(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 273 256 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.01.2003 Bulletin 2003/02

(51) Int Cl.[7]: **A47L 5/22**, A47L 9/22

(21) Application number: **02254643.6**

(22) Date of filing: **02.07.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **05.07.2001 GB 0116539**

(71) Applicant: **HOOVER LIMITED**
Merthyr Tydfil, Mid Glamorgan CF48 1PQ (GB)

(72) Inventor: **Fumagalli, Silvano**
20052 Monza (IT)

(74) Representative: **Evans, Huw David Duncan**
Urquhart-Dykes & Lord,
Three Trinity Court,
21-27 Newport Road
Cardiff CF24 OAA (GB)

(54) Vacuum cleaner

(57) A vacuum cleaner comprises a fan unit having a radial flow impeller (15) and a motor (13) for rotating the impeller (15) to cause an airflow along a flow path of the cleaner. The impeller (15) comprises a plurality of blades (16) extending radially from an axially extending central hollow region (17) having an air inlet at one axial end thereof. The air flow path through the cleaner has a substantially uniform cross-sectional area along a substantial part of its length, and comprises a portion (22) which leads directly to the impeller (15) and has an outlet end directly aligned with the air inlet of the impeller (15).

The portion (22) of the airflow path leading to the impeller (15) may extend through an insert (20) mounted inside the fan chamber (19) of a conventional vacuum cleaner.

The vacuum cleaner has an increased suction power compared with conventional vacuum cleaners having the same motor power, because the air is communicated directly to the impeller (15) through a duct having a substantially uniform cross-sectional area along a substantial part of its length.

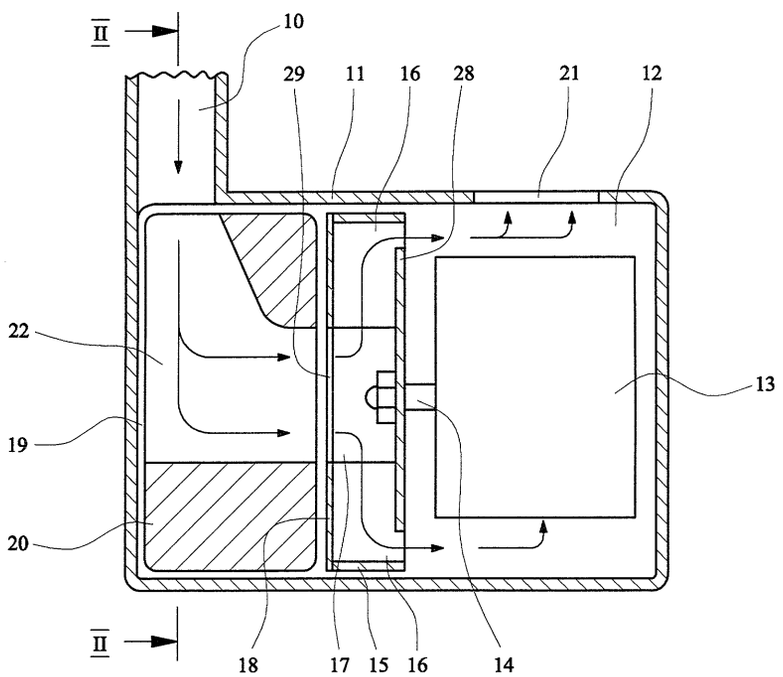

FIG. 1

EP 1 273 256 A2

Description

[0001] This invention relates to a vacuum cleaner having an increased suction power.

[0002] Typically vacuum cleaners incorporate a clean air fan system in which air is drawn through a separation unit comprising a filter bag and/or a cyclonic separator by a fan mounted downstream thereof. The separation unit removes substantially all of the dust entrained in the airflow and thus the air passing through the fan is substantially clean.

[0003] Typically the fan comprises a centrifugal radial flow impeller driven by an electric motor. The fan is arranged to draw air axially, out of a first chamber mounted in front of the impeller. The air is then driven radially by the impeller into a second chamber which is connected to the exhaust of the cleaner. A duct leads from the separation unit to the first chamber.

[0004] Vacuum cleaners of the above mentioned type function extremely well. However, there is increasing demand to improve the suction power of vacuum cleaners without increasing the wattage of the motor.

[0005] Thus, we have now devised a vacuum cleaner having an increased suction power compared with known vacuum cleaners having the same motor power.

[0006] In accordance with this invention, there is provided a vacuum cleaner having an inlet for dirty air, an outlet for cleaned air, an airflow path extending between the inlet and outlet, a fan unit mounted in the airflow path for causing an airflow between the inlet and outlet through a dust separation unit arranged to separate a substantial amount of the dust and other matter from the air flowing along said airflow path, the fan unit comprising a radial flow impeller and a motor for rotating the impeller about a rotational axis, the impeller comprising a plurality of blades extending radially from an axially extending central hollow region having an air inlet at one axial end thereof, the airflow path comprising a duct having an outlet end directly aligned with the inlet of the impeller, said duct having a substantially uniform cross-sectional area along a substantial part of its length.

[0007] In conventional vacuum cleaners, the fan chamber actually forms a part of the duct leading to the impeller. We have realised that the increased cross-sectional area of the chamber causes the airflow entering the chamber to expand and to drop in velocity. This expansion and drop in velocity causes the kinetic energy of the air molecules to drop as they enter the fan chamber. Accordingly, more power is required to move the air from the chamber. The chamber also causes a turbulent flow which further inhibits the airflow and causes noise.

[0008] The present invention overcomes the above-mentioned problems by omitting the chamber and by communicating the air directly to the impeller through a duct having a substantially uniform cross-sectional area along a substantial part of its length.

[0009] Preferably the area of said outlet end of the duct of the airflow path is substantially equal to the cross-sectional area of the inlet end of the central duct of the impeller.

[0010] Preferably said outlet end of the duct of the airflow path extends axially of the rotational axis of the impeller.

[0011] Preferably said outlet end of the duct of the airflow path is circular in cross-section.

[0012] Conventional vacuum cleaners having a fan chamber can be modified in accordance with the present invention by providing an insert member in the chamber having a passageway therethrough forming a part of the duct of the airflow path.

[0013] Preferably the member comprises a solid body of material which fills the chamber apart from the passageway.

[0014] Preferably the material comprises expanded polystyrene or polypropylene.

[0015] In vacuum cleaners of the clean air type, the separation unit is preferably mounted in the airflow path upstream of the fan unit, the duct having an inlet end connected to the outlet of the separation unit.

[0016] An embodiment of this invention will now be described by way of an example only and with reference to the accompanying drawings, in which:

Figure 1 is a sectional view through the fan assembly of an embodiment of vacuum cleaner in accordance with this invention; and
Figure 2 is a sectional view along the line II - II of Figure 1.

[0017] Referring to the drawings, there is shown the fan assembly of an upright vacuum cleaner, which assembly is arranged to draw air along an inlet duct 10 leading from a dust separation unit, such as a cyclonic separator and/or filter bag (not shown).

[0018] The output shaft 14 of the motor 13 is connected to an impeller 15 comprising a plurality of blades 16 extending radially with respect to the rotational axis of the motor shaft 14, between circular front and rear plates 18,28 of the impeller which lie normal to the rotational axis. The radially outer ends of the blades 16 terminate adjacent the inner surface of the cylindrical housing 11. The blades 16 extend outwardly from a central hollow region 17 which extends axially of the impeller 15. A circular aperture 29 is formed in the front plate of the impeller 15 to communicate with the central hollow region 17.

[0019] A large cavity 19 is formed at one end of the housing 11 between the front plate 18 of the impeller 15 and an end wall of the housing 11. The inlet duct 10 from the separation unit leads tangentially into the cavity 19.

[0020] The fan unit as hereinbefore described corresponds with that of a conventional vacuum cleaner. When the motor 13 is energised, the impeller 15 is rotated about its axis to cause air to flow radially outwardly from its central region 17 through the blades 16 and then axially over the motor 13, whereupon the air leaves the

housing 11 through an exhaust duct 21.

[0021] The impeller 15 draws air axially into the central region 17 through the aperture 29 from the cavity 19, disposed on the opposite side of the impeller 15 to the motor 13: This creates a drop in pressure in the cavity 19 which causes air to flow from the atmosphere through the dust separation unit (not shown) and into the cavity 19, whereupon it is discharged to atmosphere through the impeller 15 and exhaust 21 as hereinbefore described.

[0022] Conventional cleaners of this type function extremely well. However, we have realised that by making a relatively straightforward modification to the fan unit, the suction power of the cleaner can surprisingly be increased by approximately 15%.

[0023] Thus in accordance with the present invention, the cavity 19 is filled by a cylindrical insert 20 of expanded polypropylene material.

[0024] An involuted through passage 22 extends through the insert 20, with one end of the passage 22 extending axially to communicate directly with the tangential inlet duct 10 from the outlet of the separation unit and the other end extending axially to communicate directly with the aperture 29 in the front plate 18 of the impeller 15: preferably this end of the passage 22 is circular in cross-section and has a diameter which is substantially equal to the diameter of the aperture 29 in the front plate 18 of the impeller 15.

[0025] The insert 20 effectively fills the cavity 19, so as to maintain a substantially uniform cross-sectional area to the airflow path leading from the dust separation unit. We have found that this surprisingly increases the suction power.

[0026] We have found that in conventional vacuum cleaners any increase in the cross-sectional area of the airflow path causes a corresponding drop in velocity. Thus, the kinetic energy of the air molecules drops as the velocity falls and the airflow expands in the chamber 19. This drop in energy means that more power has to be exerted by the motor 13 to move the same volume of air.

[0027] Accordingly, the present invention solves the above-mentioned problem by effectively replacing the chamber 19 with a passageway 22 having a cross-sectional area which is substantially equal to the cross-sectional area of the duct 10 and the area of the aperture 29 in the front plate 18 of the impeller 15.

[0028] We have also found that the vacuum cleaner is quieter in operation than conventional vacuum cleaners, since a less turbulent flow is created.

[0029] It will be appreciated that instead of providing an insert 20, the duct 10 could lead directly to the impeller 15 or to a passageway of similar cross-sectional area that leads directly to the impeller 15.

Claims

1. A vacuum cleaner having an inlet for dirty air, an outlet for cleaned air, an airflow path extending between the inlet and outlet, a fan unit mounted in the airflow path for causing an airflow between the inlet and outlet through a dust separation unit arranged to separate a substantial amount of the dust and other matter from the air flowing along said airflow path, the fan unit comprising a radial flow impeller and a motor for rotating the impeller about a rotational axis, the impeller comprising a plurality of blades extending radially from an axially extending central hollow region having an air inlet at one axial end thereof, the airflow path comprising a duct having an outlet end directly aligned with the inlet of the impeller, said duct having a substantially uniform cross-sectional area along a substantial part of its length.

2. A vacuum cleaner as claimed in claim 1, in which the area of said outlet end of the duct of the airflow path is substantially equal to the cross-sectional area of the inlet end of the central hollow region of the impeller.

3. A vacuum cleaner as claimed in claims 1 or 2, in which said outlet end of the duct of the airflow path extends axially of the rotational axis of the impeller.

4. A vacuum cleaner as claimed in any preceding claim, in which said outlet end of the duct of the airflow path is circular in cross-section.

5. A vacuum cleaner as claimed in any preceding claim, comprising a fan chamber directly upstream of the impeller and an insert member mounted within the chamber and having a passageway therethrough forming a part of the duct of the airflow path.

6. A vacuum cleaner as claimed in any claim 5, in which the insert member comprises a solid body of material which fills the chamber apart from the passageway.

7. A vacuum cleaner as claimed in claims 5 or 6, in which the material comprises expanded polystyrene or polypropylene.

8. A vacuum cleaner as claimed in any of claims 5 to 7, in which the passageway through the insert member forms said outlet end of the duct.

9. A vacuum cleaner as claimed in any preceding claim, in which the separation unit is mounted in the airflow path upstream of the fan unit, the duct having an inlet end connected to the outlet of the separation unit

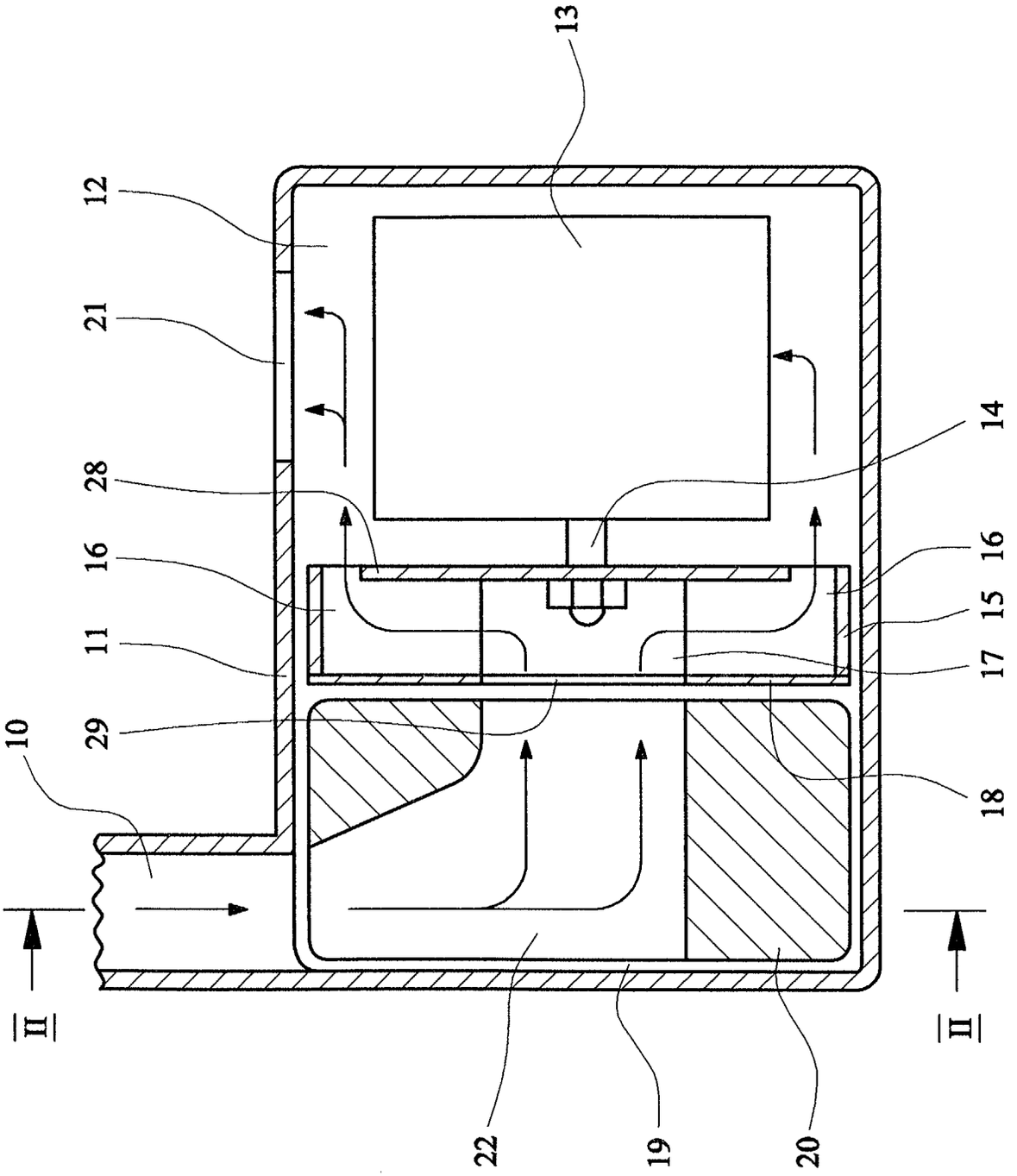

FIG. 1

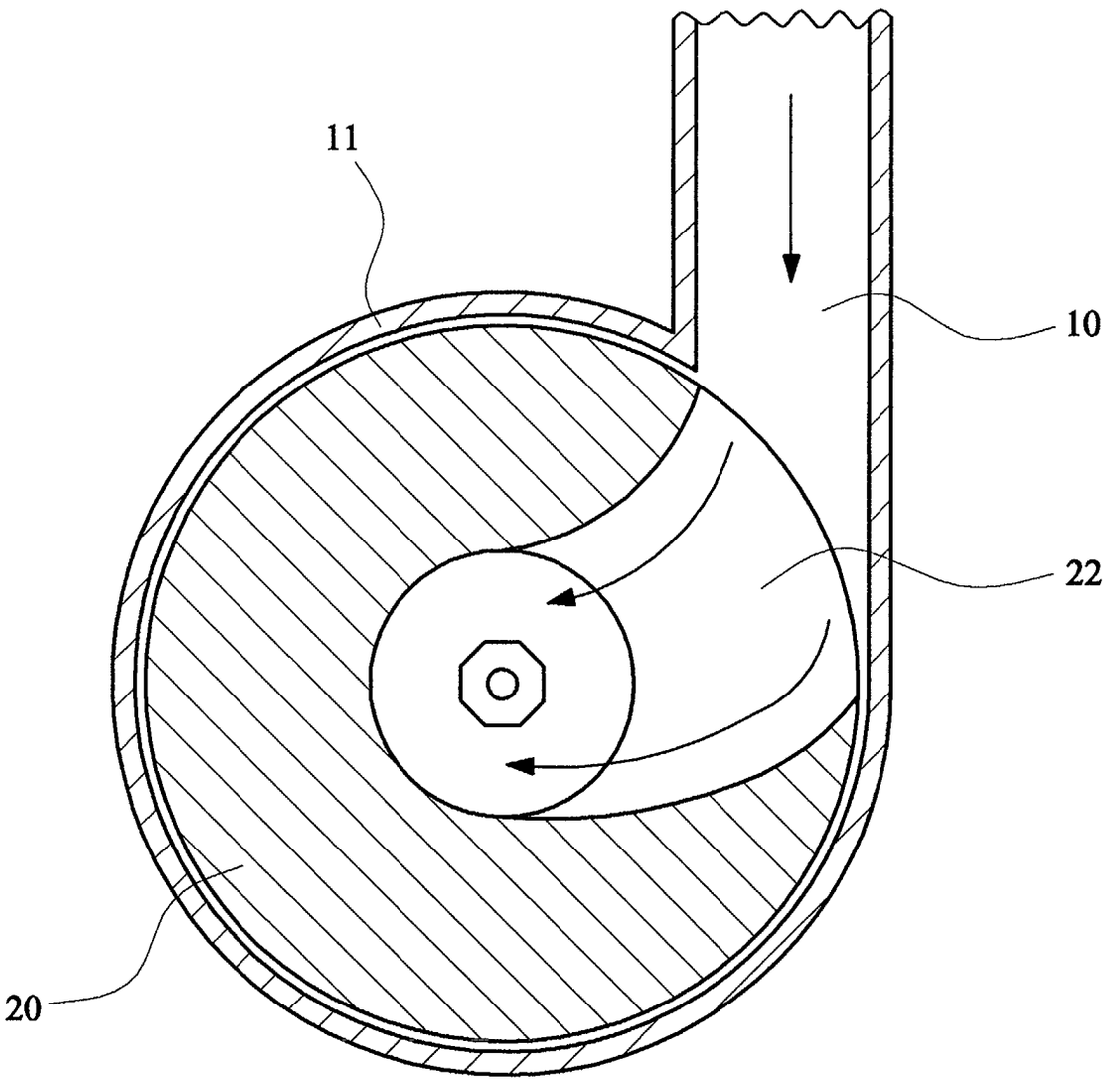

FIG. 2