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(54) **FANS AND ELECTRONIC DEVICES UTILIZING THE SAME**

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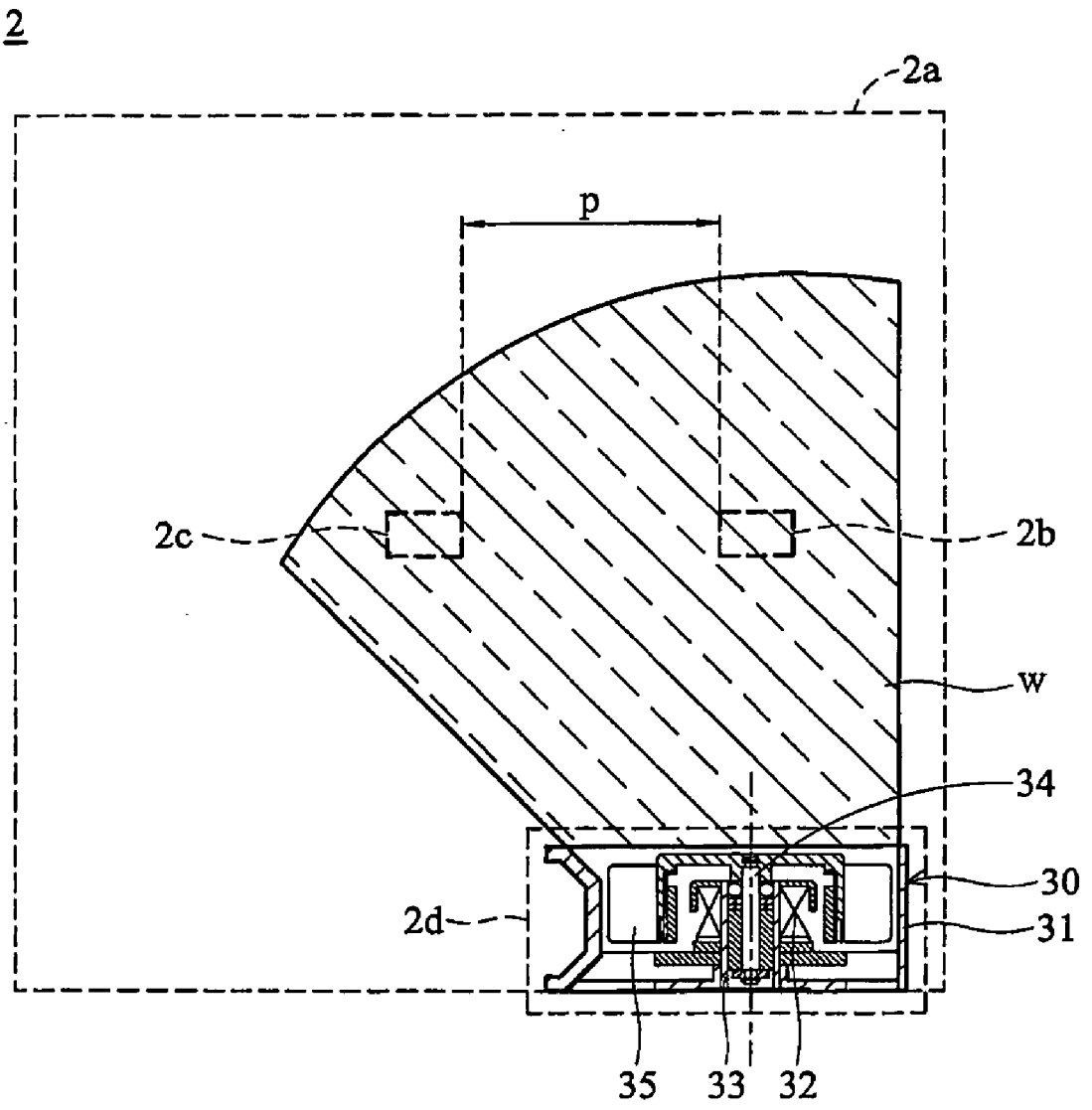
(57) **ABSTRACT**

Electronic devices and fans thereof are provided. An electronic device comprises a fan cavity and separately disposed heat sources. A fan is disposed in the fan cavity with a frame shaped according to the profile of the fan cavity. The frame also includes an extended portion formed according to the relative position of the fan cavity and separated heat sources, optimizing the heat dissipation.



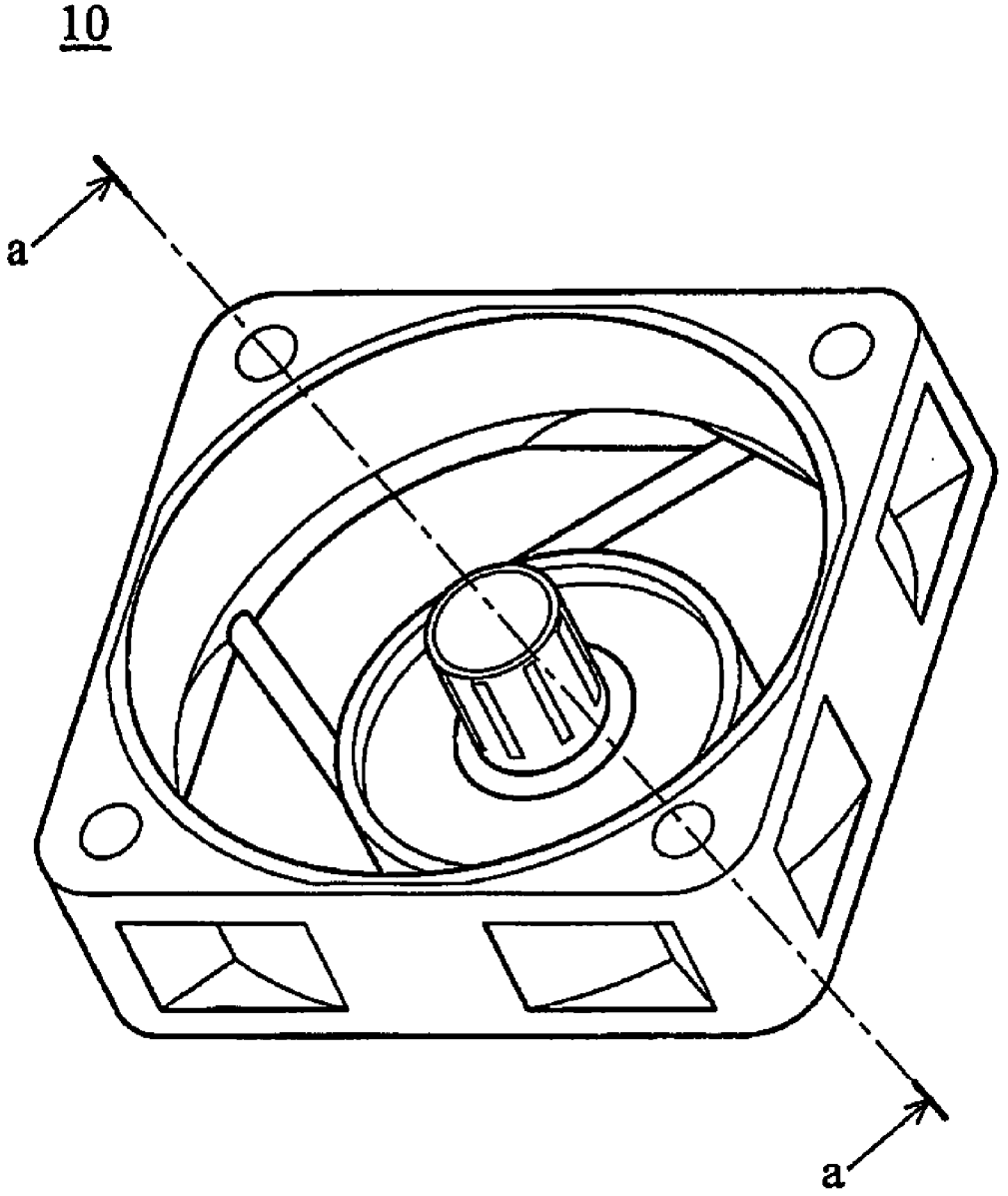


FIG. 1A (RELATED ART)

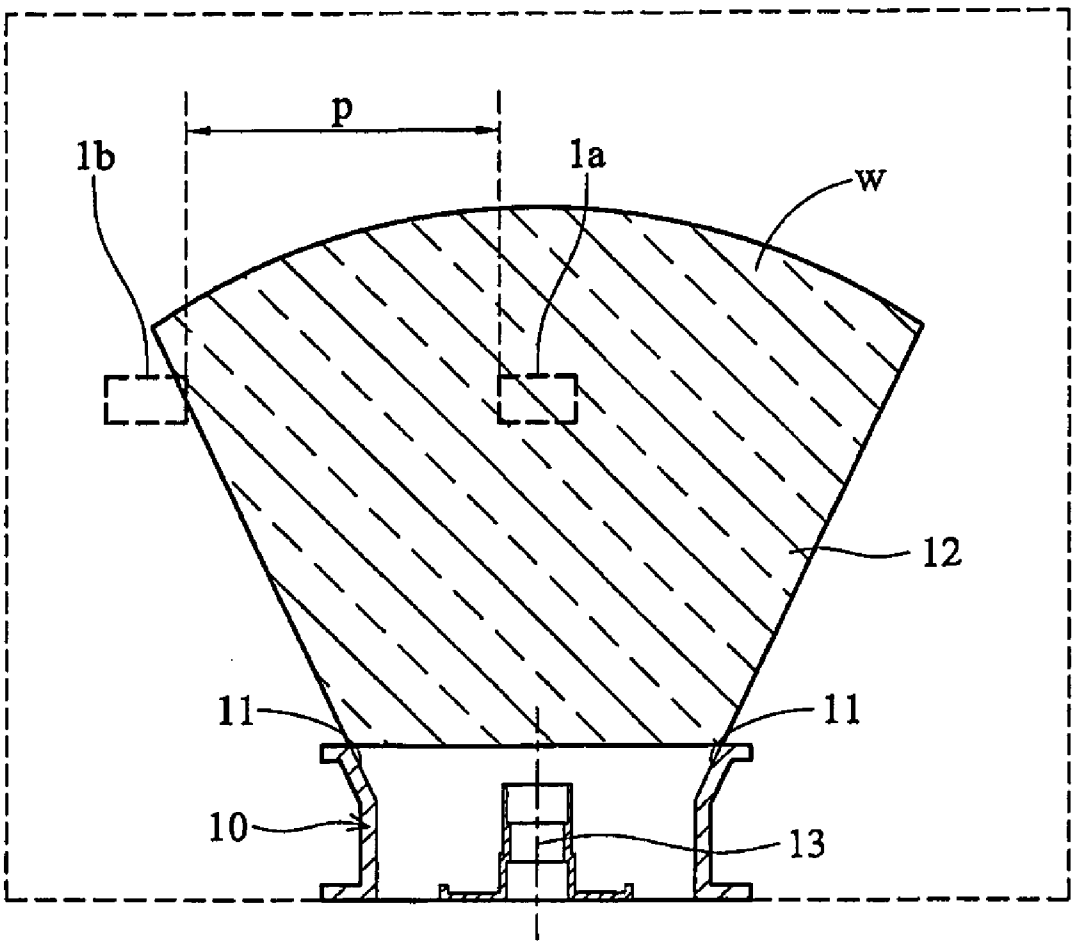


FIG. 1B (RELATED ART)

20

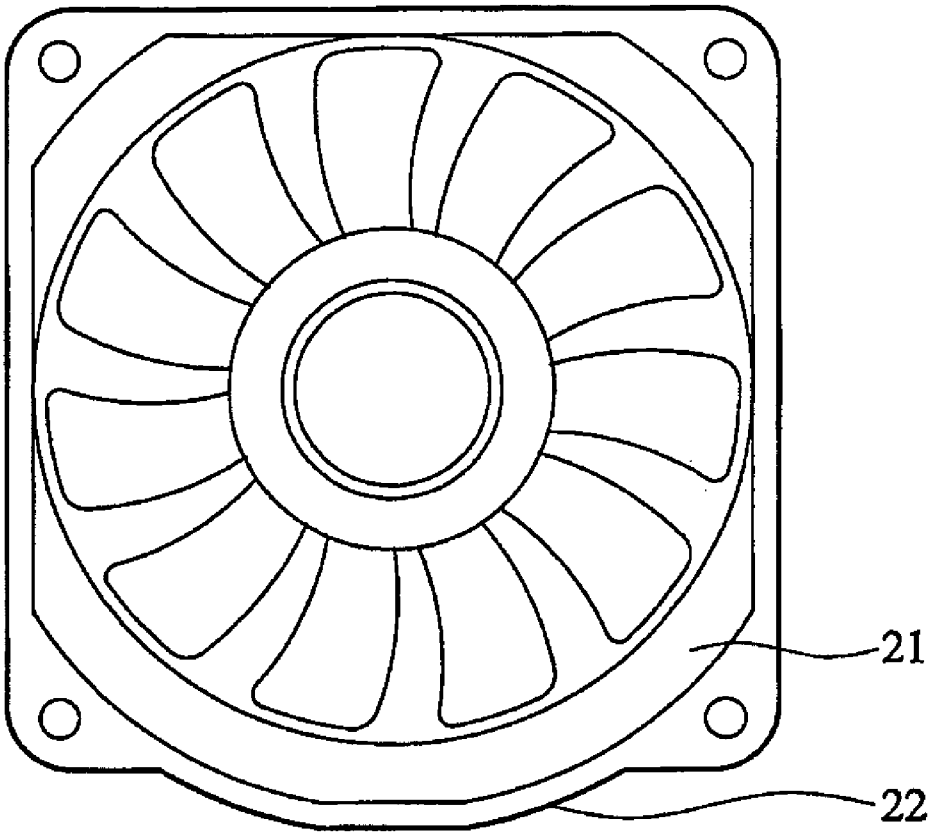


FIG. 2 (RELATED ART)

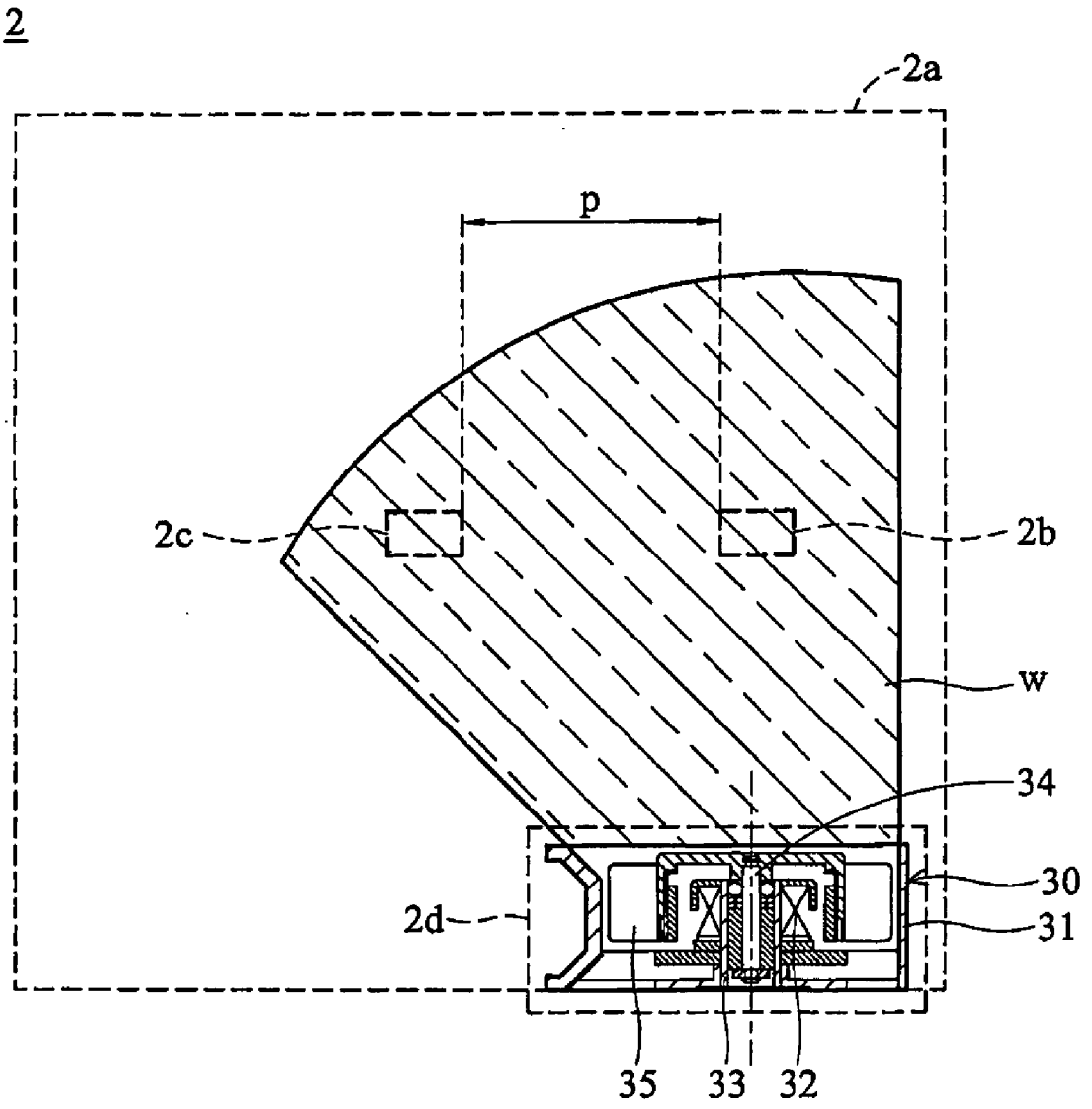


FIG. 3A

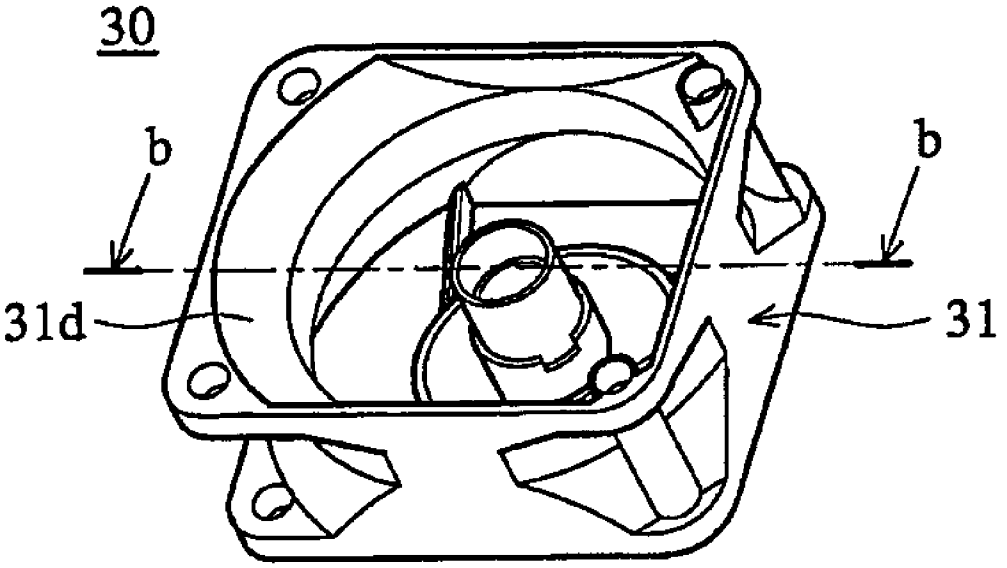


FIG. 3B

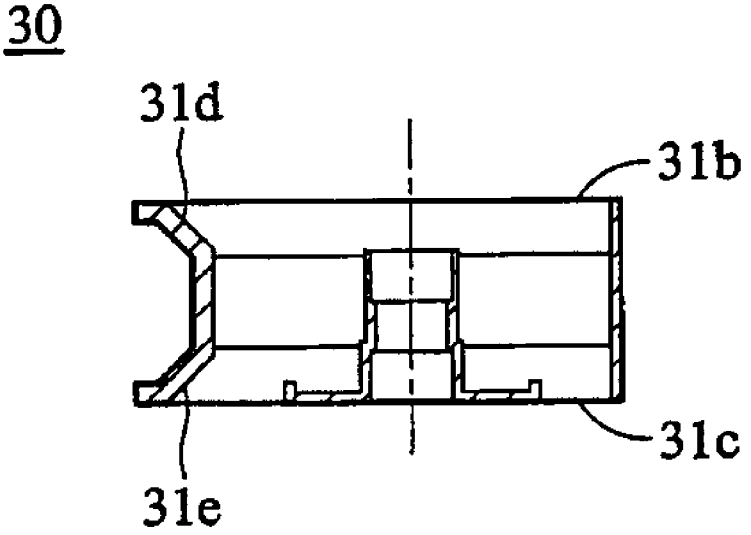


FIG. 3C

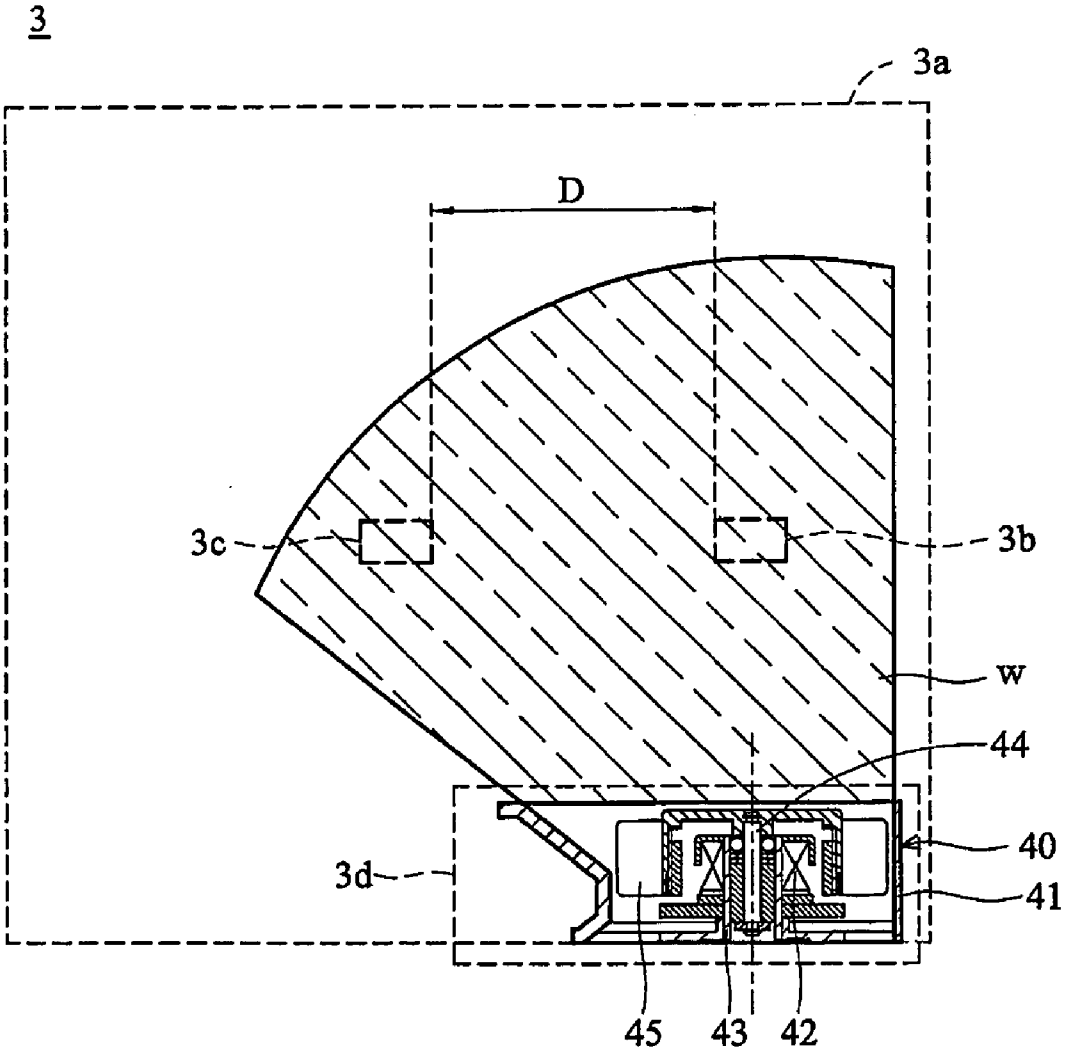


FIG. 4A

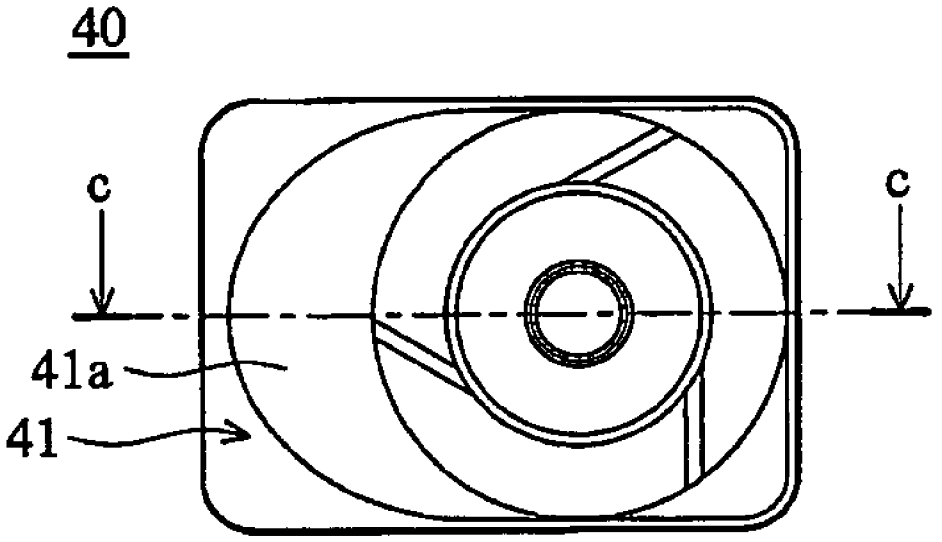


FIG. 4B

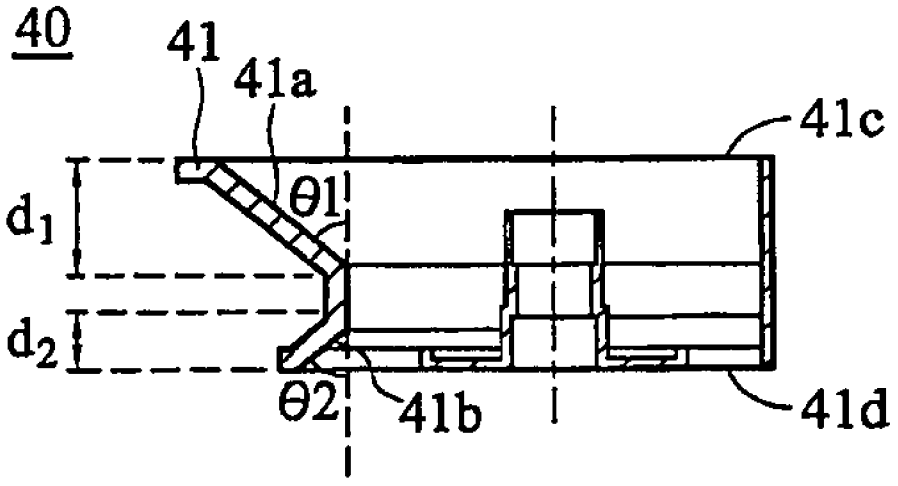


FIG. 4C

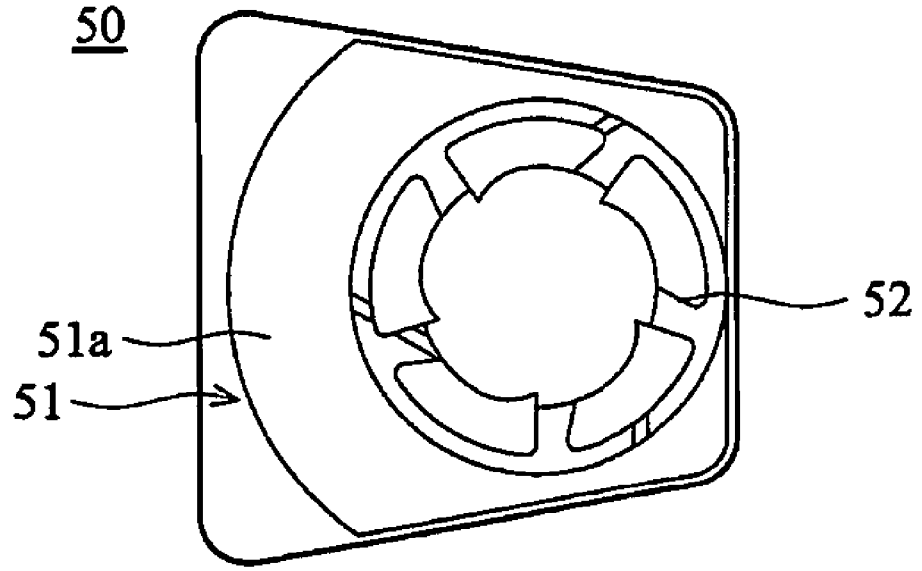


FIG. 5

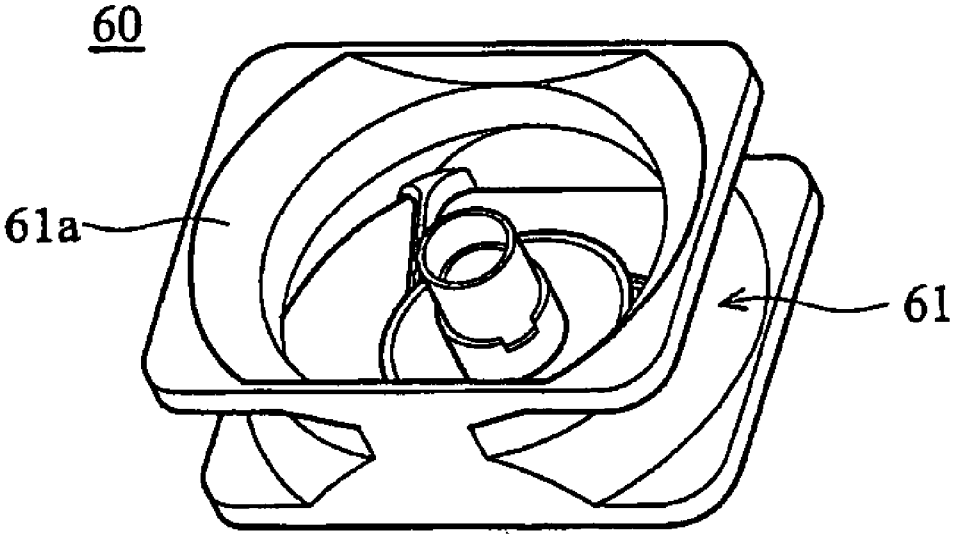


FIG. 6

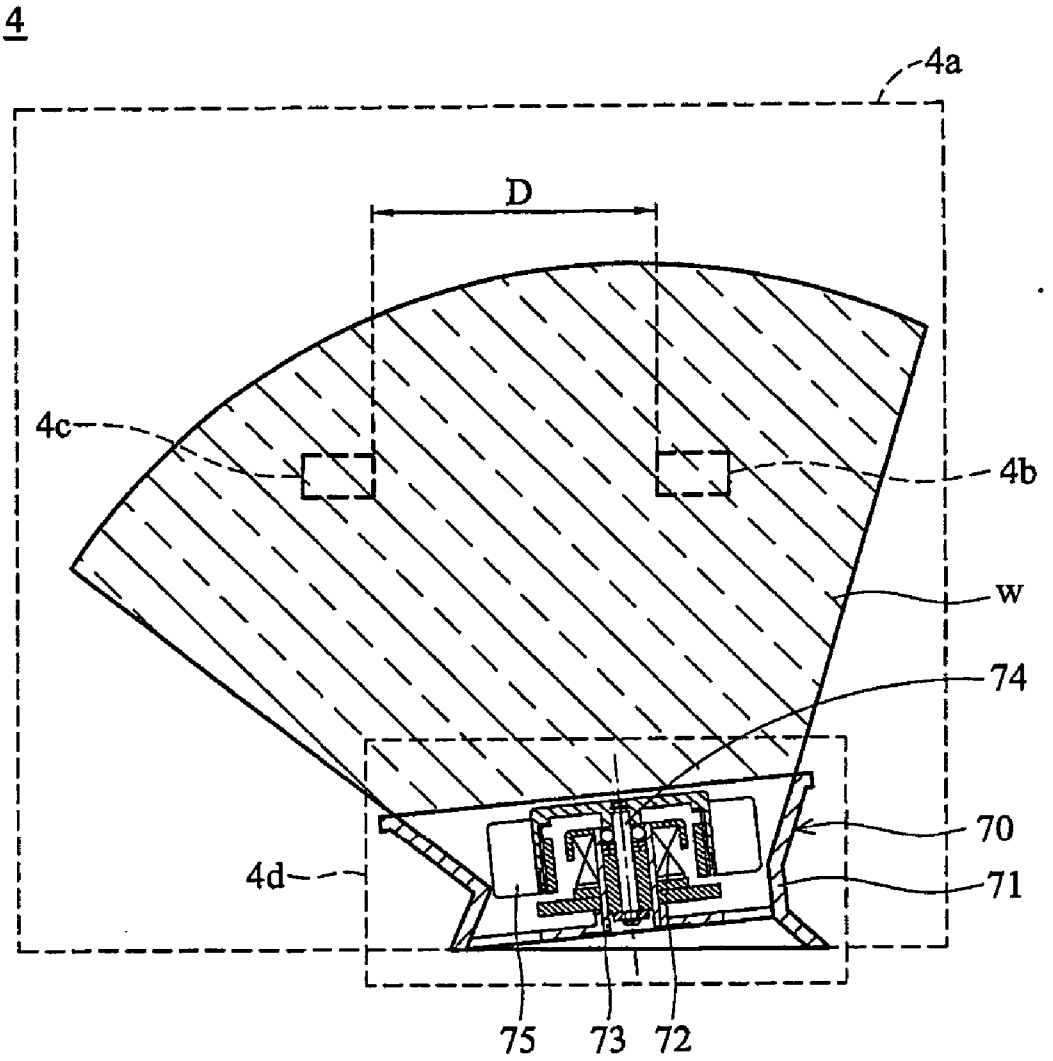


FIG. 7A

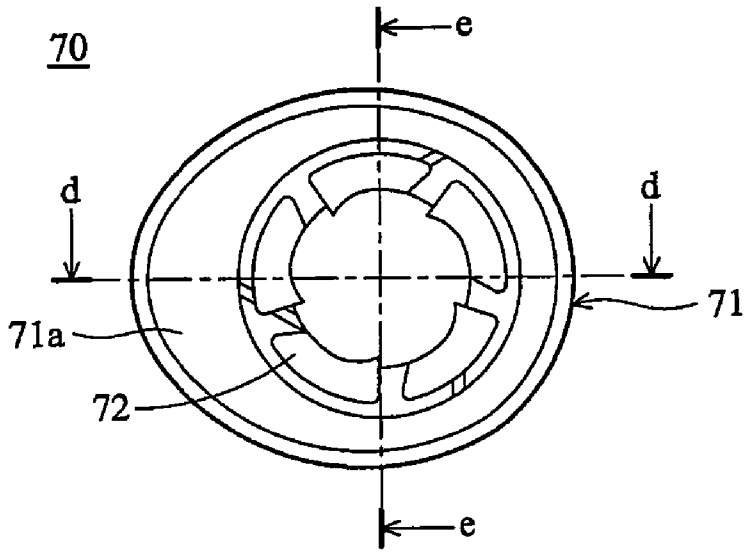


FIG. 7B

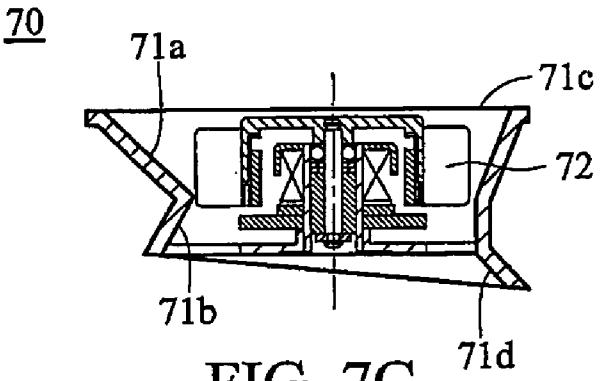


FIG. 7C

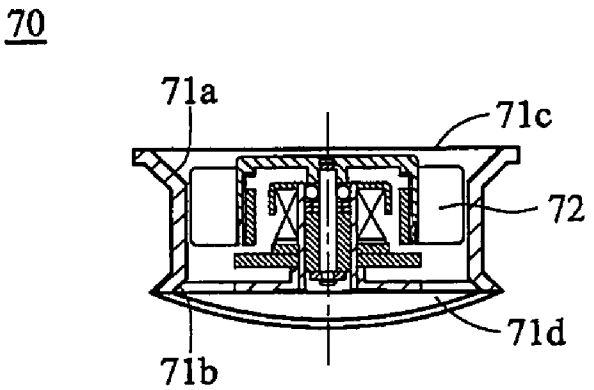


FIG. 7D

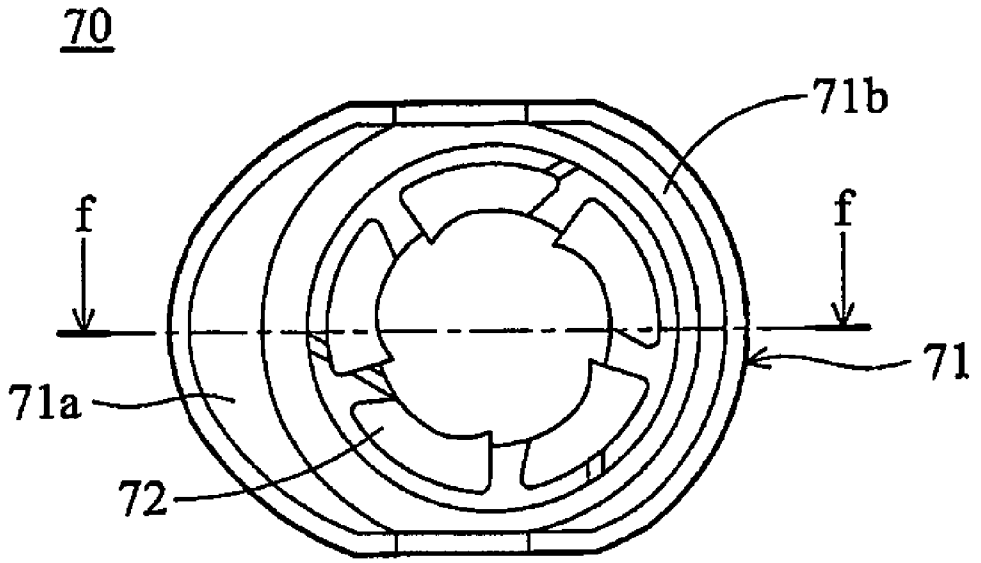


FIG. 7E

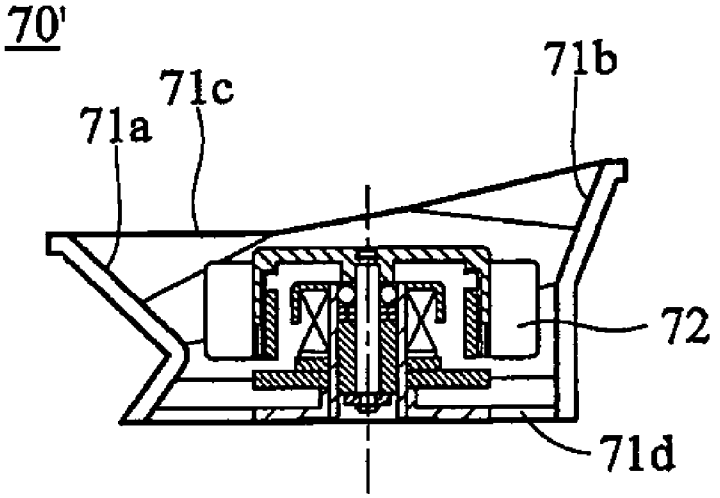


FIG. 7F

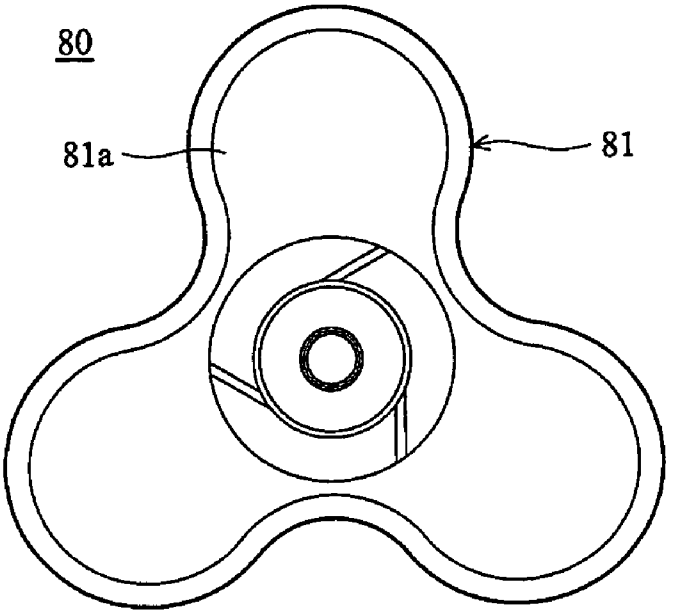


FIG. 8A

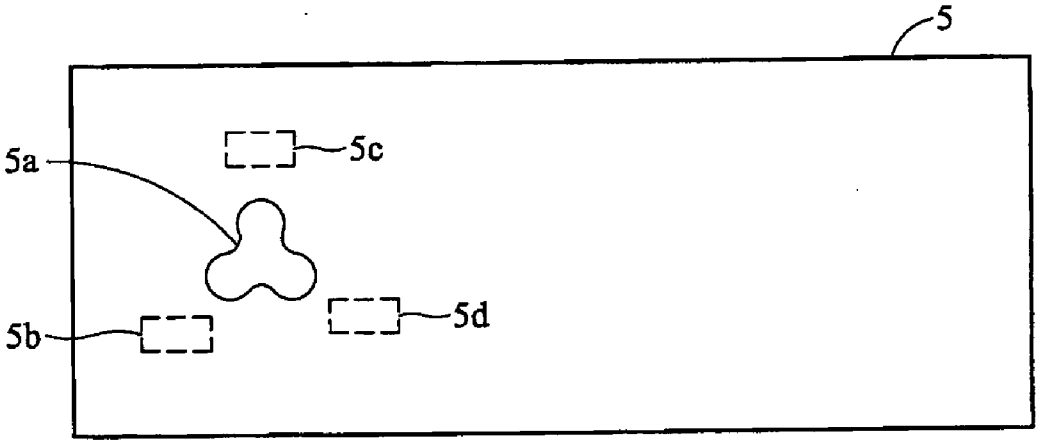


FIG. 8B

FANS AND ELECTRONIC DEVICES UTILIZING THE SAME

BACKGROUND

[0001] The invention relates to fans, and in particular, to fans for electronic devices.

[0002] Typically, when designing an axial fan, airflow outlet/inlet size thereof is increased to raise airflow. Generally, conventional fans utilize a square frame, as shown in **FIG. 1A**. Due to limitations of the frame **10**, the extended ramp **11** design of the airflow outlet/inlet cannot be optimized to maximize airflow.

[0003] Conventionally, the center of the fan is aligned with a heat source to optimize heat dissipation. **FIG. 1B** is a sectional diagram of the fan frame in **FIG. 1A** along line a-a. **FIG. 1B** shows an airflow field generated by the fan in **FIG. 1A**. In **FIG. 1B**, the notation 'w' represents the airflow field, '**13**' represents the center line of the fan, and '**1***a*' represents a heat source. The fan is disposed in system **1**, and the heat source la is on the center line **13**.

[0004] The heat source **1***a* cannot always be directly on the center line **13** of the fan because other components in the system occupy the same space. In such cases, a new fan of a larger size or with a higher rotational speed is required, raising production costs and generating relatively more noise.

[0005] Accordingly, U.S. Pat. No. 6,386,843 discloses a fan capable of dissipating heat from a plurality of heat sources. Referring to **FIG. 2**, the fan **20** has a ramp **21** formed on the frame and an extended portion **22** on its side, thereby improving heat dissipation capability. The shape of the frame is basically square. Thus, the square frame is not suitable when system space is limited.

SUMMARY

[0006] Fans and electronic devices utilizing the same are provided. An exemplary embodiment of an electronic device comprises a housing, a heat source, and a fan. The housing comprises a fan cavity. The heat source is disposed in the housing. The fan is disposed in the fan cavity. The fan comprises a frame. The frame comprises an airflow outlet, an airflow inlet, and a first extended portion. The first extended portion is disposed at the airflow outlet or the airflow inlet. An inclined angle, an entending direction or a position of the first extended portion is adjusted according to a position or a shape of the fan cavity or the heat source.

[0007] An exemplary embodiment of a fan, for dissipating heat from a heat source, comprises a frame and a blade. The frame comprises an airflow outlet, an airflow inlet, and a first extended portion. The first extended portion is disposed at the airflow outlet or the airflow inlet. An inclined angle, an entending direction or a position of the first extended portion is adjusted according to the position of the heat source. The blade is disposed on the frame.

[0008] Some embodiments of an electronic device comprise a housing, a heat source, and a fan. The heat source is disposed in the housing. The fan is disposed in the housing. The fan comprises a frame with an extended portion near the heat source.

[0009] Some embodiments of an electronic device comprise a housing, a plurality of heat sources, and a fan. The heat sources are disposed in the housing. The fan is disposed in the housing. The fan comprises a frame with an extended portion near each heat source. The extended portion is disposed at an airflow inlet or an airflow outlet of the fan.

[0010] Some embodiments of an electronic device comprise a housing and a fan, wherein the housing comprises a fan cavity with a fan disposed therein. The fan comprises a frame, and the shape of the frame is adjusted according to that of the fan cavity.

[0011] Some embodiments of a fan comprise a frame and a blade. The frame comprises an airflow outlet, an airflow inlet, a first extended portion, and a second extended portion. The first extended portion is disposed at the airflow outlet. The second extended portion is disposed at the airflow inlet. The blade is disposed on the frame. Inclined angles of the first and the second extended portions are different. Extended depths of the first and the second extended portions are different.

[0012] Some embodiments of a fan, for dissipating heat from a heat source, comprise a frame and a blade. The frame comprises an airflow outlet, an airflow inlet, and a first extended portion. The first extended portion is disposed at the airflow outlet. An inclined angle or an entending direction of the first extended portion is adjusted according to a position of the heat source. The blade is disposed on the frame. Sectional areas of the airflow inlet and the airflow outlet are different. Shapes of the airflow inlet and the airflow outlet are different.

[0013] Some embodiments of a fan comprise a frame and a blade. The frame comprises an airflow outlet, an airflow inlet, a first extended portion, and a second extended portion. The first extended portion is disposed at the airflow outlet. The second extended portion is disposed at the airflow inlet. The blade is disposed on the frame. The frame is circular, oval, equilateral polygonal, scalene polygonal, trapezoidal, sectorial, or irregular shaped.

DESCRIPTION OF THE DRAWINGS

[0014] Fans and electronic devices can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

[0015] **FIG. 1A** is a three-dimensional diagram of a conventional fan frame.

[0016] **FIG. 1B** is a sectional diagram of the fan frame in **FIG. 1A** along line a-a.

[0017] **FIG. 2** is a top view of a fan disclosed in U.S. Pat. No. 6,386,843.

[0018] **FIG. 3A** is a schematic diagram of airflow field related to an embodiment of an electronic device.

[0019] **FIG. 3B** is a three-dimensional diagram of the fan frame in **FIG. 3A**.

[0020] **FIG. 3C** is a sectional diagram of the fan frame in **FIG. 3B** along line b-b.

[0021] **FIG. 4A** is a schematic diagram of airflow field related to an embodiment of an electronic device.

[0022] **FIG. 4B** is a top view of the fan frame in **FIG. 4A**.

[0023] **FIG. 4C** is a sectional diagram of the fan frame in **FIG. 4B** along line c-c.

[0024] **FIG. 5** is a top view of an embodiment of a fan.

[0025] **FIG. 6** is a diagram of an embodiment of a fan frame.

[0026] **FIG. 7A** is a schematic diagram of airflow field related to an embodiment of an electronic device.

[0027] **FIG. 7B** is a top view of the fan in **FIG. 7A**.

[0028] **FIG. 7C** is a sectional diagram of the fan frame in **FIG. 7B** along line d-d.

[0029] **FIG. 7D** is a sectional diagram of the fan frame in **FIG. 7B** along line e-e.

[0030] **FIG. 7E** is a diagram of an embodiment of a fan frame.

[0031] **FIG. 7F** is a sectional diagram of the fan frame in **FIG. 7E** along line f-f.

[0032] **FIG. 8A** is a top view of an embodiment of a fan frame.

[0033] **FIG. 8B** is a schematic diagram of an embodiment of an electronic device utilizing the fan in **FIG. 8A**.

DETAILED DESCRIPTION

[0034] **FIG. 3A** is a schematic diagram of airflow field related to an embodiment of an electronic device. **FIG. 3B** is a three-dimensional diagram of the fan frame in **FIG. 3A**. **FIG. 3C** is a sectional diagram of the fan frame in **FIG. 3B** along line b-b. A stator and a blade are not shown in FIGS. **3**B~**3**C for simplicity.

[0035] As shown in **FIG. 3A**, the electronic device **2** comprises a housing **2***a*, a plurality of heat sources **2***b* and **2***c*, and a fan **30**. The heat sources **2***b* and **2***c* and the fan **30** are disposed in the housing **2***a*. Due to space limitations, the heat sources **2***b* and **2***c* are disposed separately. The housing **2***a* comprises a fan cavity **2***d* for accommodating the fan **30**. The scope of an airflow field w is modified by adjusting the shape of a frame **31** of the fan for heat dissipation in a limited space.

[0036] As shown in FIGS. **3A=183**C, the fan **30** is an axial fan with a rectangular frame **31**. The frame **31** comprises an airflow outlet **31***b*, an airflow inlet **31***c*, two extended portions **31***d* and **31***e*, and a bushing **33**. A stator coil **32** is wound at the bushing **33**, and a blade **35** is connected with the bushing **33** through a pivot **34**. The extended portion **31***d* is disposed at the airflow outlet **31***b*. The inclined angle of the extended portion **31***d* is adjusted according to the relative position of the fan cavity **2***d* and the heat sources **2***b* and **2***c*. Suppose two heat sources spaced the same distance are disposed in **FIGS. 1B and 3A**, the airflow field w in **FIG. 3A** is larger due to the extended portion **31***d*.

[0037] Referring to **FIGS. 3A and 3D**, the extended portion **31***e* is disposed at the airflow outlet **31***c*. The two extended portions **31***d* and **31***e* are on the same side. The inclined angle of the extended portion **31***e* is adjusted according to the position of the fan cavity **2***d* for increasing airflow to improve heat dissipation.

[0038] In **FIG. 3B**, four positioning holes are formed at the four corners of the frame **31** respectively. The frame **31** can be positioned in the electronic device **2** via the four positioning holes. The locations of the four positioning holes can be adjusted when necessary. In the following disclosed embodiments, the four positioning holes are omitted for simplicity.

[0039] **FIG. 4A** is a schematic diagram of airflow field related to an embodiment of an electronic device. **FIG. 4B** is a top view of the fan frame in **FIG. 4A**. **FIG. 4C** is a sectional diagram of the fan frame in **FIG. 4B** along line c-c. A stator and a blade are not shown in FIGS. **4**B~**4**C for simplicity.

[0040] As shown in **FIG. 4A**, the electronic device **3** comprises a housing **3***a*, a major heat source **3***b*, a minor heat source **3***c*, and a fan **40**. The heat sources **3***b* and **3***c* and the fan **40** are disposed in the housing **3***a*. The fan faces the major heat source **3***b*. In comparison of **FIGS. 3A and 4A**, the two heat sources **3***b* and **3***c* are spaced farther (D>p), the fan **40** has an extended portions with larger inclined angles, and thus the scope of the airflow field w in **FIG. 4A** is larger.

[0041] As shown in FIGS. **4**B~**4**C, the frame **41** of the fan **40** is similar to the previously described frame **31**. The frame **41** is rectangular. The frame **41** comprises an airflow outlet **41***c*, an airflow inlet **41***d*, and two extended portions **41***a* and **41***b*. The extended portions **41***a* and **41***b* are disposed at the airflow outlet **41***c* and the airflow inlet **41***d* respectively. The main difference between this and previously described frames is that the extended portions **41***a* and **41***b* have different inclined angles (θ**1** and θ**2**) and extended depths (d**1** and d**2**). As shown in **FIG. 4C**, the extended depths (θ**1** and θ**2**) are distances from the airflow outlet **41***c* or the airflow inlet **41***d* to the extended portions **41***a* or **41***b*. The inclined angles (θ**1** and θ**2**) represent the included angle between the wall of the extended portions and the connected vertical walls.

[0042] Referring to **FIG. 4A**, the extended portions **41***a* and **41***b* are formed with different inclined angles (θ**1** and θ**2**). Thus, the airflow outlet **41***c* and the airflow inlet **41***d* have different sectional areas and shapes, and the center of the blade is not located at the center of the frame. The frame design can be modified according to positions and sizes of heat sources and the fan cavity, thus optimizing heat dissipation.

[0043] **FIG. 5** is a top view of an embodiment of a fan. The fan **50** comprises a frame **51** and a blade **52**, and the frame **51** comprises an extended portion **51***a*. The main difference between this and previously described frames is described in the following. The frame **51** is trapezoidal. The extended portion **51***a* is formed along the edges of the airflow outlet or the airflow inlet. The shapes of the airflow outlet and the airflow inlet are basically sectorial for dissipating heat from separated heat sources.

[0044] **FIG. 6** is a diagram of an embodiment of a fan frame. The frame **61** comprises an extended portion **61***a* on its two sides, thus adjusting the scope of the airflow field to suit various kinds of heat sources.

[0045] **FIG. 7A** is a schematic diagram of airflow field related to an embodiment of an electronic device. **FIG. 7B** is a top view of the fan in **FIG. 7A**. **FIG. 7C** is a sectional

diagram of the fan frame in **FIG. 7B** along line d-d. **FIG. 7D** is a sectional diagram of the fan frame in **FIG. 7B** along line e-e.

[**0046**] As shown in **FIG. 7A**, the electronic device **4** comprises a housing **4***a* and a plurality of heat sources **4***b* and **4***c*. The heat sources **4***b* and **4***c* and the fan **70** are disposed in the housing **4***a*. Due to space limitations, the heat sources **4***b* and **4***c* are disposed separately. The housing **4***a* comprises a fan cavity **4***d* on its side for accommodating the fan **70**. The airflow inlet and the airflow outlet are not parallel, so the airflow direction is changed. The scope of an airflow field w is modified by adjusting the shape of a frame **71** of the fan for heat dissipation in limited space.

[**0047**] As shown in FIGS. 7A~7D, the frame **71** comprises an extended portion **71***a* formed at the airflow outlet **71***c* and another extended portion **71***b* formed at the airflow inlet **71***d*. The main difference between this and previously described frames is described in the following. The frame **71** is oval. The inclined angles and depths of the extended portions are adjusted according to the heat sources **4***b* and **4***c* and the fan cavity **4***d* in the housing **4***a*, thus changing the scope of the airflow field to suit various kinds of heat sources.

[**0048**] **FIG. 7E** is a diagram of an embodiment of a fan frame. **FIG. 7F** is a sectional diagram of the fan frame in **FIG. 7E** along line f-f. As shown in **FIGS. 7E and 7F**, the frame **71** of the fan **70** comprises a plurality of segments of different inclined angles. Shapes of any two adjacent segments are different, and axial heights of any two adjacent segments are different. The extended portions **71***a* and **71***b* are disposed at the airflow outlet **71***c*. According to heat dissipation requirements, the extended portions **71***a* and **71***b* can comprise a plurality of segments. The distance between each segment and the end of the blade can be different, and height of each segment can be different. Thus, the scope of the airflow field can be adjusted to suit various kinds of heat sources.

[**0049**] The shape of the frame can be optimized according to the fan cavity in the system. **FIG. 8A** is a top view of an embodiment of a fan frame. **FIG. 8B** is a schematic diagram of an embodiment of an electronic device utilizing the fan in **FIG. 8A**.

[**0050**] In **FIG. 8B**, the electronic device **5** comprises a fan cavity **5***a* for accommodation of the fan **80** in **FIG. 8A**. The fan cavity **5***a* has an irregular shape. By forming an extended portion **81***a* on the frame **81**, the shape of the frame **81** is changed to suit the fan cavity **5***a*. The fan **8** dissipates heat generated by heat sources **5***b*, **5***c*, and **5***d*.

[**0051**] The fan cavity **5***a* in **FIG. 8B** can be circular, oval, rectangular, trapezoidal, sectorial, equilateral polygonal, scalene polygonal, or irregular shaped, and the shape of the frame **81** can be changed accordingly.

[**0052**] While the invention has been described by way of example and in terms of several embodiments, it is to be understood that the invention is not limited thereto. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. An electronic device, comprising:

a housing;

at least a heat source disposed in the housing; and

a fan disposed in the housing, wherein the fan comprises a frame, the frame comprises an airflow outlet, an airflow inlet, and a first extended portion, the first extended portion is disposed at the airflow outlet or the airflow inlet, and an inclined angle, an extending direction or a position of the first extended portion is adjusted according to a position of the heat source.

2. The electronic device as claimed in claim 1, wherein the shape of the frame is appropriately modified according to the housing.

3. The electronic device as claimed in claim 1, wherein the frame further comprises a second extended portion, and the second extended portion is disposed at the airflow outlet or the airflow inlet where the first extended portion is not disposed.

4. The electronic device as claimed in claim 3, wherein an inclined angle of the second extended portion is adjusted according to a position of the housing for increasing airflow.

5. The electronic device as claimed in claim 3, wherein the inclined angles or the extended depths of the first and the second extended portions are different.

6. The electronic device as claimed in claim 3, wherein the second extended portion comprises a plurality of segments, and the distance between each segment and an end of a blade of the fan is different.

7. The electronic device as claimed in claim 1, wherein the sectional areas or the shape of the airflow inlet and the airflow outlet are different, or the airflow inlet and the airflow outlet are not parallel.

8. The electronic device as claimed in claim 1, wherein the frame is circular, oval, equilateral polygonal, scalene polygonal, trapezoidal, sectorial, or irregular shaped.

9. The electronic device as claimed in claim 1, wherein the first extended portion comprises a plurality of segments, and the distance between each segment and an end of a blade of the fan is different.

10. The electronic device as claimed in claim 1, wherein the frame comprises a plurality of segments with different inclined angles or axial heights.

11. A fan for dissipating heat from at least a heat source, comprising:

a frame comprising an airflow outlet, an airflow inlet, and a first extended portion, wherein the first extended portion is disposed at the airflow outlet or the airflow inlet, and an inclined angle, an extending direction or a position of the first extended portion is adjusted according to a position of the heat source; and

a blade disposed in the frame.

12. The fan as claimed in claim 11, wherein the frame further comprises a second extended portion, and the second extended portion is disposed at one of the airflow outlet or the airflow inlet where the first extended portion is not disposed.

13. The fan as claimed in claim 12, wherein the inclined angles or the extended depths of the first and the second extended portions are different.

14. The fan as claimed in claim 12, wherein the second extended portion comprises a plurality of segments, and the distance between each segment and an end of the blade is different.

15. The fan as claimed in claim 11, wherein the first extended portion comprises a plurality of segments, and the distance between each segment and an end of the blade is different.

16. The fan as claimed in claim 11, wherein the sectional areas or the shape of the airflow inlet and the airflow outlet are different, or the airflow inlet and the airflow outlet are not parallel.

17. The fan as claimed in claim 11, wherein the frame comprises a plurality of segments, and the axial heights or the inclined angles of any two adjacent segments are different.

18. The fan as claimed in claim 11, wherein the frame is circular, oval, equilateral polygonal, scalene polygonal, trapezoidal, sectorial, or irregular shaped.

19. An electronic device comprising:

a housing comprising a fan cavity; and

a fan disposed in the fan cavity, wherein the fan comprises a frame, and the shape of the frame is adjusted according to that of the fan cavity.

20. The electronic device as claimed in claim 19, wherein the frame comprises a plurality of segments, and the axial heights or the inclined angles of any two adjacent segments are different.

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