A box fan with a motor and impeller that is supported by a polymer grill is provided. The device may include a metal body and at least one polymer grill, a motor and an axial air impeller. The motor being structurally supported by the polymer grill.
BOX FAN GRILL WITH INTEGRAL MOTOR SUPPORT

CROSS-REFERENCE APPLICATIONS

[0001] This application claims priority to provisional patent application 60/829,766 filed Oct. 17, 2006.

TECHNOLOGY FIELD

[0002] The present invention relates to an air moving apparatus. More specifically, the present invention relates to the motor mounting structure utilized on a conventional box fan.

BACKGROUND

[0003] The box fan has been in existence for many years. The box fan has proven itself to be one of the most versatile air moving devices, selling numerous millions of units every year. Because of its popularity there has been constant pressure on the manufacturer to produce the box fan less expensively without compromising the safety or the quality of the final product.

[0004] One manner to effectively achieve this goal is to reduce the material usage and by default the raw material cost needed to produce the device. The use of motor production technology, plastic materials, size reduction etc. have all yielded cost reductions for the box fan over the years.

[0005] What is needed are further innovations in the box fan structure that will maintain or improve the quality and safety of the device while at the same time allow the manufacturer the ability to produce the device at a lower cost. The lower cost will enhance the appeal of the item to a greater number of users.

SUMMARY

[0006] The present invention is directed to embodiments of a box fan that utilizes a motor mounting structure incorporated into a polymer rear grill of the device. The utilization of the polymer grill in this manner eliminates the need for metal brackets and the additional labor needed to assemble the metal brackets in the construction of a conventional box fan. This reduces the cost of the box fan to the consumer and allows the product to be more affordable to a wider range of users and more profitable to the manufacturer. Another advantage of the described device is the ability of the polymer rear grill to electrically isolate the motor of the device from external metal components such as the body of the box fan.

[0007] In accordance with one embodiment, a box fan includes a fan body formed of metal comprising at least one wall forming a substantially polygonal shape having a rear body opening and a front body opening. The front and rear openings are substantially parallel to one another and are located on the opposite side of the fan body. A unitary rear grill formed of polymer may be disposed proximate and substantially covering the rear body opening. The unitary rear grill includes a perimeter rail defining extents of the unitary rear grill, a plurality of grill elements defining flow through openings that allow air to pass through the unitary rear grill, and an integrated motor interface structure substantially centered with reference to the extents of the unitary rear grill. The box fan includes a front grill disposed proximate and substantially covering the front body opening. An interior space is defined by the at least one wall of the fan body, the unitary rear grill, and the front grill. A motor having a shaft extension is disposed within the interior space. The motor is connected to and structurally supported by the integrated motor interface structure of the unitary rear grill. An axial air impeller is disposed within the interior space. The air impeller includes a hub connected to the shaft extension of the motor, and a plurality of blades extending radially outward from the hub.

[0008] According to one aspect of the invention, the unitary rear grill includes support channels extending from the motor interface structure to the perimeter rail of the unitary rear grill. The support channels structurally support the motor and the axial air impeller. The support channel may define a conduit and control wires of the box fan may be located in the conduit. The support channel may include at least one wall defining a recess.

[0009] According to another aspect of the invention, the at least a portion of the plurality of grill elements extend from the motor interface structure to the perimeter rail of the unitary rear grill. This portion of the plurality of grill elements functions, in part, to structurally support the motor and the axial air impeller.

[0010] According to another aspect of the invention, the unitary rear grill comprises a spherical form as defined by a surface of the rear grill, wherein the surface comprises a spherical radius.

[0011] According to another aspect of the invention, the motor includes a rear end bell having ventilation openings. The integrated motor interface includes a motor mounting surface, and a cooling opening substantially centered in the motor mounting surface. The ventilation openings of the rear end bell and the cooling opening in the integrated motor interface may be substantially aligned.

[0012] According to another aspect of the invention, the hub of the axial air impeller further comprises a first circumferential periphery and the motor mounting surface is defined by a second circumferential periphery. The first and the second circumferential peripheries may be substantially aligned.

[0013] According to another aspect of the invention, the integrated motor interface structure further comprises a plurality of motor mounting holes for receiving fasteners to secure the motor to the integrated motor interface structure.

[0014] According to another aspect of the invention, the perimeter rail, grill elements, motor interface, and support channels are a single molded polymer part. The single molded polymer part electrically isolates the motor from all external surfaces of the box fan.

[0015] According to another aspect of the invention, the perimeter rail includes: a first wall substantially parallel to the grill elements; a second wall extend substantially orthogonal and outward from the first wall; and a third wall extending substantially orthogonal from the second wall.

[0016] According to another aspect of the invention, the rear grill perimeter rail includes: a first wall substantially parallel to the grill elements; a second wall extending outward from the first wall; a recess formed in the second wall; a third wall extending from the second wall; the third wall oriented substantially orthogonal to the first wall; and angular ribs extending between the first wall and the third wall, the angular ribs connecting the first wall, the second wall, and the third wall.
According to yet another aspect of the invention, the rear grill further includes: horizontal structural supports extending from the integrated motor interface to sides of the perimeter rail; and vertical structural supports extending from the integrated motor interface to a top and a bottom of the perimeter rail. The horizontal structural supports and the vertical structural supports may be constructed dimensionally thicker than the grill elements.

According to another aspect of the invention, the rear grill includes: a plurality of substantially concentric arcuate grill elements; and radial structural supports extending radially from the integrated motor interface to the perimeter rail. The radial structural supports may be connected to the concentric arcuate grill elements.

According to another embodiment of the invention, a box fan includes a fan body formed of metal. The fan body includes at least one wall forming a substantially polygonal shape having a rear body opening and a front body opening. The rear and front openings are substantially parallel to one another and located on the opposite sides of the fan body. A unitary rear grill may be formed of polymer and may be disposed proximate and substantially covering the rear body opening. The unitary rear grill includes a perimeter rail defining extents of the unitary rear grill. The unitary rear grill also includes a plurality of grill elements defining flow through openings, the flow through openings allowing air to pass through the unitary rear grill. The unitary rear grill further includes a substantially circular-shaped integrated motor interface structure substantially centered with reference to the extents of the unitary rear grill. Moreover, the unitary rear grill includes support channels extending between and connecting the motor interface structure to the perimeter rail of the unitary rear grill. The box fan also includes a front grill disposed proximate and substantially covering the front body opening. An interior space is defined by the at least one wall of the fan body, the unitary rear grill, and the front grill. A motor is disposed within the interior space, the motor being connected to and structurally supported by the integrated motor interface structure of the unitary rear grill. The motor also has a shaft extension. An axial air impeller is disposed within the interior space. The air impeller includes a hub connected to the shaft extension of the motor and a plurality of blades extending radially outward from the hub.

According to yet another embodiment of the invention, a box fan includes at least one wall formed of metal forming a substantially polygonal shape. Rear and front openings are formed by the at least one wall. The rear and front openings are oriented substantially parallel to one another and are located on the opposite sides of the at least one wall. A front grill is disposed proximate and substantially covering the front opening. The front grill includes a plurality of front grill elements defining front flow through openings that allow air to pass through the front grill. A rear grill is disposed proximate and substantially covering the rear opening. A perimeter rail defines extents of the rear grill. The rear grill includes a plurality of rear grill elements defining rear flow through openings that allow air to pass through the rear grill. The rear grill also includes a substantially circular shaped integrated motor interface structure substantially centered with reference to the extents of the rear grill. Motor cooling openings may be provided in a center region of the integrated motor interface structure. Support channels may extend outward from the motor interface structure and connect to the perimeter rail. The rear grill, the perimeter rail, the rear grill elements, the motor interface, and the support channels are preferably formed as a single molded polymer part. An interior space is defined by the at least one wall of the fan body, the front grill, and the rear grill. A motor is disposed within the interior space and may be connected to and structurally supported by the integrated motor interface structure of the rear grill. The motor includes a shaft and a rear end bell. Ventilation openings may be provided in the rear end bell. Preferably, the ventilation openings of the motor rear end bell substantially align with the motor cooling openings in the integrated motor interface structure. An axial air impeller is disposed within the interior space. A substantially circular shaped hub of the air impeller connects to the motor shaft. A circumference of the substantially circular shaped hub may be substantially equal to the substantially circular shaped integrated motor interface structure. A plurality of blades of the air impeller extend radially outward from the hub.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is best understood from the following detailed description when read in connection with the accompanying drawings. It is emphasized that, according to common practice, the various features of the drawings are not to scale. On the contrary, the dimensions of the various features are arbitrarily expanded or reduced for clarity. Included in the drawings are the following Figures:

FIG. 1 is a rear perspective view of an exemplary box fan in accordance with embodiments of the present invention;

FIG. 2 is a front perspective exploded view of the exemplary box fan of FIG. 1;

FIG. 3A is a rear perspective view illustrating an embodiment of a grill of the present invention;

FIG. 3B is a partial cross section through a support channel of the grill embodiment of FIG. 3A;

FIG. 3C is a partial cross section view through the a perimeter rail of the grill embodiment of FIG. 3A;

FIGS. 3D and 3E are a partial cross sectional view and a partial front view respectively of an alternate embodiment for the perimeter rail;

FIG. 4 is a rear perspective view illustrating an alternative structure for an embodiment of a grill of the present invention;

FIG. 5 is a rear perspective view illustrating another alternative structure for an embodiment of a grill of the present invention;

FIGS. 6A, 6B and 6C are rear, top and side views of another embodiment of the present invention; and

FIG. 7 shows another embodiment of the present invention in conjunction with various incorporated features.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

FIG. 1 is a rear perspective view of box fan 100. As shown, box fan 100 includes rear grill 110, front grill 150
and body 120. Body 120 may be fabricated of metal and is generally polygonal in shape. In a preferred embodiment, body 120 includes four surfaces 120a arranged in two substantially parallel sets, the first substantially parallel set is positioned substantially orthogonal to the second substantially parallel set. For example, the first substantially parallel set may be positioned horizontally and the second substantially parallel set may be positioned vertically. In a preferred embodiment, corners 120b where orthogonal surfaces 120a meet are arcuate in form. It is contemplated that other shapes and/or non-arcuate corners can be utilized as alternative embodiments of corners 120b.

[0034] Rear grill 110 is fabricated of polymer and is substantially planar in form. As shown in this example, the substantially planar form of rear grill 110 is positioned substantially orthogonal to all surfaces 120a of body 120. Also as shown, front grill 150 is substantially planar in form and is positioned substantially parallel to rear grill 110 on the opposing side of body 120.

[0035] As shown, body 120, rear grill 110 and front grill 150 define interior space 123. Disposed within interior space 123 is electric motor 130 and axial air impeller 140. Electric motor 150 rotates axial air impeller 140 causing air to enter interior space 123 through either rear grill 110 or front grill 150. The air is accelerated and exits interior space 123 as an exhaust air flow through either rear grill 110 or front grill 150.

[0036] Also shown in FIG. 1 is handle 160 and control 162. Handle 160 is used to facilitate the portability of box fan 100. Control 162 controls a function of box fan 100, such as, for example, the rotational speed of electric motor 130 and axial air impeller 140.

[0037] Power cord 105 may be utilized to connect box fan 100 to an electrical power source (i.e. wall outlet). The electrical component connections of box fan 100 are integrated within the device, such as, for example, between control 162 and motor 130. The integration of the electrical component connections within the device eliminates the need for the user to make such connections. In the exemplary embodiment shown, only the connection of power cord 105 to an electrical power source is required for operation of box fan 100.

[0038] Preferably, power cord 105 utilizes a safety plug. Details of the safety plug and its advantages can be referenced in U.S. Pat. No. 6,793,535, which is hereby incorporated into this patent application in its entirety.

[0039] FIG. 2 is a front perspective exploded view of box fan 100 of FIG. 1. As shown, body 120 includes front perimeter lip 128a and rear perimeter lip 128b. Front body opening 124 as shown, is defined by front perimeter lip 128a. Rear body opening 122 may similarly be defined by rear perimeter lip 128b. Located on both front and rear perimeter lips 128a and 128b are holes 126. Holes 126 are used to attach front and rear grills, 150 and 110 respectively, to body 120. It is contemplated that assembly devices (not shown) such as, for example, screws may be utilized via holes 126 in body 120 and holes 153, 113 of front and rear grills, 150 and 110 respectively, to assemble front and rear grills 150 and 110 to body 120. It is further contemplated that other assembly devices such as adhesives or snaps may be used to assemble front grill 150 and rear grill 110 to body 120. Interior space 123 of box fan 100 is defined by the assembly of body 120, front grill 150 and rear grill 110.

[0040] Front grill 150 may include, as shown, perimeter rail 152. Perimeter rail 152 defines the planar extents of front grill 150. Vertical and horizontal grill elements 156 are located within the planar area defined by perimeter rail 152. Grill elements 156 are designed to minimize their impedance to the flow of air into and/or exiting box fan 100 while at the same time protecting box fan 100 from the penetration of foreign objects into interior space 123.

[0041] As shown, rear grill 110 may include perimeter rail 112. Perimeter rail 112 defines the planar extents of rear grill 110. Vertical and horizontal grill elements 116 are located within the planar area defined by perimeter rail 112. Grill elements 116 are designed to minimize their impedance to the flow of air into and/or exiting box fan 100 while at the same time protecting box fan 100 from the penetration of foreign objects into interior space 123. Rear grill 110 also includes motor interface 118 and support channels 114. As shown, support channels 114 extend from motor interface 118 outward to perimeter rail 112. In a preferred embodiment, perimeter rail 112, grill elements 116, motor interface 118 and support channels 114 are a single molded polymer part.

[0042] As shown, electric motor 130 and axial air impeller 140 are disposed within interior space 123. Electric motor 130 is attached to motor interface 118 of rear grill 110 via motor mounting holes 111. It is contemplated that assembly devices, (not shown) such as, for example, screws can be utilized via motor mounting holes 111 to assemble electric motor 130 to rear grill 110. It is further contemplated that other assembly devices such as adhesives or snaps may be used to assemble electric motor 130 to rear grill 110.

[0043] Electric motor 130 may include at least one shaft 132, rear end bell 134, front end bell 136 and ventilation openings 138 in both rear end bell 134 and front end bell 136. Axial air impeller 140 is attached to shaft 132 and rotated by electric motor 130.

[0044] Axial impeller 140 may include hub 142 and multiple blades 144. As shown, hub 144 has a circular form. The rotation of axial air impeller 140 generates and exhaust air flow, as described with reference to FIG. 1.

[0045] It can be appreciated that assembling electric motor 130 to rear grill 110 has an advantage of electrically isolating electric motor 130 from all external surfaces of box fan 100. This advantage serves to provide greater safety for the user when compared to conventional box fans that utilize metal mounting brackets. It can also be seen that assembling electric motor 130 to rear grill 110 has a manufacturing advantage of eliminating the metal motor mounting brackets commonly used on a conventional box fan. The elimination of the metal brackets not only eliminates the material required to fabricate the metal brackets, but also eliminated the assembly process and labor associated with attaching the metal brackets to body 120. The material and assembly cost reductions combined with the additional safety of box fan 100 enhance marketability when compared to a conventional box fan.

[0046] Also shown in FIG. 2 are handle 160 and control 162. As shown, handle 160 is attached to body 120 through holes 125 located in body 120. It is contemplated that assembly devices such as adhesives, snaps or screws may be used in conjunction with holes 125 to attach handle 160 to body 120. Control 162 may include such items, (not shown) such as switches, knobs, thermostats, LEDs and power control boards. It is also contemplated that a remote control may be
used in lieu of and/or in conjunction with control 162. Control 162 may be external to body 120 and/or partially located within interior space 123 of body 120. As shown, passage 127 permits control 162 to access both internal space 123 and exterior of body 120.

[0047] FIG. 3A is a rear perspective view of rear grill 110. As shown, in a preferred embodiment perimeter rail 112 includes at least six holes 113 used to assemble rear grill 110 to body 120 of box fan 100. It is contemplated that more and/or fewer holes 113 can be used to assemble rear grill 110 to body 120.

[0048] As shown, support channels 114a, 114b, 114c and 114d extend outward from motor interface 118 and connect to perimeter rail 112. It is contemplated that multiple support channels 114 may extend from motor interface 118 and connect at a plurality of locations along perimeter rail 112. In a non-limiting fashion four support channels 114 are shown.

[0049] In a preferred embodiment, motor interface 118 is substantially circular in shape as defined by circumference 118a. In one exemplary embodiment, circumference 118a of motor interface 118 is approximately the same size as hub 142 of impeller 140, see FIG. 2. Located proximate the center of motor interface 118 are motor cooling openings 118b. In one exemplary embodiment, openings 118b are substantially aligned with ventilation openings 138 of rear end bell 134 of motor 130, see FIG. 2. Openings 118b may include grill elements 118c. The shape and size of circumference 118a, motor cooling openings 118b and grill elements 118c are utilized to allow motor interface 118 to function as an air impedance shield as per U.S. patent application Ser. No. 10/903,061, filed Jul. 30, 2004, which is hereby incorporated by reference into this patent application in its entirety.

[0050] Also shown is a plurality of motor mounting holes 111. In a preferred embodiment, the number of motor mounting holes 111 is about four; however, the invention is not so limited. It is contemplated that any number of motor mounting holes 111 may be used.

[0051] Vertical and horizontal grill elements 116 define flow through openings 117. Although grill elements 116 are shown horizontal and vertically orthogonal to one another the invention is not so limited. It is contemplated that other shaped such as arcuate shaped and radially oriented grill elements may be used.

[0052] FIG. 3B is a partial cross section view cut through support channel 114 of the rear grill 110 of FIG. 3A. As shown, support channel 114 includes recess 306 and walls 115r and 115l. The use of walls 115a and 115b increase the structural integrity of support channel 114 and enhance the ability of rear grill 110 to support the weight and dynamic forces of motor 130 and axial air impeller 140. Support channel 114 may also be used as a conduit for wires 304. Wires 304 electrically connect components of box fan 100 such as, for example, control 160, motor 130 and power cord 105. Clips 302, used to retain wires 304 within space 308 of support channel 114 can be molded integral to support channel 114 or be a separate component. Although support channel 114 is shown having a substantially rectangular cross sectional form the invention is not so limited, it is contemplated that the cross sectional form of support channel 114 may include triangular and arcuate forms as well.

[0053] FIG. 3C is a partial cross section view cut through perimeter rail 112 of rear grill 110 of FIG. 3A. Perimeter rail 112 as shown supports the vertical and horizontal grill elements 116 of rear grill 110. The cross sectional form of perimeter rail 112 includes walls 112a, 112b and 112c. The substantially orthogonal and parallel relationships of walls 112a, 112b and 112c increase the structural integrity of perimeter rail 112.

[0054] FIGS. 3D and 3E show a partial cross sectional side view and a partial front view respectively of an alternate embodiment for the perimeter rail. As shown, perimeter rail 312 includes recess 315, walls 316a, 316b and 316c and angular ribs 318. As shown in FIG. 3E, angular ribs 318 are oriented at an angle relative to walls 316a, 316b and 316c and serve to connect walls 316a, 316b and 316c together. The use of walls 316a, 316b and 316c in conjunction with ribs 318 increase the structural integrity of perimeter rail 312 and enhance the ability of rear grill 110 to support motor 130 and axial air impeller 140 via support channels 114.

[0055] FIG. 4 is a rear perspective view of rear grill 410. Rear grill 410 is an alternative embodiment for rear grill 110 of FIG. 3A. As shown, rear grill 410 uses horizontal structural supports 402 and vertical structural supports 404 to enhance the structural integrity of motor interface 118. Horizontal structural supports 402 and vertical structural supports 404 are used in lieu of support channels 114, as shown on rear grill 110 of FIG. 3A. Horizontal structural supports 402 and vertical structural supports 404 may be constructed dimensionally thinner than grill elements 116 while not overtly departing from the homogeneous appearance of grill elements 116. In other respects, rear grill 410 may be similar to the embodiment of rear grill 110 of FIG. 3A.

[0056] FIG. 5 is a rear perspective view of rear grill 510. Rear grill 510 is an alternative embodiment for rear grill 110 of FIG. 3A. As shown, rear grill 510 uses radial structural supports 502 to enhance the structural support of motor interface 118. Another aspect of rear grill 510 that contributes to the structural support of motor interface 118 are the substantially concentric arcuate grill elements 516. Radial structural supports 502 and substantially concentric arcuate grill elements 516 are used in lieu of support channels 114, as shown on rear grill 110 of FIG. 3A. Radial structural supports 502 may be constructed dimensionally thinner than grill elements 516 thus enhancing their structure without departing from the homogeneous overall appearance of rear grill 510. In other respects, rear grill 510 may be similar to the embodiment of rear grill 110 of FIG. 3A.

[0057] FIGS. 6A, 6B and 6C are rear, top and side views of box fan 600. Box fan 600 utilizes rear grill 610. Rear grill 610 has a spherical form as defined by spherical radius R in both top view FIG. 6B and side view FIG. 6C. Spherical radius R of rear grill 610 increases the overall rigidity of the structure supporting motor interface 118. As shown, radius R is convex relative to body 120, however the invention is not so limited. It is contemplated that spherical radius R may be concave relative to body 120.

[0058] In the illustrated embodiment of rear grill 610, support channels 114 are used. It is contemplated that other support structures such as, for example, horizontal structural supports 402 and vertical structural supports 404 of FIG. 4 and/or radial structural supports 502 and substantially concentric arcuate grill elements 516 of FIG. 5 may be used in conjunction with spherical radius R. In other respects, box fan 600 may be similar to box fan 100 of FIG. 1.
FIG. 7 shows in a non-limiting fashion other features that can be incorporated into box fan 700. As shown, FIG. 7 handle 760 is an integral part of rear grill 710. This has the advantage of not requiring the additional component and assembly of handle 160 as shown in FIG. 1.

Also shown in FIG. 7 is control 762. Control 762 is located near motor 130 and is allowed access to motor 130 through rear grill 710. This feature has the advantage of eliminating the a control wire (not shown) required to connect motor 130 to control 162 located at a more remotely as shown in FIG. 1. This feature also allows control 762 and motor 130 to be pre assembled as a sub assembly bringing further advantages to the assembly process.

In the illustrated embodiment of rear grill 710, support channels 114 are used. It is contemplated that other support structures such as, for example, horizontal structural supports 402 and vertical structural supports 404 of FIG. 4 and/or radial structural supports 502 and substantially concentric arcuate grill elements 516 of FIG. 5 may be used in conjunction with handle 760 and control 762. In other respects, box fan 700 may be similar to box fan 100 of FIG. 1.

As described and shown, box fan 100 utilizing motor interface 118 incorporated into polymer rear grill 110 eliminates the need for metal motor mounting brackets and the additional labor to assemble the metal brackets used on a conventional box fan. This reduces the final cost of the box fan. Another advantage of incorporating motor interface 118 into rear grill 110 is the ability of the polymer material of rear grill 110 to electrically isolate motor 130 from external metal components of box fan 100 such as, for example, the body 120.

As described and shown, body 120 of box fan 100 is substantially the same as the body used on a conventional box fan. The similarities between body 120 of box fan 100 and the body used on a conventional box fan allow the manufacturer to more easily alternate between the production of box fan 100 with motor interface 118 and the production of a conventional box fan with metal brackets. The ability to alternate production allows the manufacturers to respond to material costs and produce the box fan that yields the most cost savings.

As described and shown, the use of the polymer rear grill to support the motor can also incorporate other features within the structure such as, for example; handles, switches, improved cooling features, etc. The combination of these features and the motor support incorporated into the rear polymer grill of the box fan yield further cost savings for the user.

The box fan structure as described will maintain or improve the quality and safety of the device while permitting the manufacturer the flexibility of production to produce the device at a lower cost.

Although the invention has been described with reference to exemplary embodiments, it is not limited thereto. Rather, the appended claims should be construed to include other variants and embodiments of the invention, which may be made by those skilled in the art without departing from the true spirit and scope of the present invention.

What is claimed:
1. A box fan comprising:
a fan body formed of metal comprising:
at least one wall forming a substantially polygonal shape having a rear body opening and a front body opening substantially parallel to said rear body opening and located on the opposite side of said fan body from said rear body opening;
a unitary rear grill formed of polymer disposed proximate and substantially covering said rear body opening, said unitary rear grill comprising:
a perimeter rail defining extents of said unitary rear grill;
a plurality of grill elements defining flow through openings, said flow through openings allowing air to pass through said unitary rear grill;
an integrated motor interface structure substantially centered with reference to said extents of said unitary rear grill;
a front grill disposed proximate and substantially covering said front body opening;
an interior space defined by said at least one wall of said fan body, said unitary rear grill, and said front grill;
a motor having a shaft extension disposed within said interior space, said motor being connected to and structurally supported by said integrated motor interface structure of said unitary rear grill; and
an axial air impeller disposed within said interior space, said air impeller comprising:
a hub connected to said shaft extension of said motor;
a plurality of blades extending radially outward from said hub.
2. The box fan of claim 1, wherein said unitary rear grill further comprises support channels extending from said motor interface structure to said perimeter rail of said unitary rear grill, said support channels structurally support said motor and said axial air impeller.
3. The box fan of claim 2, wherein said support channel further defines a conduit and electric conducting wires of said box fan are located in said conduit.
4. The box fan of claim 2, wherein perimeter rail, grill elements, motor interface, and support channels are a single molded polymer part.
5. The box fan of claim 4, wherein said single molded polymer part electrically isolates said motor from all external surfaces of said box fan
6. The box fan of claim 2, wherein said support channel further comprises at least one wall defining a recess.
7. The box fan of claim 1, wherein at least a portion of said plurality of grill elements extend from said motor interface structure to said perimeter rail of said unitary rear grill and said portion of said plurality of grill elements structurally support said motor and said axial air impeller.
8. The box fan of claim 1, wherein said unitary rear grill comprises a spherical form as defined by a surface of the rear grill, wherein said surface comprises a spherical radius.
9. The box fan of claim 1, wherein said motor further comprises a rear end bell including ventilation openings and said integrated motor interface further comprises:
a motor mounting surface; and
a cooling opening substantially centered in said motor mounting surface;
wherein said ventilation openings of said rear end bell and said cooling opening in said integrated motor interface are substantially aligned.

10. The box fan of claim 9, wherein said hub of said axial air impeller further comprises a first circumferential periphery and said motor mounting surface is defined by a second circumferential periphery and said first and said second circumferential peripheries are substantially aligned.

11. The box fan of claim 1, wherein said integrated motor interface structure further comprises a plurality of motor mounting holes.

12. The box fan of claim 1, wherein said unitary rear grill further comprises a unitary handle.

13. The box fan of claim 1, further comprising a controller wherein said motor and controller is accessible through said unitary rear grill.

14. The box fan of claim 13, wherein said unitary rear grill further comprises a handle as an integral part of said unitary rear grill.

15. The box fan of claim 1, wherein said perimeter rail further comprises:
   a first wall substantially parallel to said grill elements;
   a second wall extending substantially orthogonal and outward from said first wall; and
   a third wall extending substantially orthogonal from said second wall.

16. The box fan of claim 1, wherein said rear grill perimeter rail further comprises:
   a first wall substantially parallel to said grill elements;
   a second wall extending outward from said first wall;
   a recess formed in said second wall;
   a third wall extending from said second wall, said third wall oriented substantially orthogonal to said first wall; and
   angular ribs extending between said first wall and said third wall, said angular ribs connecting said first wall, said second wall, and said third wall.

17. The box fan of claim 1, wherein said rear grill further comprises:
   horizontal structural supports extending from said integrated motor interface to sides of said perimeter rail; and
   vertical structural supports extending from said integrated motor interface to a top and a bottom of said perimeter rail.

18. The box fan of claim 17, wherein said horizontal structural supports and said vertical structural supports are constructed dimensionally thinner than said grill elements.

19. The box fan of claim 1, wherein said rear grill further comprises:
   a plurality of substantially concentric arcuate grill elements; and
   radial structural supports extending radially from said integrated motor interface to said perimeter rail, said radial structural supports connected to said concentric arcuate grill elements.

20. A box fan comprising:
   a fan body formed of metal comprising:
   at least one wall forming a substantially polygonal shape having a rear body opening and a front body opening substantially parallel to said rear body opening and located on the opposite side of said fan body from said rear body opening;
   a unitary rear grill formed of polymer disposed proximate and substantially covering said rear body opening, said unitary rear grill comprising:
   a perimeter rail defining extents of said unitary rear grill;
   a plurality of grill elements defining flow through openings, said flow through openings allowing air to pass through said unitary rear grill;
   a substantially circular-shaped integrated motor interface structure substantially centered with reference to said extents of said unitary rear grill;
   support channels extending between and connecting said motor interface structure to said perimeter rail of said unitary rear grill;
   a front grill disposed proximate and substantially covering said front body opening:
   an interior space defined by said at least one wall of said fan body, said unitary rear grill, and said front grill;
   a motor disposed within said interior space, said motor being connected to and structurally supported by said integrated motor interface structure of said unitary rear grill, said motor having a shaft extension;
   an axial air impeller disposed within said interior space, said air impeller comprising:
   a hub connected to said shaft extension of said motor;
   a plurality of blades extending radially outward from said hub.

21. A box fan comprising:
   at least one wall formed of metal forming a substantially polygonal shape;
   a rear opening formed by said at least one wall;
   a front opening formed by said at least one wall, said front opening oriented substantially parallel to said rear body opening and located on the opposite side of said at least one wall;
   a front grill disposed proximate and substantially covering said front opening;
   a plurality of front grill elements defining front flow through openings, said front flow through openings allowing air to pass through said front grill;
   a rear grill disposed proximate and substantially covering said rear opening;
   a perimeter rail defining extents of said rear grill;
   a plurality of rear grill elements defining rear flow through openings, said rear flow through openings allowing air to pass through said rear grill;
   a substantially circular shaped integrated motor interface structure substantially centered with reference to said extents of said rear grill;
   motor cooling openings in a center region of said integrated motor interface structure;
   a shaft extending from said motor; and
   a rear end bell of said motor;
ventilation openings in said rear end bell, wherein said ventilation openings of said motor rear end bell substantially align with said motor cooling openings in said integrated motor interface structure; an axial air impeller disposed within said interior space; a substantially circular shaped hub of said air impeller connected to said motor shaft, wherein a circumference of said substantially circular shaped hub is substantially equal to said substantially circular shaped integrated motor interface structure; and a plurality of blades of said air impeller extending radially outward from said hub.

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