A motor-fan assembly for a vacuum cleaner configured to remove debris from a surface. The motor-fan assembly includes a fan, a motor including an output shaft coupled to the fan, the motor operable to rotate the fan, and a diffuser. The diffuser includes a disc, a wall that surrounds the disc, and a plurality of vanes that are coupled to an outer surface of the wall and extend radially outward from the outer surface of the wall.
DIFFUSER FOR A VACUUM CLEANER MOTOR-FAN ASSEMBLY

BACKGROUND

[0001] The present invention relates to vacuum cleaners, and more particularly to diffusers for a motor-fan assembly for vacuum cleaners.

[0002] Vacuum cleaners typically include a base and a handle that pivots with respect to the base between an upright or storage position and an inclined position to allow the user to move the base of the vacuum cleaner along a surface to be cleaned. The base of the vacuum cleaner often includes a nozzle that defines an inlet. The handle of the vacuum cleaner often includes a motor-fan assembly that is operable to generate an airflow through the inlet. The airflow includes a mixture of air and debris from the surface to be cleaned. In many vacuum cleaners, the motor-fan assembly includes a diffuser for improving system efficiency. The diffuser includes vanes that cause an entering airflow to slow, which raises the static pressure of the airflow. Thus, the diffuser converts air velocity into static pressure rise. Although the diffuser improves the air performance of the system, the design of the vanes can create a high pitched whistle that is annoying to users of the vacuum cleaner. After the airflow passes through the vanes, it is directed to radially arranged vanes on the under side of the diffuser which further slows the airflow and further directs the airflow to the electric motor for cooling before exiting the vacuum cleaner.

SUMMARY

[0003] In one embodiment, the invention provides a motor-fan assembly for a vacuum cleaner. The motor-fan assembly includes a fan, a motor including an output shaft coupled to the fan, the motor operable to rotate the fan, and a diffuser. The diffuser includes a disc, a wall that surrounds the disc, and a plurality of vanes that are coupled to an outer surface of the wall and extend radially outward from the outer surface of the wall. The disc has a first surface that faces towards the fan, a second surface that faces away from the first surface, and an aperture that extends through the disc between the first surface and the second surface. The output shaft extends through the aperture. The disc further includes an outer periphery that extends radially around the aperture. The wall surrounds the outer periphery of the disc. The wall has an inner surface that faces toward the output shaft and an outer surface that faces away from the inner surface.
In another embodiment the invention provides a vacuum cleaner that includes a dirt collection chamber, a base including a nozzle defining an inlet of the vacuum cleaner through which debris travels towards the dirt collection chamber, a handle coupled to the base and configured to move the base along a surface to be cleaned, and a motor-fan assembly operable to generate an airflow through the inlet and the dirt collection chamber. The motor-fan assembly includes a fan, a motor including an output shaft coupled to the fan, the motor operable to rotate the fan to generate the airflow, and a diffuser. The diffuser includes a disc, a wall that surrounds the disc, and a plurality of vanes that are coupled to an outer surface of the wall and extend radially outward from the outer surface of the wall. The disc has a first surface that faces towards the fan, a second surface that faces away from the first surface, and an aperture that extends through the disc between the first surface and the second surface. The output shaft extends through the aperture. The disc further includes an outer periphery that extends radially around the aperture. The wall surrounds the outer periphery of the disc. The wall has an inner surface that faces toward the output shaft and an outer surface that faces away from the inner surface.

Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a vacuum cleaner according to one embodiment of the invention.

FIG. 2 is an exploded view of a motor-fan assembly of the vacuum cleaner of FIG. 1.

FIG. 3 is a cross-sectional view of the motor-fan assembly of FIG. 2 assembled and taken along line 3-3 of FIG. 2.

FIG. 4 is a partial cross-sectional view of a portion of the motor-fan assembly of FIG. 2.

FIG. 5 is a partial cross-sectional view of a portion of a motor-fan assembly according to another embodiment of the invention.
FIG. 6 is an enlarged cross-sectional view of a portion of the motor-fan assembly of FIG. 5.

FIG. 7 is an enlarged cross-sectional view of a portion of a motor-fan assembly according to another embodiment of the invention.

FIG. 8 is an enlarged cross-sectional view of a portion of a motor-fan assembly according to another embodiment of the invention.

Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways.

DETAILED DESCRIPTION

FIG. 1 illustrates a vacuum cleaner 10. The illustrated vacuum cleaner 10 includes a base 14 and a handle 18 that is pivotally coupled to the base 14 and configured to move the base 14 along a surface to be cleaned such that in the illustrated embodiment, the vacuum cleaner 10 is an upright vacuum cleaner. In other embodiments, the vacuum cleaner can be other types of vacuum cleaners, such as a canister vacuum, hand held vacuum, etc. The base 14 includes a nozzle 30 that defines an inlet 32 of the vacuum cleaner 10. The vacuum cleaner 10 further includes a canister 24 that is removably coupled to the handle 18. The canister 24 defines a dirt collection chamber 26 and a separator 28. In the illustrated embodiment, the separator 28 is a cyclonic separator, and in other embodiments, other types of separators, such as filters, bags, and the like can be used. The illustrated vacuum cleaner 10 further includes a conduit 36. The conduit 36 fluidly couples the inlet 32 and the separator 28.

Referring to FIGS. 1 and 2, the vacuum cleaner 10 further includes a motor-fan assembly 34. The motor-fan assembly 34 is operable to generate an airflow through the inlet 32, the conduit 36, and the separator 28. The motor-fan assembly 34 includes a fan 38, an electric motor 42, a diffuser 50, and a cover 58. The fan 38 includes fan blades 54 arranged around an aperture 40. In the illustrated embodiment, the fan 38 is a centrifugal fan, but in other embodiments, other types of fans can be used. The electric motor 42 includes a housing.
44 and an output shaft 46. The output shaft 46 extends through the aperture 40 of the fan 38 to couple the output shaft 46 and the fan 38 for co-rotation. The electric motor 42 receives electric current and is operable to rotate the fan 38.

[0017] The cover 58 includes an inlet aperture 60. The housing 44 of the motor 42 includes an outlet aperture 48. The cover 58 is coupled to the housing 44 of the motor 42 to surround the fan 38 and the diffuser 50 so that the airflow generated by the motor-fan assembly 34 travels through the inlet aperture 60 and is exhausted through the outlet aperture 48 of the housing 44.

[0018] Referring to FIGS. 2 and 4, the diffuser 50 includes a disc 62, a wall 66, and a plurality of vanes 70. The disc 62 includes a first surface 74 (FIG. 3) that faces toward the fan 38, a second surface 78 that faces away from the first surface 74 and away from the fan 38, and an aperture 82 that extends through the disc 62 between the first surface 74 and the second surface 78. The output shaft 46 of the motor 42 extends through the aperture 82 (FIG. 3). The disc 62 further includes an outer periphery 86 that extends radially around the aperture 82.

[0019] Referring to FIGS. 3 and 4, the wall 66 surrounds the outer periphery 86 of the disc 62 and includes an inner surface 90 that faces toward the output shaft 46 and an outer surface 94 that faces away from the inner surface 90 and the output shaft 46. The wall 66 extends in a direction away from the disc 62 and toward the fan 38 to surround an outer periphery 98 of the fan 38. The wall 66 includes a first edge 63 and a second edge 64 opposite the first edge 63. In other constructions, as discussed in more detail below, the wall 66 can extend in other directions. The wall 66 is a continuous wall (i.e., no breaks or apertures in the wall 66) that extends three-hundred and sixty degrees around the disc 62. Also, in the illustrated construction, the wall 66 extends perpendicularly from the disc 62.

[0020] The plurality of vanes 70 are coupled to the outer surface 94 of the wall 66 and extend radially outward from the outer surface 94 of the wall 66. The vanes 70 are positioned between the first edge 63 and the second edge 64 of the wall 66 such that the vanes 70 do not extend past the edges 63 and 64 in the illustrated embodiment. In other embodiments, the vanes can extend past the edges 63 and 64. The plurality of vanes 70 are each airfoil-shaped. The airfoil-shaped vanes 70 each include a leading edge 102 and a trailing edge 106. A chord line 110 connects the leading edge 102 and the trailing edge 106 and forms an acute angle
116 with respect to a reference plane 114 that intersects the chord line 110 at the trailing edge 106 and is parallel to the first surface 74 of the disc 62. Another set of vanes 118 are coupled to the second surface 78 of the disc 62 and arranged circumferentially around the aperture 82. Although in the illustrated embodiment, the vanes 70 are airfoil-shaped, in other embodiments, the vanes can take other suitable shapes.

[0021] In operation, referring to FIG. 1, the motor-fan assembly 34 of the vacuum cleaner 10 generates an airflow that travels into the vacuum cleaner 10 through the inlet. The airflow includes a mixture of air and debris from the surface to be cleaned. The airflow travels through the conduit 36 and into the separator 28 where the air and debris are separated. The relatively clean and filtered air exits the separator 28 and travels to the motor-fan assembly 34. Referring to FIG. 3, the air travels into the motor-fan assembly 34 through the inlet aperture 60 of the cover 58 as indicated by lines 126 in FIG. 3. The air passes into the fan 38 where the air is directed radially outward toward the diffuser vanes 70. The diffuser vanes 70 are coupled to the outer surface 94 of the wall 66 and extend radially outward from the outer surface 94 of the wall 66 and cause the entering air to slow, which raises the static pressure of the air. In addition, the vanes 70 reduce noise by aligning the air and making it more uniform. After the air passes through the diffuser vanes 70, it is directed to radially arranged vanes 118 on the under side 78 of the disc 62 which further slows the air and then directs the air through the outlet 48 of the housing 44 to be exhaust to atmosphere and also cool the motor 42.

[0022] FIGS. 5 and 6 illustrate a motor-fan assembly 234 including a diffuser 250 according to another embodiment. The motor-fan assembly 234 includes features similar to the motor-fan assembly 34 of FIGS. 1-4, and therefore, like components have been given like reference numbers plus 200 and only differences between the motor-fan assemblies 34 and 234 will be discussed in detail below.

[0023] The motor-fan assembly 234 includes a diffuser 250 having a wall 266, a first plurality of vanes 270 that extend from the wall 266, and a second plurality of vanes 272 that extend from the wall 266. The wall 266 includes a first portion 330 that extends in a first direction from the disc 262 and toward the fan 238 to surround the outer periphery 298 of the fan 238, forming a first edge 263, and a second portion 334 that extends away from the first portion 330 in a second direction from the disc 262 and toward the motor 242 along the output shaft of the motor 242 and away from the fan 238, forming a second edge 264. The
first plurality of vanes 270 extend radially outward from the first portion 330 and the outer surface 294 of the wall 266. The first plurality of vanes 270 are positioned between the disc 262 and the first edge 263 of the first portion 330 of the wall 266. The second plurality of vanes 272 extend radially outward from the second portion 334 and the outer surface 294 of the wall 266. The second plurality of vanes 272 are positioned between the disc 262 and the second edge 264 of the second portion 334 of the wall 266. The first plurality of vanes 270 and the second plurality of vanes 272 both include airfoil-shaped vanes.

[0024] FIG. 7 illustrates a motor-fan assembly 434 including a diffuser 450 according to another embodiment. The motor-fan assembly 434 includes features similar to the motor-fan assembly 34 of FIGS. 1-4, and therefore, like components have been given like reference numbers plus 400 and only differences between the motor-fan assemblies 34 and 434 will be discussed in detail below.

[0025] The motor-fan assembly 434 includes the diffuser 450 having a wall 466 and a plurality of vanes 470. The wall 466 extends in a direction from the disc 462 and toward the motor 442 along the output shaft of the motor 442 and away from the fan 438, forming a first edge 463 and a second edge 264. The plurality of vanes 470 are coupled to an outer surface 494 of the wall 466 and extend radially outward from the outer surface 494 of the wall 466. The plurality of vanes 470 are positioned between the first edge 463 and the second edge 464 of the wall 466 such that the vanes 470 do not extend past the edges 463 and 464.

[0026] FIG. 8 illustrates a motor-fan assembly 634 including a diffuser 650 according to another embodiment. The motor-fan assembly 634 includes features similar to the motor-fan assembly 34 of FIGS. 1-4, and therefore, like components have been given like reference numbers plus 600 and only the differences between the motor-fan assemblies 34 and 634 will be discussed in detail below.

[0027] The motor-fan assembly 634 includes the diffuser 650 having an inner wall 666, a plurality of vanes 670, and an outer wall 668. The inner wall 666 surrounds an outer periphery 686 of a disc 662 and includes an inner surface 730 that faces toward the output shaft of the motor 642 and an outer surface 734 that faces away from the inner surface 730. The inner wall 666 extends in a direction from the disc 662 and toward the fan 638 to surround the outer periphery 698 of the fan 638, forming a first edge 663 and a second edge 664. The plurality of vanes 670 are coupled to the outer surface 734 of the inner wall 666.
and extend radially outward from the outer surface 734 of the inner wall 666. The plurality of vanes 670 are positioned between the first edge 663 and the second edge 664 of the inner wall 666. The outer wall 668 is located radially outward from the inner wall 666, away from the output shaft of the motor 642 such that the plurality of vanes 670 extend between the inner wall 666 and the outer wall 668.

[0028] Various features and advantages of the invention are set forth in the following claims.
CLAIMS

What is claimed is:

1. A motor-fan assembly for a vacuum cleaner, the motor-fan assembly comprising:
   a fan;
   a motor including an output shaft coupled to the fan, the motor operable to rotate the
   fan; and
   a diffuser including,
      a disc having a first surface facing toward the fan, a second surface facing
      away from the first surface, an aperture extending through the disc between the first
      surface and the second surface, the output shaft extending through the aperture, the
      disc further including an outer periphery that extends radially around the aperture,
      a wall that surrounds the outer periphery of the disc having an inner surface
      that faces toward the output shaft and an outer surface facing away from the inner
      surface, and
      a plurality of vanes coupled to the outer surface of the wall and extending
      radially outward from the outer surface of the wall.

2. The motor-fan assembly of claim 1, wherein the wall extends in a direction from the
disc and toward the fan to surround an outer periphery of the fan.

3. The motor-fan assembly of claim 1, wherein the wall extends in a direction from the
disc and toward the motor along the output shaft and away from the fan.

4. The motor-fan assembly of claim 1, wherein the wall extends in a first direction from
the disc and toward the fan to surround an outer periphery of the fan and in a second direction
from the disc and toward the motor along the output shaft and away from the fan.

5. The motor-fan assembly of claim 1, wherein the wall is a continuous wall that extends
three-hundred and sixty degrees around the disc.
6. The motor-fan assembly of claim 1, wherein the wall includes a first portion and a second portion, wherein the plurality of vanes are a first plurality of vanes and extend from the first portion, wherein the diffuser further includes a second plurality of vanes that extend radially outward from the second portion of the wall and the outer surface of the wall, and wherein the first plurality of vanes are spaced from the second plurality of vanes in a direction along the output shaft of the motor.

7. The motor-fan assembly of claim 6, wherein the first plurality of vanes and the second plurality of vanes both include airfoil-shaped vanes.

8. The motor-fan assembly of claim 1, wherein the wall is an inner wall, wherein the diffuser further includes an outer wall located radially outward from the inner wall with respect to the aperture, and wherein the plurality of vanes extend between the inner wall and the outer wall.

9. The motor-fan assembly of claim 1, wherein the plurality of vanes include airfoil-shaped vanes.

10. The motor-fan assembly of claim 9, wherein the airfoil-shaped vanes each include a leading edge, a trailing edge, and a chord line connecting the leading edge and the trailing edge, wherein a reference plane intersects the chord line at the trailing edge and the reference plane is parallel to the first surface and the second surface of the disc, and wherein an acute angle is defined between the chord line and the reference plane.

11. The motor-fan assembly of claim 1, further comprising a plurality of vanes extending from the second surface of the disc and arranged circumferentially around the aperture.
12. A vacuum cleaner, comprising:
   a dirt collection chamber;
   a base including a nozzle defining an inlet of the vacuum cleaner through which debris travels toward the dirt collection chamber;
   a handle coupled to the base and configured to move the base along a surface to be cleaned; and
   a motor-fan assembly operable to generate an airflow through the inlet and the dirt collection chamber, the motor-fan assembly including,
   a fan,
   a motor including an output shaft coupled to the fan, the motor operable to rotate the fan to generate the airflow, and
   a diffuser including,
   a disc having a first surface facing toward the fan, a second surface facing away from the first surface, an aperture extending through the disc between the first surface and the second surface, the output shaft extending through the aperture, the disc further including an outer periphery that extends radially around the aperture,
   a wall that surrounds the outer periphery of the disc and the wall having an inner surface that faces toward the output shaft and an outer surface facing away from the inner surface, and
   a plurality of vanes coupled to the outer surface of the wall and extending radially outward from the outer surface of the wall.

13. The vacuum cleaner of claim 12, wherein the motor-fan assembly includes a cover defining an inlet of the motor-fan assembly through which air travels toward the motor, and wherein the fan and the diffuser are disposed within the cover.

14. The vacuum cleaner of claim 12, wherein the wall extends in a direction from the disc and toward the fan to surround an outer periphery of the fan.

15. The vacuum cleaner of claim 12, wherein the wall extends in a direction from the disc and toward the motor along the output shaft and away from the fan.
16. The vacuum cleaner of claim 12, wherein the wall extends in a first direction from the disc and toward the fan to surround an outer periphery of the fan and in a second direction from the disc and toward the motor along the output shaft and away from the fan.

17. The vacuum cleaner of claim 12, wherein the wall is a continuous wall that extends three-hundred and sixty degrees around the disc.

18. The vacuum cleaner of claim 12, wherein the wall comprises a first portion and a second portion, wherein the plurality of vanes are a first plurality of vanes and extend from the first portion, wherein the diffuser further includes a second plurality of vanes that extend radially outward from the second portion of the wall and the outer surface of the wall, and wherein the first plurality of vanes are spaced from the second plurality of vanes in a direction along the output shaft of the motor.

19. The vacuum cleaner of claim 12, wherein the wall is an inner wall, wherein the diffuser further includes an outer wall located radially outward from the inner wall with respect to the aperture, and wherein the plurality of vanes extend between the inner wall and the outer wall.

20. The vacuum cleaner of claim 12, further comprising a plurality of vanes extending from the second surface of the disc and arranged circumferentially around the aperture.