Aug. 2, 1966 R. G. KROKER ETAL 3,263,908

COOLING ARRANGEMENT FOR A VACUUM CLEANER MOTOR OR THE LIKE

Filed May 15, 1964 2 Sheets-Sheet 1

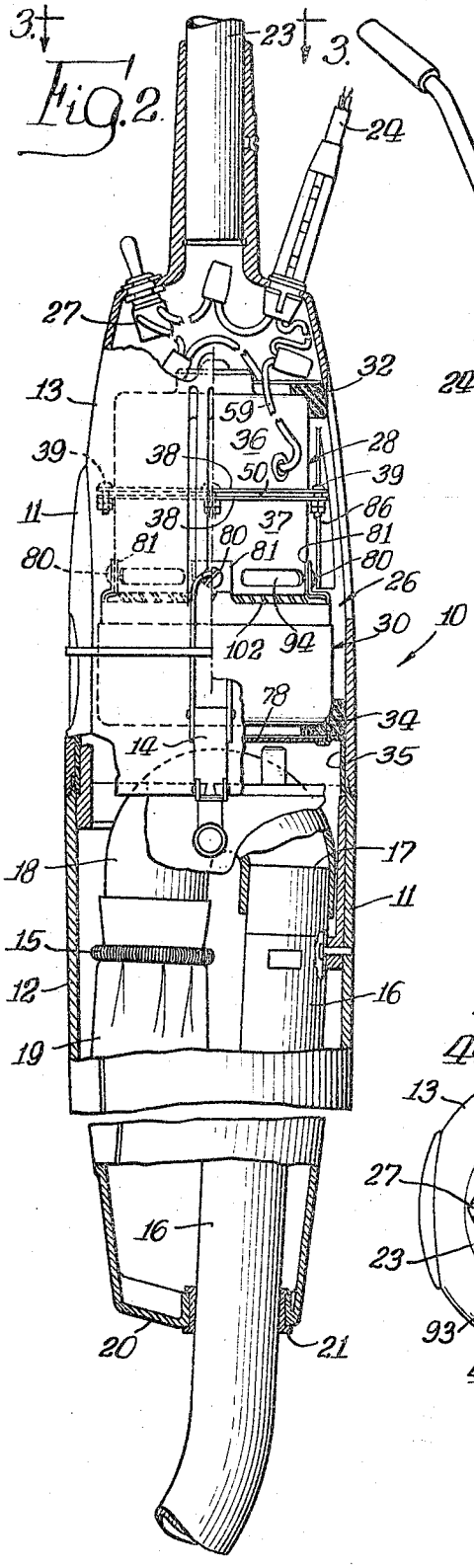


Fig. 2.

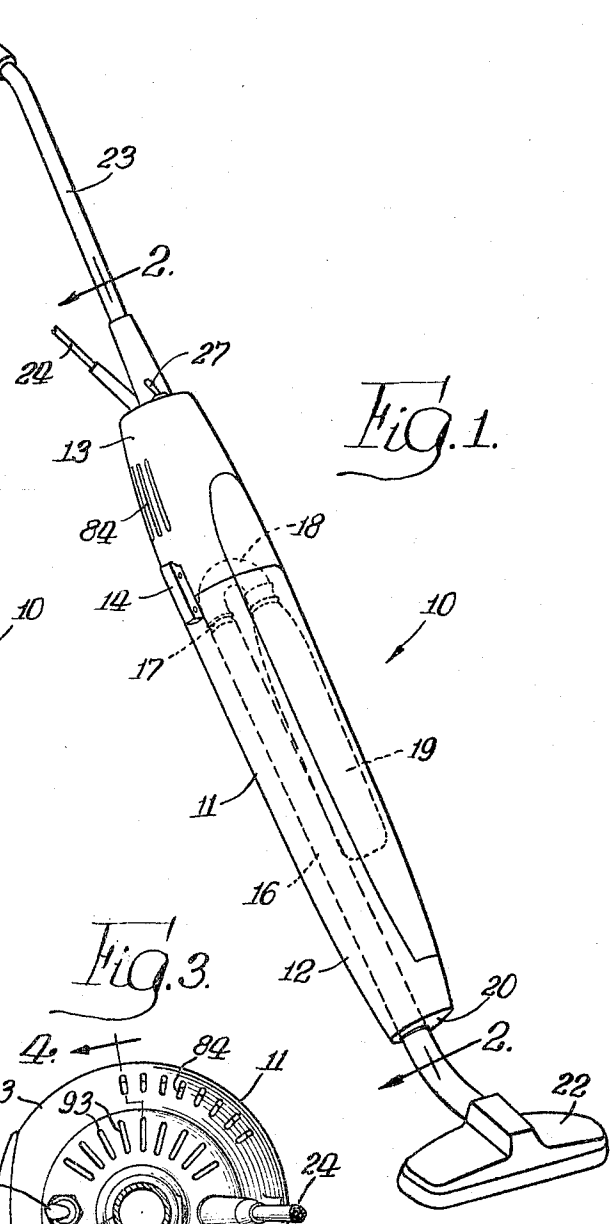


Fig. 1.

Fig. 3.

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Fig. 4.

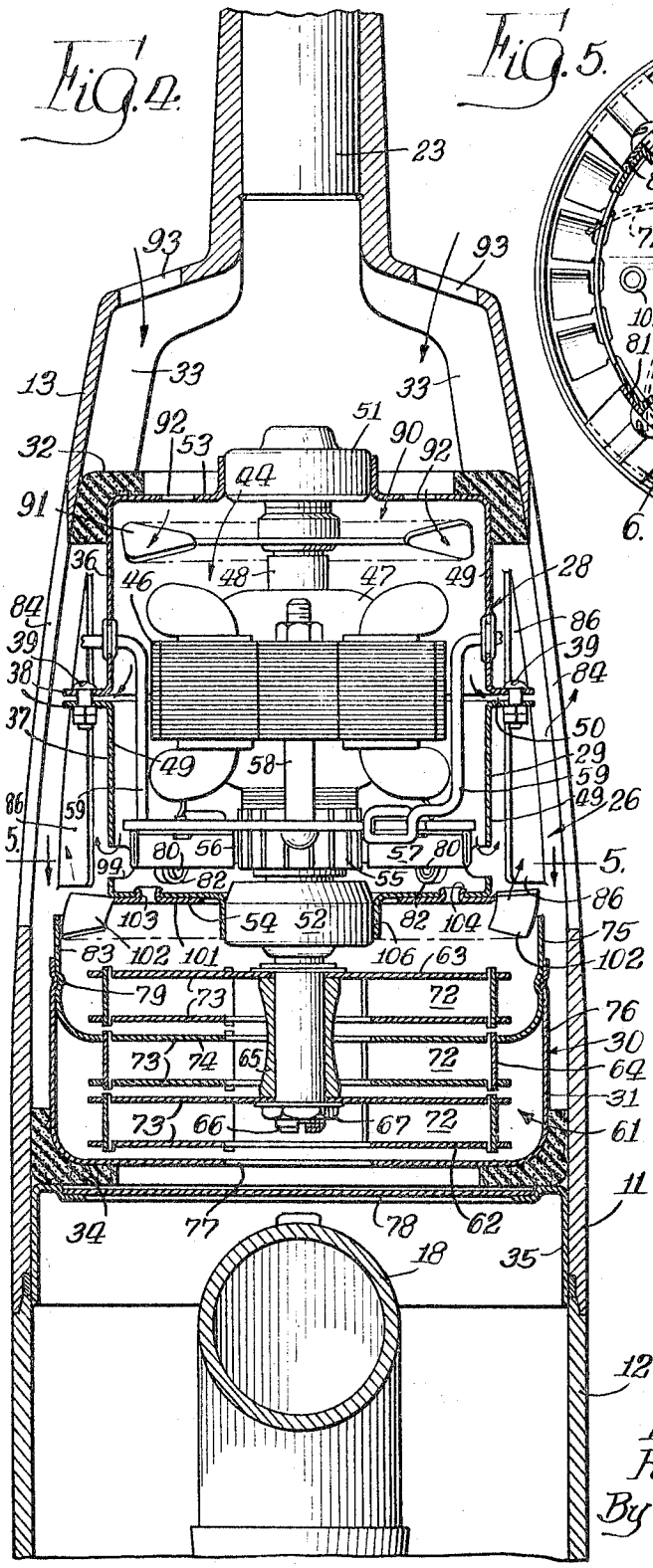


Fig. 5.

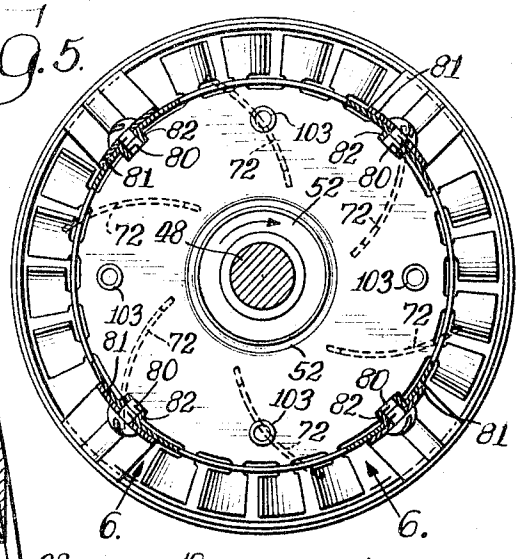
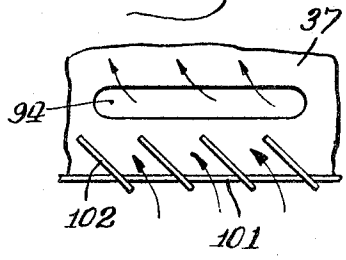


Fig. 6.



10

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COOLING ARRANGEMENT FOR A VACUUM CLEANER MOTOR OR THE LIKE

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11 Claims. (Cl. 230—117)

This invention relates to an improved motor-fan unit and more particularly to a novel and improved cooling arrangement for the motor of such a unit. Motor-fan units of the type here involved are particularly useful in vacuum cleaners, but may also be used in many other environments.

Because of the fact that the currently popular upright, lightweight-type vacuum cleaners employ a compact or slim line styling, the motor-fan unit of such cleaners must be small. Since most of the cleaners of this type depend solely upon suction for their cleaning action, the fan must operate at high speeds in order to develop the required vacuum. As a result of such high speed operation, a substantial amount of heat is developed by the motor of the unit which must be dissipated if permature failure is to be avoided. Such heat is also detrimental where a plastic cleaner housing is employed in that excessive heat may cause the housing to become deformed or melt.

The heat dissipation problem is particularly aggravated in the aforementioned type of cleaner in that it is undesirable to utilize the main air flow through the cleaner for cooling the motor due to the back pressure that is developed and the consequent reduction in the suction available for cleaning.

Accordingly, it is a general object of the present invention to provide a novel and improved motor-fan unit adapted for use in a variety of applications involving movement or flow of a gaseous fluid.

A more particular object is to provide a novel and improved cooling arrangement for the drive motor of a motor-fan unit of the foregoing character.

Another object is to provide a novel and improved cooling arrangement for the drive motor of an upright, lightweight type vacuum cleaner wherein a separate flow of cooling air from the exterior of the cleaner is utilized to cool the motor.

Still another object is to provide a novel and improved cooling arrangement of the foregoing character wherein the separate cooling air flow does not enter the casing which encloses the main suction fan.

A further object is to provide a novel cooling air flow arrangement for the fan drive motor of an upright, lightweight-type vacuum cleaner wherein the main air flow through the cleaner is utilized in a novel manner to augment a separate cooling air flow through the motor casing.

Another object is to provide a novel combination cooling air flow augmenting means and a fan guard adapted for use with the motor-fan unit of a vacuum cleaner of the character described.

Still another object is to provide a novel combination cooling air flow augmenting means and fan guard of the foregoing character which acts as a heat sink to cool at least one of the motor bearings of the motor-fan unit.

A further object is to provide a novel combination cooling air flow augmenting means and fan guard of the foregoing character, which is simple in construction and economical to manufacture.

Other objects and advantages of the invention will become apparent from the following detailed description and accompanying sheets of drawings, in which:

FIG. 1 is a perspective view of a vacuum cleaner embodying the features of the present invention;

FIG. 2 is an enlarged, broken, longitudinal sectional view with some parts in elevation, taken substantially along the line 2—2 of FIG. 1;

FIG. 3 is an end view of the upper end of the housing of the vacuum cleaner shown in FIGS. 1 and 2, taken substantially along the line 3—3 of FIG. 2;

FIG. 4 is an enlarged fragmentary longitudinal sectional view of the upper portion of the vacuum cleaner illustrated in FIG. 2 and showing additional structural details of the air flow arrangement therethrough;

FIG. 5 is a transverse sectional view taken substantially along the line 5—5 of FIG. 4; and

FIG. 6 is a fragmentary side elevational view of the fan motor casing of the cleaner taken substantially along the line 6—6 of FIG. 5, and showing additional details of the air flow directing structure.

Briefly described, the present invention contemplates an improved motor-fan unit for effecting movement or flow of a gaseous fluid, the unit incorporating a novel cooling arrangement for the fan drive motor thereof. While the motor-fan unit of the present invention may be used in a variety of applications, the structural details and operation thereof will be described hereinafter in conjunction with one specific application, namely as the means for producing a main or cleaning air flow through an upright, lightweight-type vacuum cleaner. Thus, the motor-fan unit generally comprises a motor portion and a fan portion, the motor portion including a motor which is enclosed in a casing and which serves to drive a main fan. The main fan is also enclosed in a casing secured to the motor casing. The motor and fan, together, comprise the aforementioned motor-fan unit or assembly which is mounted in and enclosed by the cleaner housing. The main fan provides a main or cleaning air flow through the cleaner housing which serves to draw dirt or other foreign particles into the housing through a flow pipe having a suitable attachment connected to the inlet end thereof. The dirt laden air passes through a suitable filter or bag within the housing, and substantially clean air from the filter is exhausted through outlet openings in the side wall of the housing adjacent the motor portion of the motor-fan unit.

Because of the fact that the main air flow may contain minute particles of dirt, or moisture due to a wet pick-up situation or possibly a broken filter bag, and may be at an elevated temperature due to its passage through the main fan, this air is not well suited for cooling the motor. Instead, a novel separate cooling air flow for the motor is contemplated, such flow being substantially isolated from the main or cleaning air flow. Such cooling air flow, to be hereinafter described in detail, is provided in part by a supplemental cooling fan secured to the drive shaft of the motor and disposed within the motor casing. In addition, a novel flow directing means is provided for augmenting both the main and cooling air flows through the motor casing.

Such flow directing means, in the embodiment of the invention described more fully hereinafter, comprises a plurality of circumferentially spaced radially outwardly extending blades or vanes disposed in the main air flow discharging from the main fan. The blades serve to augment the main air flow by reducing turbulence in the main fan casing and main air flow. The blades also serve to augment the cooling air flow by directing the main air flow across a plurality of openings or slots in the side wall of the motor casing, adjacent its lower end, to provide a venturi effect. Such venturi effect increases the cooling air flow through the motor casing. Preferably, the blades are inclined so as to lie in planes paralleling the natural flow path of the main air flow. A more uniform flow of the main air is thus obtained across the slots in the motor

casing which contributes to the aforementioned venturi effect.

In addition to directing the main air flow across the slots in the motor casing, such blades also function as a guard for the main fan of the motor-fan unit as required by certain safety specifications for this type of device.

In FIG. 1, a vacuum cleaner **10** incorporating a motor-fan unit **26** shown in detail in FIGS. 2 and 4 and embodying the features of the present invention, is illustrated. The vacuum cleaner **10**, in the present instance, comprises an elongated, separable housing **11** which includes a lower section **12** and an upper section **13**. A pair of toggle clamps or latches **14**, only one of which is shown in FIG. 1, are provided for holding the sections **12** and **13** engaged.

An intake or suction pipe **16** (FIGS. 1 and 2) is mounted within the lower casing section **12** and the upper end, indicated at **17**, of the pipe terminates adjacent the upper end of the casing section **12**. A U-shaped fitting or elbow **18** engages the upper end **17** of the pipe **16** and connects the latter with an elongated filter bag **19** removably secured to the other end of the elbow **18**, as by a garter spring **15**. The bag **19** is conventional to the extent that it is of porous paper, or similar materials, and is adapted to expand when subjected to a differential pressure. The pipe **16** extends through the lower end wall, indicated at **20**, of the lower housing section **12**, and a seal **21** (FIG. 2) is disposed between the pipe **16** and an opening in the end wall **20** to provide an airtight joint therebetween. The lower end of the pipe **16** is adapted to receive various types of cleaning attachments, a rug and floor cleaner attachment **22** being illustrated.

A suitable handle **23** is secured to the upper housing section **13** to permit manipulation of the cleaner and lead wires **24** are provided for supplying current to the motor portion of the motor-fan unit **26** (FIG. 2) mounted within the upper casing section **13**. A switch **27** controls current flow to the motor-fan unit **26** and the operation of the cleaner.

Referring now to FIG. 4 in conjunction with FIG. 2, it will be seen that the motor-fan unit **26** includes a motor portion **28** enclosed by a generally cylindrical casing **29** and a depending fan portion **30** also enclosed by a generally cup-shaped casing **31** secured to the motor casing **29**. The upper end of the motor casing **29** is engaged and centered in the housing section **13** by a support and seal ring **32** which is preferably of sponge rubber and which engages the end edges of a plurality of longitudinally extending circumferentially spaced ribs **33** in the upper end of the housing section **13**. Another support and seal ring **34**, also of sponge rubber, engages and centers the lower end of the fan casing **31**, the ring **34** being retained by a mounting ring **35** which engages the inner wall of the housing section **13**.

The motor casing **29** of the unit **26**, in the present instance, comprises a two-piece casing which includes an upper inverted cup-shaped section **36** and a lower cup-shaped section **37**. A pair of radially outwardly extending flanges **38** are provided around the adjacent end edges of the motor casing sections **36** and **37** for receiving screws **39**, or the like, which hold the sections together.

Mounted within the motor casing sections is an electric motor **44** which, in the present instance, comprises a field coil assembly defined by a stack of laminations **46** and an armature assembly **47** which is mounted on a shaft **48**. The laminations **46** are supported and located in the motor casing **29** by indentations or lances (not shown) in the annular side wall portions, indicated at **49**, of the motor casing sections **36** and **37**. Such indentations engage the uppermost and innermost laminations of the stack **46** when the screws **39** are drawn up. To permit this, the annular side wall portions **49** have an axial length, such that when the casing sections **36** and **37** are drawn together by the screws **39** with the indentations engaging the laminations **46**, a gap **50** is defined between the flanges **38**.

The armature shaft **48** is rotatably carried in bearing assemblies **51** and **52** mounted in the upper and lower end walls, indicated at **53** and **54**, respectively, of the motor casing sections **36** and **37**. Current is supplied to the armature **47** by a commutator **55** and brushes **56**, the latter being carried in a brush holder assembly **57**. The assembly **57** is supported by a pair of screws **58**, only one of which is shown in FIG. 4, which extend through the laminations **46**. The brushes **56** are connected by wires **59** to the electrical lead wires **24** and switch **27** (FIG. 2).

The fan portion **30** of the unit **26**, in the present instance, comprises a two-stage centrifugal-type fan **61** which includes a pair of axially spaced rotating elements **62** and **63** and a fixed or stator element **64** disposed between the rotating elements **62** and **63**. The rotating elements **62** and **63** are mounted on a hub **65** at the lower end, indicated at **66**, of the motor shaft **48** and are secured thereto by a nut **67**. The stator element **64** serves to redirect the flow of air from the element **62** into the element **63** when the fan **61** is being driven.

The rotating fan elements **62** and **63**, as well as the stationary fan element **64**, are provided with a plurality of generally radially extending arcuate blades **72** (FIGS. 4 and 5) which are carried between axially spaced disks **73**. The upper disk of the stator element **64** is formed by the end wall, indicated at **74**, of a shallow cup-shaped casing section **75** which nests in the upper end of a larger cup-shaped casing section **76**. The end wall of the casing section **76** has a central opening **77** therein forming an inlet for the fan portion **30**, such inlet being covered by a sheet metal guard **78** carried by the mounting ring **35** and having openings therein. The upper and lower casing sections **75** and **76** thus comprise the fan casing **31**.

In the present instance, the lower casing section **76** is secured to the upper casing section **75** by a press fit and further retained by interlocking dimples **79**. The upper fan casing section **75** is secured to the lower motor casing section **37** by a plurality of machine screws **80** (FIG. 2) which extend through upwardly extending tabs or lugs **81** on the upper casing section **75**. The screws **80** are threaded into internally threaded tubular extrusions **82** (FIGS. 4 and 5) formed in the side wall portion **49** of the motor casing section **37**.

As will be apparent from FIG. 4, the diameter of the rotating fan elements **62**, **63** and stator **64** is somewhat less than the internal diameter of the fan casing **31**, and a substantially annular opening for air discharging upwardly from the periphery of the fan element **63** is defined between the annular side wall, indicated at **83**, of the upper fan casing section **75** and the lower end of the motor casing **29**, particularly the annular side wall **49** of the casing section **37**. Such opening communicates with an outlet in the upper housing section **13**, for discharge to the atmosphere. Such outlet, in the present instance, comprises a plurality of longitudinally extending circumferentially spaced slots **84** (FIGS. 1, 3 and 4). A plurality of circumferentially spaced longitudinally extending ribs **86** (FIGS. 2 and 4) are provided on the inner side wall of the upper housing section **13** to strengthen the latter in the area of the slots **84**.

With the foregoing construction, it will be apparent that upon closing of the switch **27** and energization of the motor **44**, the fan **61** will rotate thereby providing suction at the fan inlet **77** and a reduction in pressure in the interior of the lower housing section **12** and around the filter bag **19**. The fan **61** thus provides a main or cleaning air flow through the cleaner **10**, the flow originating at the attachment **22** and proceeding upwardly through the pipe **16** to the filter bag **19**, through the latter to the interior of the housing section **12**, and thence through the fan portion **30** to the interior of the upper housing section **13** from whence it discharges through the slots **84** to the atmosphere. Dirt and other foreign particles are trapped in the filter bag **19** so that substantially clean air passes

through the fan portion **30** for discharge through the outlet slots **84**.

Such main air flow thus exerts some cooling effect on the motor as it flows around the motor casing sections **36** and **37** toward the outlet slots **84**. However, this main air flow is not suitable for cooling the motor **44** by directing it through the interior of the motor casing **29** because such a flow would substantially increase the back pressure on the main air flow and thus reduce the suction available for cleaning. In addition, the mean air flow may contain minute particles of dirt, or may contain moisture due to a wet pick-up situation or possibly a broken filter bag. Either condition is injurious to the motor **44**.

To this end, a motor cooling fan **90** (FIG. 4) having a plurality of blades **91** therearound is mounted on the motor shaft **48** within the upper motor casing section **36** and adjacent the upper end wall **53** thereof. The fan **90** is adapted to supply a cooling air flow to the interior of the motor casing **29**, which is wholly separate from the main air flow provided by the fan **61**. To provide for such separate cooling air flow, the upper end wall **53** of the motor casing section **36** is provided with a plurality of openings **92** therethrough, the latter communicating with a plurality of radially extending circumferentially spaced slots **93** (FIGS. 3 and 4) formed in the upper end of the housing section **13**.

Thus, when the motor **44** is operating to provide the main air flow through the housing **11**, the fan **90** will also supply a separate cooling air flow to the interior of the motor casing **29** to cool the motor **44**. Such cooling air flow passes around and through the components of the motor **44** and then discharges into the interior of the upper housing section **13** through a plurality of circumferentially extending openings or slots **94** (FIGS. 2 and 4) in the side wall **49** of the lower motor casing section **37** immediately above the end wall **54** thereof. A portion of the cooling air flow will discharge radially outwardly through the gap **50** to the interior of the housing section **13** and thence through the outlet slots **84**. The cooling air flow thus does not become mixed with the main air flow discharging upwardly from the fan **61** until the former leaves the motor casing **29**. The possibility of damage to the motor **44** from minute particles of dirt or moisture which may be present in the main air flow from the fan due to a broken filter bag or a wet pick-up situation, is thus eliminated.

The location of the slots **94** in the lower portion of the motor casing side wall **49**, rather than in the end wall **54**, provides a significant structural advantage in that the end wall **54** does not have to be weakened by cutouts or openings to accommodate a cooling air flow. In addition, the absence of large openings in the end wall **54** permits the latter to conduct heat away from the lower bearing **52** for dissipation in the main air flow, as will be described more fully hereinafter.

Because of the fact that the main air flow in the interior and at the outlet of the fan casing **31** is turbulent, it is desirable to reduce such turbulence in order to reduce flow losses and increase the suction of the cleaner. To this end, stator means in the form of a plate-like member or disk **101** having a plurality of circumferentially spaced radially outwardly extending flow straightening blades or vanes **102** therearound, is provided.

The disk **101**, in the present instance, is preferably formed from sheet metal and secured to the end wall **54** by extruding or otherwise forming the material of the disk **101** to provide a plurality of axially upwardly extending tubular portions or extrusions **103** which are adapted to extend through openings in the end wall **54**. The inner ends of the tubular portions **103** are flared as at **104** to rigidly connect the disk **101** to the end wall **54**. The combined area of the open central portions of the tubular portions **103** is so small that no significant air flow will occur therethrough. The main and cooling air flows thus remain separated throughout their passage through the motor-fan unit **26**.

The blades **102** are divided into four circumferentially spaced groups of four blades each and span the annular discharge opening for the fan **61**. Such opening is defined by the space between the inner wall **83** of the fan casing section **75** and the motor casing side wall **49**. The groups of blades are circumferentially spaced to accommodate the upwardly extending lugs or tabs **81** (FIGS. 2 and 5) of the fan casing **31**.

The blades **102** are preferably inclined with respect to the axis of rotation of the fan **61** so as to lie in planes parallel to the natural flow path of the main air flow discharging upwardly from the fan **61** and out of the fan casing **31**. A blade angle of from about 15° to about 55° will be preferred, dependent upon such factors as motor speed and fan diameter. The use of a blade angle within this range results in a significant increase in the efficiency of the fan system. For example, in the embodiment shown in the drawing having a motor speed of about 16,500 r.p.m. and a fan diameter of about 3¼ inches, a blade angle of about 45° is used and results in about a 10% increase in air flow.

The aforementioned upward flow of air across the slots **94** provides another advantage in that because of the high velocity of the main air flow, a venturi effect is achieved at the slots **94**. Such venturi effect provides a substantial increase in the flow of cooling air through the motor casing **29** than could be achieved from a utilization of the low pressure zone in the fan casing **30**, between the bearing **52** and upper fan element **53**, for this purpose.

In addition to increasing the suction developed by the motor-fan unit **26**, the disk **101** and blades **102** also function as a heat sink for cooling the lower motor bearing assembly **52**. Thus, heat from the bearing **52** flows through an annular axially extending flange **106** in which the bearing **52** is mounted and then flows radially outwardly through the end wall **54** and disk **101** to the blades **102**. After reaching the blades **102**, the heat is carried off in the main air flow. Because of the number of blades **102** around the periphery of the disk **101**, a substantial quantity of heat can be dissipated in the main air flow passing between the blades.

A similar heat sink effect is achieved by the fan **90** with respect to the upper bearing assembly **51**. In this instance, heat from the bearing **51** flows through the shaft **48** to the hub of the fan **90** and thence radially outwardly to the blades **91** where it is carried off in the cooling air flow entering the motor casing **29**, such air being substantially at room temperature and not being subjected to the heating effect of passage through the motor **44**.

The blades **102** also serve another purpose in that because they extend across and substantially cover the annular discharge outlet at the upper end of the fan casing **31** they function as a guard. As such, the blades **102** satisfy certain specifications covering fan devices, as previously mentioned.

Because of the fact that the disk **101** and blades **102** are preferably of sheet metal, they may be readily formed in one piece by a stamping operation which construction is simple and low in cost.

The motor cooling arrangement heretofore described is effective to prevent over-heating or burn-out of the motor **44** during periods of operation when the main air flow through the unit **26** is low or completely stopped, such as would occur if the attachment **22** became obstructed or the filter bag **19** became clogged. Thus, should either of these conditions occur, the speed of the motor **44** and fan **61** would increase due to unloading of the latter thereby providing more cooling air through the motor. While the motor would draw less current at this time, a sufficient amount of heat would still be generated to cause damage or even failure of the motor

unless adequately cooled. Cooling under such an operating condition is achieved by the fan **90** which provides a cooling air flow through the motor casing **29** wholly independent of the main air flow. Damage to the motor is thus avoided.

When the attachment **22** is not in contact with a surface to be cleaned, or the intake pipe **16** and filter bag **19** are unobstructed, the fan **61** will deliver the greatest flow of air and the motor will draw maximum wattage. At this time, the speed of the motor **44** and fan **61** will drop, but adequate cooling of the motor **44** is assured by the flow of cooling air through the motor casing **29**, such flow being due to the fan **90** as augmented by the venturi action of the main air flow across the slots **94**.

As peviously mentioned, while the motor-fan unit **26** has been described herein in conjunction with the vacuum cleaner **10**, such unit is also useable in other applications involving the movement or flow of a gas. Thus, the motor-fan unit **26** could also be used, for example, to exhaust gases from a fume hood, as a cooling fan for exhausting hot air from the interior of a housing enclosing a business machine or the like, or merely as a suction generating device. The novel motor cooling arrangement of the unit **26** renders it particularly well suited for use in the first two exemplary applications due to the fact that a separate flow of cooling air, wholly independent of the main flow through the unit, may be employed to cool the motor **44**. Thus, even though the main fluid flow through the unit **26** may be poorly suited or incapable of use for cooling the motor **44**, the separate cooling fluid flow through the motor casing **29** permits operation of the unit **26** in such an environment.

While only one embodiment of the invention has been herein illustrated and described, it will be understood that modifications and variations thereof may be effected without departing from the scope of the invention as set forth in the appended claims.

We claim:

1. A motor-fan unit comprising a motor portion and a fan portion, said motor portion including a generally cylindrical casing having an annular side wall, an end wall and a motor mounted therein, said fan portion including a generally cup-shaped casing having an annular side wall of greater diameter than said motor casing side wall and an end wall having a main air inlet therein, said fan casing being secured to one end of said motor casing so that the open end of said fan casing and said one end of said motor casing define an annular axially opening main air outlet for said fan portion adjacent said motor casing end wall, said outlet being unobstructed downstream therefrom, a fan in said fan casing connected to said motor and operable when driven to provide a main air flow through said fan portion, and a combined fan guard and stator means including a plurality of inclined blades disposed in said main air outlet of said fan portion for increasing the flow of air therethrough, said blades spanning said outlet and also serving as a guard for said fan.

2. A motor-fan unit comprising a motor portion and a fan portion, said motor portion including a generally cylindrical casing having an annular side wall, an end wall, and a motor mounted therein, said fan portion including a generally cup-shaped casing having an annular side wall of greater diameter than said motor casing side wall and an end wall having a main air inlet therein, said fan casing being secured to one end of said motor casing so that the open end of said fan casing and said one end of said motor casing define an annular main air outlet for said fan portion adjacent said motor casing end wall, a fan in said fan casing connected to said motor and operable when driven to provide a main air flow through said fan portion, and stator means secured to said motor casing end wall and having a plurality of annularly arranged blades spanning said annular main air outlet of said fan portion, said blades being inclined with respect to the axis of rotation of said fan so as to lie in planes parallel to the natural flow path of air discharging from said fan, whereby said blades are effective to increase the flow of suction air through said fan portion, said blades also serving as a guard for said fan.

3. The combination of claim **2** further characterized in that said blades have an angle of inclination of between about 15° and 55°.

4. The combination of claim **2** further characterized in that said stator means comprises a sheet metal disk having a plurality of integral radially outwardly extending blades around the periphery thereof.

5. The combination of claim **4** further characterized in that said disk includes a plurality of integrally formed tubular portions extending upwardly through openings in said motor casing end wall, the ends of said tubular portions being flared to secure said disk to said end wall.

6. A motor-fan unit comprising a motor portion and a fan portion, said motor portion including a generally cylindrical casing having an annular side wall, spaced end walls, and a motor mounted therein, said fan portion including a generally cup-shaped casing having an annular side wall of greater diameter than said motor casing side wall and an end wall having a main air inlet therein, said fan casing being secured to one end of said motor casing so that the open end of said fan casing and said one end of said motor casing define an annular main air outlet for said fan portion, a fan in said fan casing connected to said motor and operable when driven to provide a main air flow through said fan portion, said main air outlet discharging air across at least a portion of the annular side wall of said motor casing, said motor casing also having a cooling air inlet in the other end wall thereof, and means coacting with said main air flow for inducing a cooling air flow through said motor casing, said coacting means comprising at least one opening in the side wall of said motor casing registering with a high velocity zone of said main air flow, whereby a separate flow of cooling air is induced through said motor casing to cool said motor.

7. The combination of claim **6** further characterized in that said opening in said motor casing side wall comprises a plurality of circumferentially spaced slots.

8. The combination of claim **7** further characterized in that said slots are disposed closely adjacent said one end wall of said motor casing and said annular main air outlet.

9. The combination of claim **6** further characterized in that a cooling fan is provided in said motor casing and driven by said motor, said cooling air fan providing a flow of cooling air through said motor casing in addition to the flow induced therethrough by said main air flow.

10. A motor-fan unit comprising a motor portion and a fan portion, said motor portion including a generally cylindrical casing having an annular side wall, spaced end walls, and a motor mounted therein, said fan portion including a generally cup-shaped casing having an annular side wall of greater diameter than said motor casing side wall and an end wall having a main air inlet therein, said fan casing being secured to one end of said motor casing so that the open end of said fan casing and said one end of said motor casing define an annular main air outlet for said fan portion, a fan in said fan casing connected to said motor and operable when driven to provide a main air flow through said fan portion, said main air outlet discharging air across at least a portion of the annular side wall thereof of said motor casing, said motor casing also having a cooling air inlet in the other end wall thereof, and means coacting with said main air flow for inducing a cooling air flow through said motor casing, said coacting means comprising at least one opening in the side wall of said motor casing registering with a high velocity zone of said main air

flow, and stator means including a plurality of inclined blades disposed in said main air outlet for increasing the main air flow through said fan portion and across said opening, said increased main air flow across said opening increasing the flow of cooling air through said motor casing.

11. A motor-fan unit comprising a motor portion and a fan portion, said motor portion including a generally cylindrical casing having an annular side wall and spaced end walls, bearing means carried by each of said end walls, a motor within said casing having a shaft rotatably journalled in said bearing means, said fan portion including a generally cup-shaped casing having an annular side wall and an end wall having a main air inlet therein, said fan casing being secured to said motor casing with the open end of said fan casing disposed adjacent one end wall of said motor casing so as to define an annular main air outlet for said fan portion, a fan in said fan casing secured to said motor shaft and operable when driven to provide a main air flow through

said fan portion, and stator means comprising a disk having a plurality of blades around the periphery thereof secured to said one end wall of said motor casing with said blades disposed in said main air outlet, said blades being effective to increase the main air flow through said fan portion, said blades also being effective to transfer heat from said bearing means in said one end wall to said main air flow passing therebetween.

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