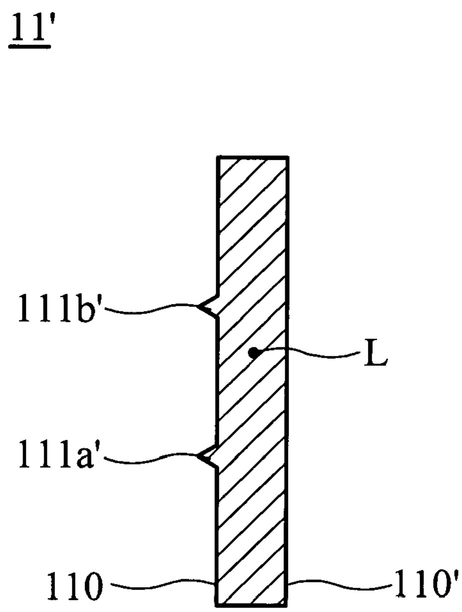


FIG. 2B

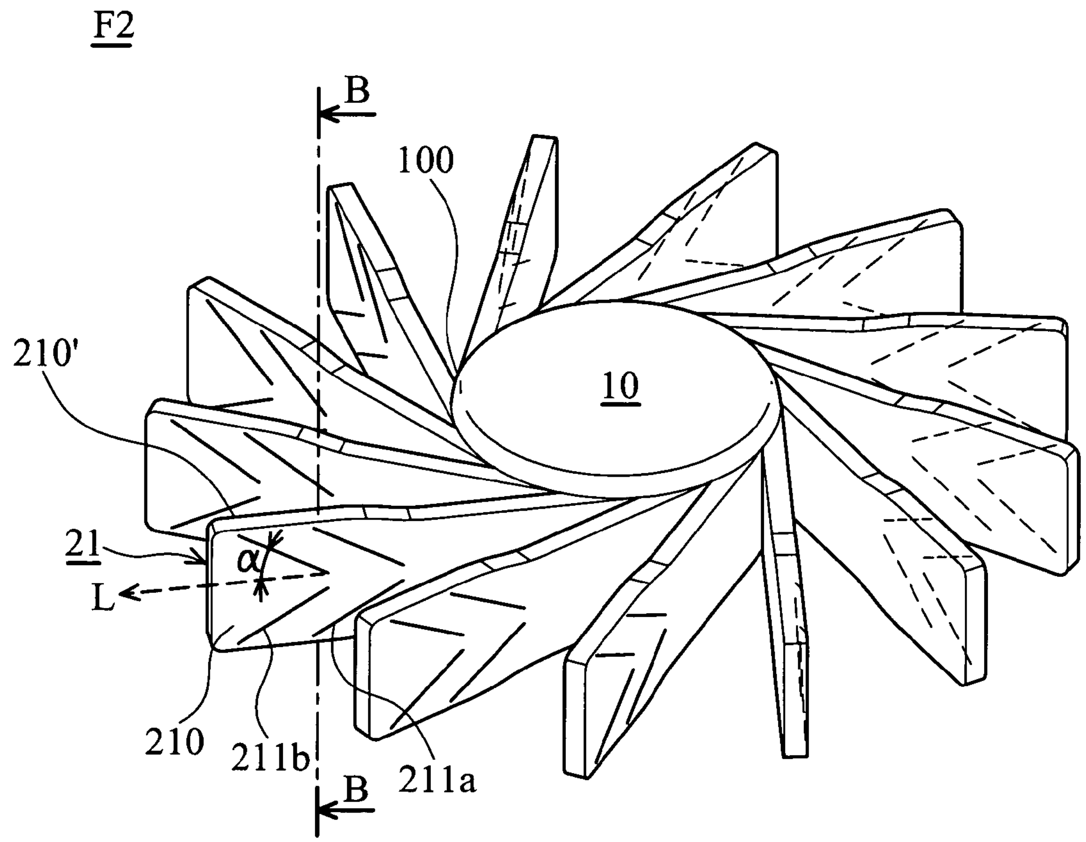


FIG. 3

21

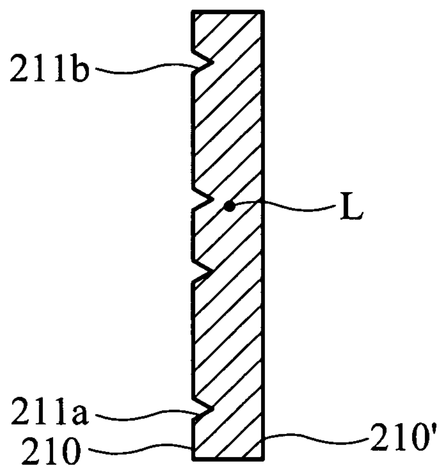


FIG. 4A

21'

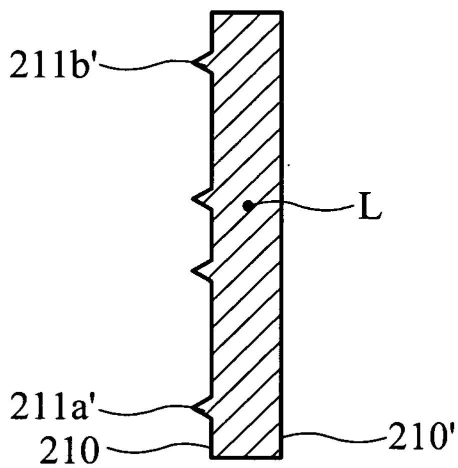


FIG. 4B

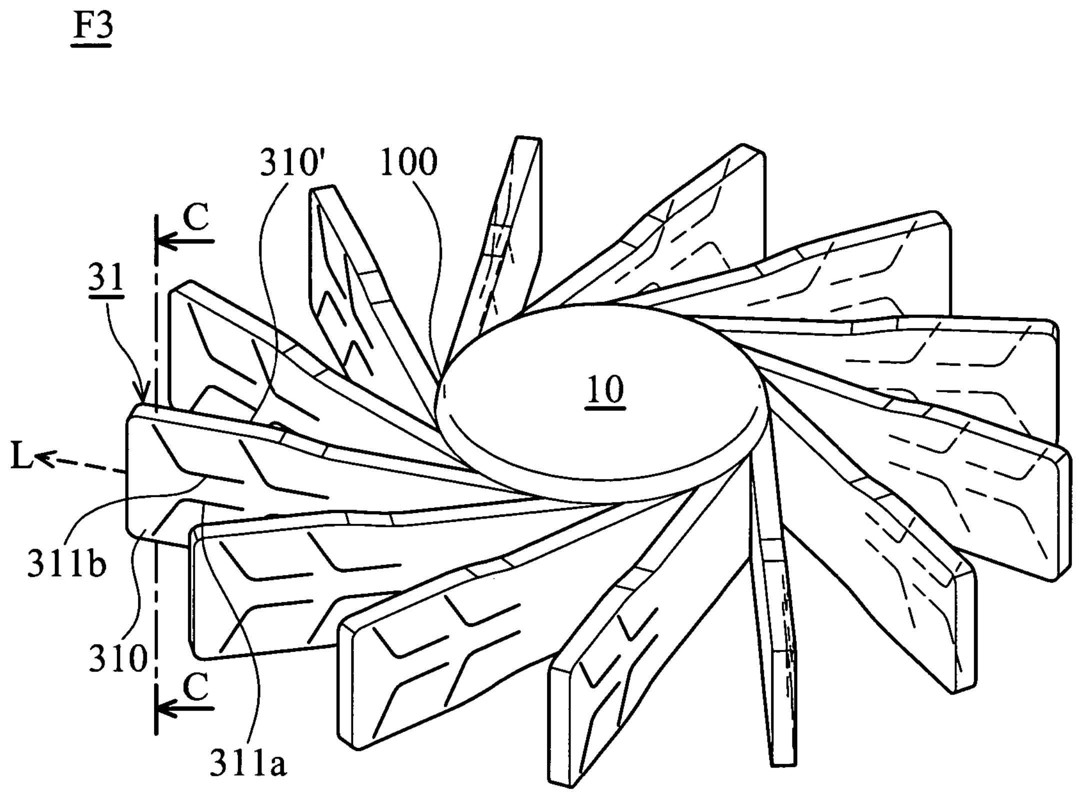


FIG. 5

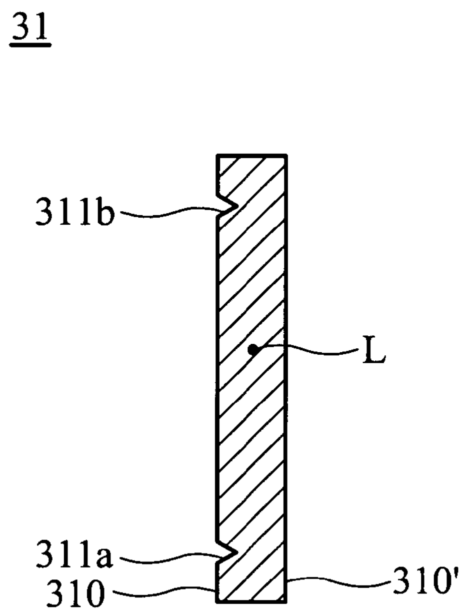


FIG. 6A

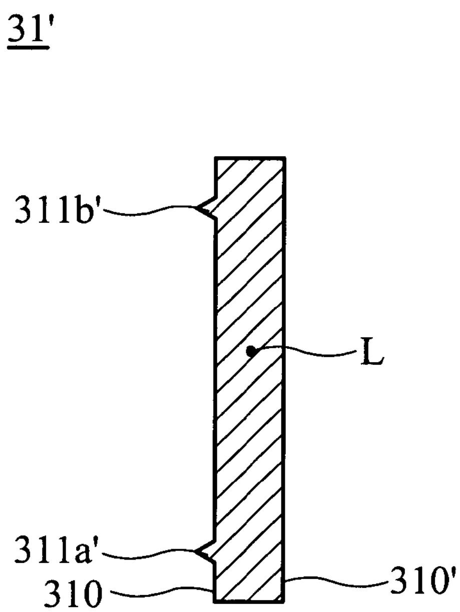


FIG. 6B

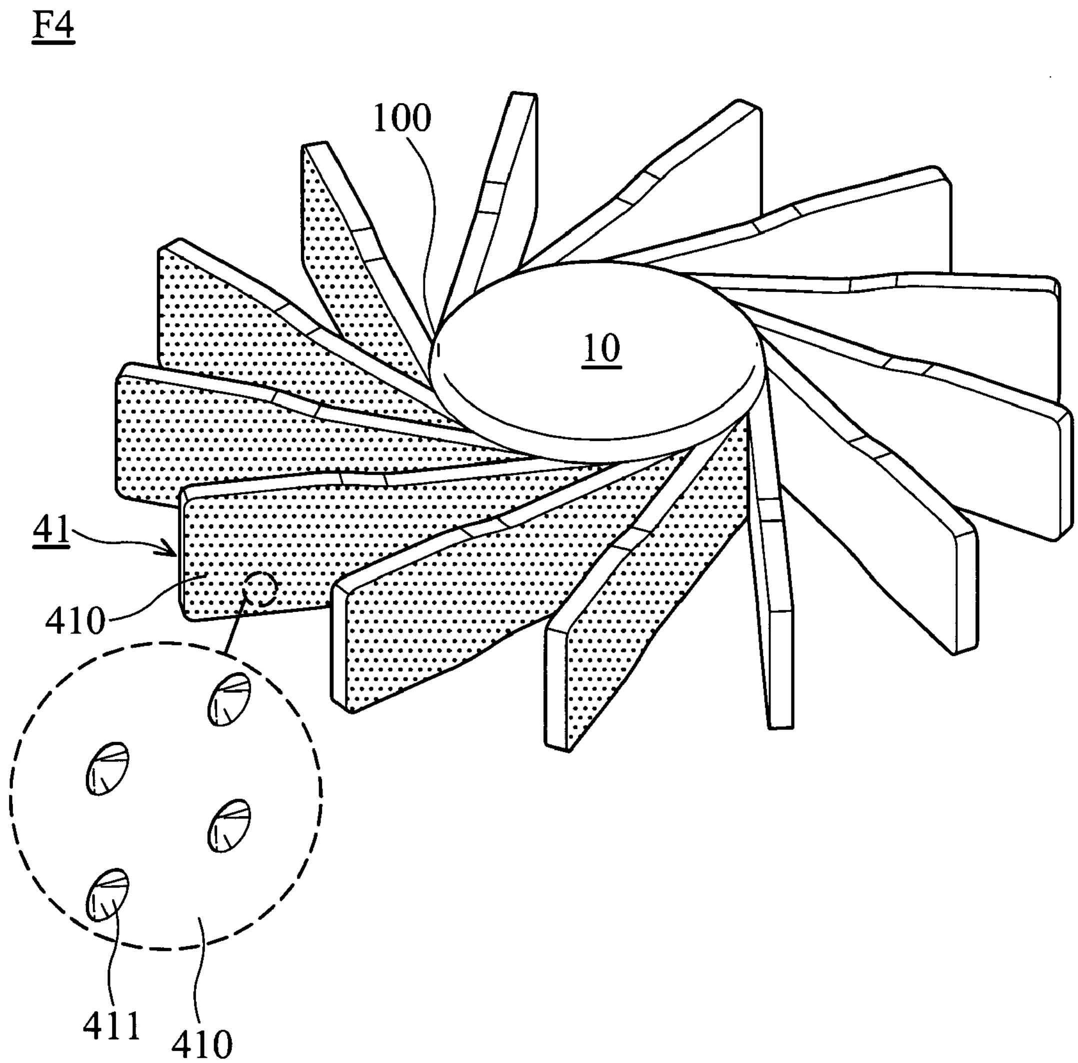


FIG. 7A

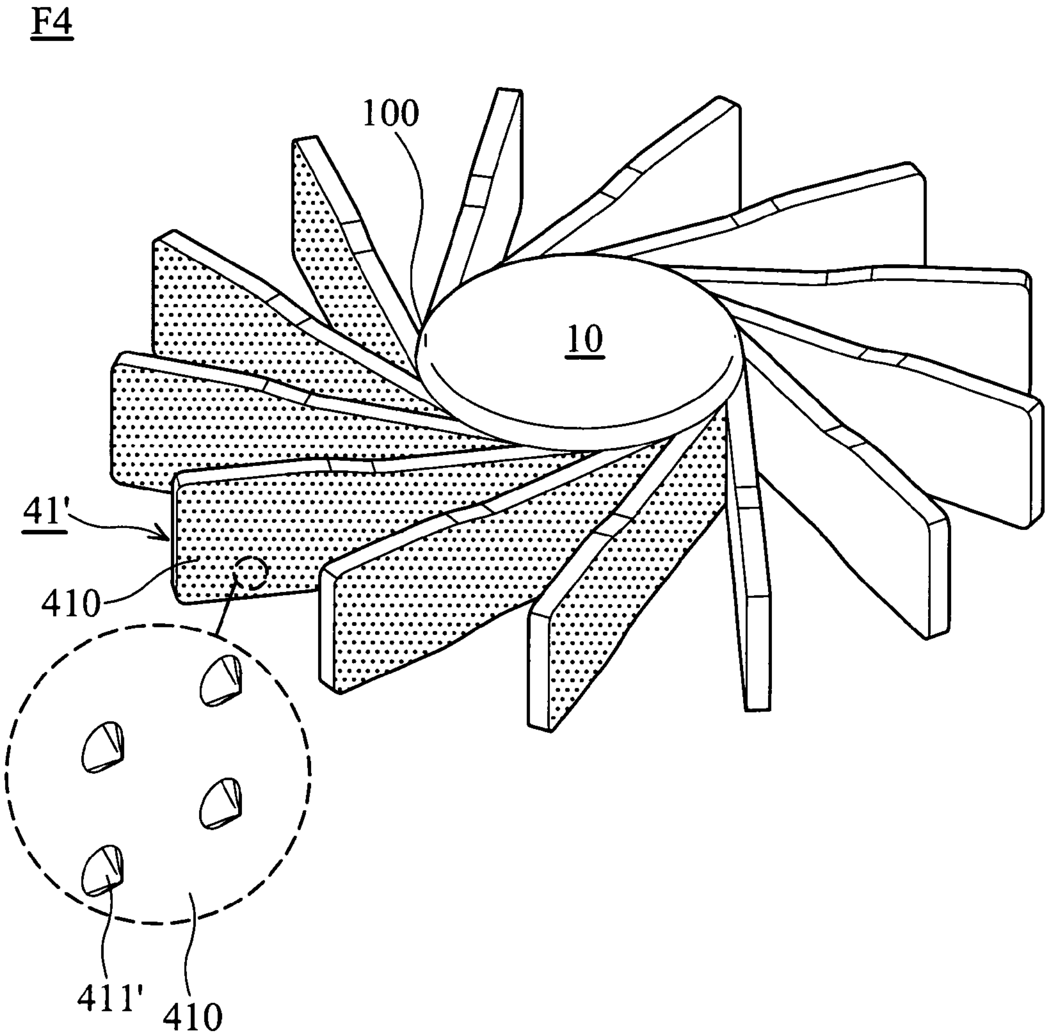


FIG. 7B

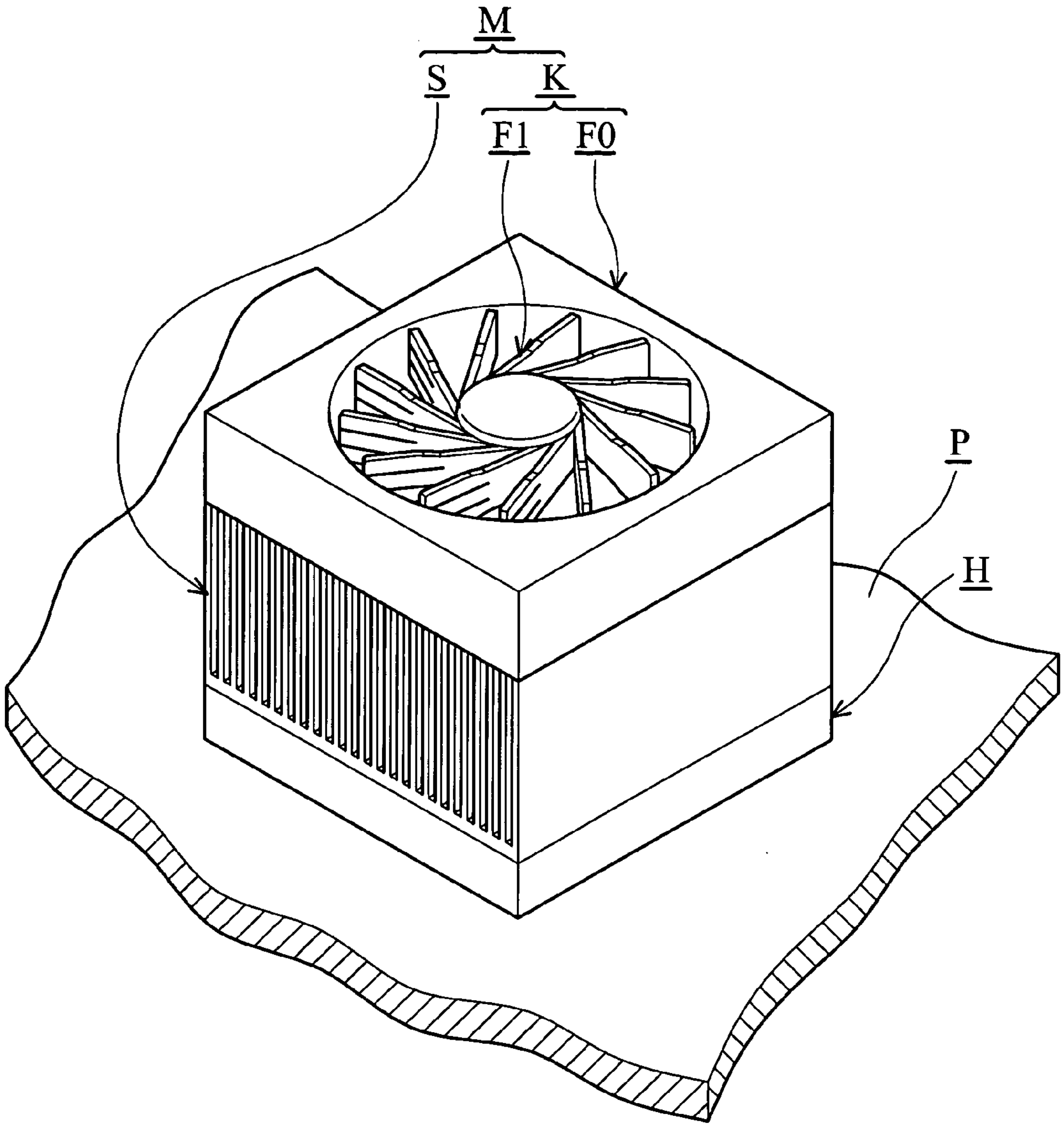


FIG. 8

HEAT-DISSIPATING MODULE, FAN STRUCTURE AND IMPELLER THEREOF

BACKGROUND

[0001] The present invention relates to a heat-dissipating module, and in particular to a heat-dissipating module comprising an impeller formed with a plurality of guiding portions dispersed on the blade surfaces thereof for reducing noise and discrete tone and expelling heat therefrom.

[0002] From earlier 333 MHz to 400 MHz, 400 MHz to 533 MHz, 533 MHz to 800 MHz and 800 MHz to the present, the Front-end bus speed of computer processors are getting faster for enhancing data transmission. Computer functions are integrally systematized on the same circuit or motherboard, decreasing space available therein for convection and heat dissipation. Thus, forced air convection by an electrical fan is employed to increase flow rate of air for dissipating heat generated. Broadband noise and narrowband noise, however, are enlarged as maximum static pressure and flow rate of airflow increase.

SUMMARY

[0003] Accordingly, an object of the invention is to provide an impeller formed with a designated pattern to overcome the problems of the above described fan structure.

[0004] The impeller of the invention comprises a main body and a plurality of blade units. The main body has a base surface, and the blade units extending from the base surface of the main body. Each blade unit comprises a blade surface and a plurality of guiding portions disposed on the blade surface. The guiding portions are integrally indented on or protrude from the blade surface of the blade unit.

[0005] At least one of the guiding portions is substantially aligned with the blade surface of the blade unit. At least two of the guiding portions are substantially spaced apart on the blade surface of the blade unit in parallel. At least one of the guiding portions is substantially curved on the blade surface of the blade unit. Two of the guiding portions are substantially and expansively curved on the blade surface of the blade unit in the longitudinal direction thereof. At least two of the guiding portions are substantially and symmetrically spaced on the blade surface of the blade unit. Additionally, the guiding portions comprise a plurality of recesses or dimples, uniformly formed on the blade surface of the blade unit. Moreover, the guiding portions comprise a plurality of protrusions or particles, uniformly formed on the blade surface of the blade unit.

[0006] Another object of the invention is to provide a fan structure comprising an impeller therein. The fan structure comprises a housing and an impeller rotatably disposed in the housing. The impeller comprises a main body having a base surface and a plurality of blade units extending from the base surface of the main body. Each blade unit comprises a blade surface and a plurality of guiding portions disposed on the blade surface.

[0007] Still another object of the invention is to provide a heat-dissipating module comprising a fan structure and an impeller thereof to expel heat from a heat source such as a CPU. The heat-dissipating module comprises a conductive element disposed on the heat source and a fan structure disposed on the conductive element. The fan structure comprises a housing and an impeller rotatably disposed in the housing. The impeller comprises a main body having a base surface and a plurality of blade units extending from the base surface of the main body, and each blade unit comprises a blade surface and a plurality of guiding portions disposed on the blade surface.

[0008] In other preferred embodiments, the shapes of the guiding portions are selected from a group consisting of linear, curved, parallel or symmetrical, indented on or protruding from the blade units of the impeller, forming different veins, sand-like particles or rough spots on the blade surfaces of the blade unit.

[0009] The guiding portions formed on each blade units of the impeller increase remains on stagnation of airflow, meaning airflow can stay on the surfaces of the blade units longer, thus delaying the occurrence of separation flow. Furthermore, configuration of the airflow boundary layer can be adjusted to form different types of wake flow for decreasing narrowband noise.

[0010] A detailed description is given in the following embodiments with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

[0012] **FIG. 1** is a perspective view of an impeller (F1) according the first embodiment of the present invention;

[0013] **FIG. 2A** is a sectional view of a single blade unit **(11)** of the impeller (F1) along line (A-A) of **FIG. 1**;

[0014] **FIG. 2B** is a plane view of a variant blade unit **(11')** according to the blade unit **(11)** of the impeller (F1) of **FIG. 2A**;

[0015] **FIG. 3** is a perspective view of an impeller (F2) according the second embodiment of the present invention;

[0016] **FIG. 4A** is a sectional view of a single blade unit **(21)** of the impeller (F2) along line (B-B) of **FIG. 3**;

[0017] **FIG. 4B** is a plane view of a variant blade unit **(21')** according to the blade unit **(21)** of the impeller (F2) of **FIG. 4A**;

[0018] **FIG. 5** is a perspective view of an impeller (F3) according the third embodiment of the present invention;

[0019] **FIG. 6A** is a sectional view of a single blade unit **(31)** of the impeller (F3) along line (C-C) of **FIG. 5**;

[0020] **FIG. 6B** is a plane view of a variant blade unit **(31')** according to the blade unit **(31)** of the impeller (F3) of **FIG. 6A**;

[0021] **FIG. 7A** is a perspective view of an impeller (F4) according the fourth embodiment of the present invention, wherein the impeller (F4) comprises a plurality of blade units **(41)**;

[0022] **FIG. 7B** is a perspective view of a variant blade unit **(41')** according to the blade unit **(41)** of the impeller (F4) of **FIG. 7A**; and

[0023] **FIG. 8** is a perspective view of a heat-dissipating module (M) disposed on a heat source (H), wherein the heat-dissipating module (M) comprises a conductive element (S) and a fan structure (K) having the impeller (F1).

DETAILED DESCRIPTION

[0024] The impeller of the invention is applicable to different types of fan structures or modules for dissipating heat from a heat source such as a CPU, or other electronic components that generate heat.

[0025] Referring to **FIG. 1**, in a first embodiment of the invention, an impeller F1 comprises a cylindrical main body **10** and a plurality of blade units **11**.

[0026] The main body **10** has an annular base surface **100** on the periphery thereof. The blade units **11** extend from the base surface **100** of the main body **10**. Each blade unit **11** comprises two blade surfaces **110**, **110**' and a plurality of guiding portions **111***a* and **111***b*. The blade surfaces **110**, **110**' are two opposite surfaces formed on each blade unit **11**, and each blade surface **110** of each blade unit **11** functions as an active surface to form airflow while the impeller F1 rotates. The guiding portions **111***a*, **111***b* are formed on each blade surface **110** of the blade units **11**.

[0027] In this embodiment, the number of guiding portions for each blade surface **110** of the blade units **11** is two (**111***a*, **111***b*), and the guiding portions **111***a*, **111***b* are substantially spaced apart and disposed in parallel on the blade surface **110** of each blade unit **11**, i.e., the guiding portions **111***a*, **111***b* formed on the blade surface **110** extend in the longitudinal direction L of each blade unit **11** in parallel.

[0028] In **FIG. 2A**, a cross-sectional view shows the rectangular structure of the blade unit **11** of the impeller F1 along line A-A of **FIG. 1**. The guiding portions **111***a*, **111***b* are two linear recesses, uniformly and symmetrically, formed on the blade surface **110** of the blade unit **11**, i.e., the guiding portions **111***a*, **111***b* are integrally lined and indented on the blade surface **110** of the blade unit **11**.

[0029] **FIG. 2B** shows a variant blade unit **11**' differing from the blade unit **11** of the impeller F1 of **FIG. 2A** in that two guiding portions **111***a*', **111***b*' are integrally protruded from the blade surface **110** of the blade unit **11**', i.e., the guiding portions **111***a*', **111***b*' are two linear protrusions, uniformly and symmetrically, formed on the blade surface **110** of the blade unit **11**'.

[0030] Referring to **FIG. 3**, in a second embodiment of the invention, an impeller F2 comprises the cylindrical main body **10** and a plurality of blade units **21** extending from the base surface **100** of the main body **10**.

[0031] The blade units **21** of the impeller F2 in **FIG. 3** differs from the blade units **11** of the impeller F1 in **FIG. 1** in that a plurality of spaced guiding portions **211***a* and **211***b*, radially and in parallel, are formed on each blade surface **210** of the blade units **21**, opposite to another blade surface **210**' thereof. That is to say, each guiding portion **211***a*, **211***b* formed on the blade surface **210** of the blade units **21** is linear and substantially angular to the longitudinal direction L of the blade unit **21** with an angle "a".

[0032] In **FIG. 4A**, a cross-sectional view shows the rectangular structure of the blade unit **21** of the impeller F2 along line B-B of **FIG. 3**. The guiding portions **211***a*, **211***b* are spaced linear recesses, uniformly and symmetrically, formed on the blade surface **210** of the blade unit **21**, i.e., the guiding portions **211***a*, **211***b* are integrally indented on the blade surface **210** of the blade unit **21**.

[0033] In **FIG. 4B**, a variant blade unit **21**' differs from the blade unit **21** of the impeller F2 of **FIG. 4A** in that two guiding portions **211***a*, **211***b* are integrally protruded from the blade surface **210** of the blade unit **21**', i.e., the guiding portions **211***a*', **211***b*' are spaced linear protrusions formed uniformly and radially on the blade surface **210** of the blade unit **21**'.

[0034] Referring to **FIG. 5**, in a third embodiment of the invention, an impeller F3 comprises the cylindrical main body **10** and a plurality of blade units **31** extending from the base surface **100** of the main body **10**.

[0035] The blade units **31** of the impeller F3 in **FIG. 5** differ from the blade units **11** of the impeller F1 in **FIG. 1** in that a plurality of spaced guiding portions **311***a*, **311***b* are symmetrically formed on each blade surface **310** of the blade units **31**, opposite to another blade surface **310**' thereof. That is to say, each pair of guiding portions **311***a*, **311***b* formed on the blade surface **310** of the blade units **31** is symmetrical and expansively curved on the blade surface **310** of the blade unit **31** in the longitudinal direction L.

[0036] In **FIG. 6A**, a sectional view shows the rectangular structure of the blade unit **31** of the impeller F3 along line C-C of **FIG. 5**. The guiding portions **311***a*, **311***b* are spaced linear recesses, uniformly and symmetrically, formed on the blade surface **310** of the blade unit **31**, i.e., the guiding portions **311***a*, **311***b* are integrally indented on the blade surface **310** of the blade unit **31**.

[0037] **FIG. 6B** shows a variant blade unit **31**' differing from the blade unit **31** of the impeller F3 of **FIG. 6A** in that two spaced guiding portions **311***a*', **311***b*' are integrally protruded from the blade surface **310** of the blade unit **31**', i.e., the guiding portions **311***a*', **311***b*' are linear protrusions, uniformly and symmetrically, formed on the blade surface **310** of the blade unit **31**'.

[0038] Referring to **FIG. 7A**, in a fourth embodiment of the invention, an impeller F4 comprises the cylindrical main body **10** and a plurality of blade units **41** extending from the base surface **100** of the main body **10**.

[0039] Each blade unit **41** comprises a blade surface **410** and a plurality of guiding portions **411** formed on the blade surface **410**. The blade surface **410** of each blade unit **41** functions as an active surface to form airflow while the impeller F4 rotates.

[0040] In an exploded view of **FIG. 7A** (dotted line), the guiding portions **411** are spaced dimples or recesses, uniformly or irregularly, formed on the blade surface **410** of the blade unit **41**, i.e., the guiding portions **411** are integrally indented on the blade surface **410** of the blade unit **41**.

[0041] **FIG. 7B** shows a variant blade unit **41**' differing from the blade unit **41** of the impeller F4 of **FIG. 7A** in that a plurality of guiding portions **411**' are spaced protrusions or sand-like particles uniformly or irregularly formed on the blade surface **410** of the blade unit **41**, i.e., the guiding portions **411**' are integrally protruded from the blade surface **410** of the blade unit **41**.

[0042] In **FIG. 8**, a heat-dissipating module M is disposed on a heat source H of a circuit or motherboard P of a notebook or personal computer. The heat-dissipating module M comprises a conductive element S and a fan structure K. The conductive element S is a fin structure directly attached on the heat source H. The fan structure K, comprising a housing F**0** and the impeller F**1** rotatably disposed in the housing F**0**, is directly disposed on the conductive element S to transmit airflow to the conductive element S. In this application, the impeller F**1** disposed in the housing F**0** of the fan structure K can be replaced by the impeller F**2**, F**3** or F**4**. During operation, the inducted air flowing by the impeller F**1** passes the conductive element S to dissipate heat therefrom.

[0043] With the guiding portions (**111***a*/**111***b*, **111***a*'/**111***b*', **211***a*/**211***b*, **211***a*'/**211***b*', **311***a*/**311***b*, **311***a*'/**311***b*', **411**, **411**') formed on each blade unit (**11**, **11**', **21**, **21**', **31**, **31**', **41**, **41**') of the impeller (F**1**, F**2**, F**3**, F**4**), designed from a group consisting of linear, curved, parallel or symmetrical, indented on or protruded from the blade units, viscosity of airflow to the surfaces of the blade units can thus increase the length of the stagnation phenomenon of airflow. That is to say, airflow remains on the surfaces of the blade units longer to delaying the occurrence of the separation flow.

[0044] Furthermore, the guiding portions (**111***a*/**111***b*, **111***a*'/**111***b*', **211***a*/**211***b*, **211***a*'/**211***b*', **311***a*/**311***b*, **311***a*'/**311***b*', **411**, **411**') formed on the blade units (**11**, **11**', **21**, **21**', **31**, **31**', **41**, **41**') of the impeller (F**1**, F**2**, F**3**, F**4**) can change the configuration of the airflow boundary layer of airflow to form different types of wake flow thereby decreasing narrowband noise.

[0045] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to accommodate various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. An impeller, comprising:

a main body comprising a base surface; and

a plurality of blade units extending from the base surface of the main body, wherein each blade unit comprises a blade surface and a plurality of guiding portions disposed on the blade surface.

2. The impeller as claimed in claim 1, wherein the guiding portions are integrally indented structures on the blade surface of the blade unit.

3. The impeller as claimed in claim 1, wherein the guiding portions are integrally protruded structures from the blade surface of the blade unit.

4. The impeller as claimed in claim 1, wherein at least one of the guiding portions is substantially aligned with the blade surface of the blade unit.

5. The impeller as claimed in claim 1, wherein at least two of the guiding portions are substantially spaced on the blade surface of the blade unit in parallel.

6. The impeller as claimed in claim 1, wherein at least one of the guiding portions is substantially curved on the blade surface of the blade unit.

7. The impeller as claimed in claim 6, wherein two of the guiding portions are substantially and expansively curved on the blade surface of the blade unit in the longitudinal direction thereof.

8. The impeller as claimed in claim 1, wherein at least two of the guiding portions are substantially and symmetrically spaced on the blade surface of the blade unit.

9. The impeller as claimed in claim 1, wherein the guiding portions are substantially and expansively linear structures on the blade surface of the blade unit in the longitudinal direction thereof.

10. The impeller as claimed in claim 1, wherein the guiding portions comprise a plurality of recesses or protrusions, formed on the blade surface of the blade unit.

11. A fan structure, comprising:

a housing;

an impeller rotatably disposed in the housing, comprising a main body having a base surface and a plurality of blade units extending from the base surface of the main body, wherein each blade unit comprises a blade surface and a plurality of guiding portions disposed on the blade surface.

12. The impeller as claimed in claim 11, wherein the guiding portions of the impeller are integrally indented structures on the blade surface of the blade unit.

13. The fan structure as claimed in claim 11, wherein the guiding portions of the impeller are integrally protruded structures from the blade surface of the blade unit.

14. The fan structure as claimed in claim 11, wherein at least one of the guiding portions of the impeller is substantially aligned with the blade surface of the blade unit.

15. The fan structure as claimed in claim 11, wherein at least two of the guiding portions of the impeller are substantially spaced apart in parallel and on the blade surface of the blade unit.

16. The fan structure as claimed in claim 11, wherein at least one of the guiding portions of the impeller is substantially curved on the blade surface of the blade unit.

17. The fan structure as claimed in claim 16, wherein two of the guiding portions of the impeller are substantially and expansively curved on the blade surface of the blade unit in the longitudinal direction thereof.

18. The fan structure as claimed in claim 11, wherein at least two of the guiding portions of the impeller are substantially and symmetrically spaced on the blade surface of the blade unit.

19. The fan structure as claimed in claim 11, wherein the guiding portions are substantially and expansively linear structures on the blade surface of the blade unit in the longitudinal direction thereof.

20. The fan structure as claimed in claim 11, wherein the guiding portions of the impeller comprise a plurality of recesses or protrusions, formed on the blade surface of the blade unit.

21. A heat-dissipating module for dissipating heat from a heat source, comprising:

a conductive element disposed on the heat source;

a fan structure disposed on the conductive element, comprising a housing and an impeller rotatably disposed in the housing, wherein the impeller comprises a main body having a base surface and a plurality of blade units extending from the base surface of the main body, and each blade unit comprises a blade surface and a plurality of guiding portions disposed on the blade surface.

22. The heat-dissipating module as claimed in claim 21, wherein the guiding portions of the impeller are integral recesses or protrusions on the blade surface of the blade unit.

* * * * *