A floor cleaning apparatus includes a nozzle assembly and a canister assembly. A suction generator is carried on the nozzle assembly or the canister assembly. A dirt collection vessel is also carried on the nozzle assembly or the canister assembly. Still further, a first agitator with a first internal drive motor and a second agitator with a second internal drive motor are both carried on the nozzle assembly. Additionally, a method is also provided. The method includes the steps of equipping a floor cleaning apparatus with first and second agitators and independently driving those agitators.
VACUUM CLEANER WITH TWIN INDEPENDENTLY DRIVEN AGITATORS

[0001] This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/539,467 filed on Jan. 27, 2004.

TECHNICAL FIELD

[0002] The present invention relates generally to the vacuum cleaner art and, more particularly, to a vacuum cleaner incorporating twin agitators with each agitator driven by an internal drive motor.

BACKGROUND OF THE INVENTION

[0003] A vacuum cleaner is an electromechanical appliance utilized to effect the dry removal of dust, dirt and other small debris from carpets, rugs, fabrics or other surfaces in both domestic and industrial environments. In order to achieve the desired dirt and dust removal, a rotary agitator is provided to beat dirt and dust from the nap of the carpet and a pressure drop or vacuum is used to force air entrained with this dirt and dust into the nozzle of the vacuum cleaner. The particulate-laden air is then drawn through a bag-like filter, a dirt cup or a cyclonic separation chamber and filter combination which traps the dirt and dust, while substantially clean air is exhausted by an electrically operated fan that is driven by an on board motor. It is this fan and motor arrangement that generates the drop in air pressure necessary to provide the desired cleaning action. Thus, the fan and motor arrangement is commonly known as the vacuum or suction generator.

[0004] Many advanced, high performance vacuum cleaners incorporate a dual motor system. In such a system, a separate agitator drive motor is provided in addition to the motor of the suction generator. In most designs the separate agitator drive motor is mounted on the nozzle assembly adjacent the agitator. A gear drive or more commonly a pulley and belt arrangement transmits the power from the agitator drive motor shaft to the agitator.

[0005] While very effective for its intended purpose, the mounting of a separate agitator drive motor in front of or behind the agitator necessitates a significant increase in the fore-aft length of the nozzle assembly in order to accommodate the motor. This not only increases the overall weight of the nozzle assembly but also the wheelbase and/or the body overhang beyond the wheels. All of these characteristics negatively impact the ease of manipulation of the vacuum cleaner in and around furniture and, therefore, are a detriment.

[0006] In contrast, it is possible to mount the agitator drive motor above the agitator. In this situation, no increase in the length of the nozzle assembly and/or the wheelbase thereof is necessary to accommodate the agitator motor. The height of the nozzle assembly must, however, be increased significantly to provide motor clearance. This unacceptably restricts the use of the vacuum cleaner as the resulting higher profile will not clear many overhanging obstructions such as bed frames, tables and chair frames. Accordingly, this is generally recognized to be an unacceptable solution.

[0007] Another possible alternative is the mounting of the separate agitator drive motor within the agitator itself. Such an arrangement makes use of what would otherwise be lost space within the agitator. Further, it allows the agitator motor to be accommodated without any substantial increase in the height or length of the nozzle assembly. Thus, the vacuum cleaner may be more easily manipulated on a shorter wheel base and is of lighter overall weight. It also includes the desired low profile which allows cleaning under bed frames, tables, chairs and other such objects.

[0008] More recently, it has been determined that vacuum cleaners equipped with multiple agitators provide a performance advantage resulting in enhanced cleaning efficiency. The present invention relates to a multi-agitator vacuum cleaner wherein each agitator is independently driven and includes its own internally mounted drive motor. Such a vacuum cleaner provides maximum cleaning performance while also limiting the height and footprint of the nozzle assembly. As a consequence, the vacuum cleaner is easy to maneuver and has a relatively low profile so as to allow cleaning under beds, chairs and the like.

SUMMARY OF THE INVENTION

[0009] In accordance with the purposes of the present invention as described herein, an improved floor cleaning apparatus is provided. That floor cleaning apparatus comprises a nozzle assembly, a canister assembly and a suction generator carried on one of the nozzle assembly and the canister assembly. Additionally, the floor cleaning apparatus includes a dirt collection vessel also carried on one of the canister assembly and the nozzle assembly. Still further, a first agitator having a first internal drive motor is carried on the nozzle assembly. Additionally, a second agitator having a second internal drive motor is carried on the nozzle assembly.

[0010] The canister assembly may be pivotally connected to the nozzle assembly. Further, the dirt collection vessel may take any of various forms including but not limited to a filter bag, a dirt cup and a cyclonic airflow chamber. Further, the cleaning apparatus itself may be a device selected from a group consisting of an upright vacuum cleaner, a canister vacuum cleaner, a hand-held vacuum cleaner and an extractor.

[0011] Alternatively, the present invention may be described as a floor care cleaning apparatus comprising a nozzle assembly, a canister assembly, a suction generator carried on one of the nozzle assembly or the canister assembly and a dirt collection vessel carried on one of the nozzle or the canister assembly. The apparatus further includes a first agitator and first agitator drive motor and a second agitator and second agitator drive motor. Thus, the two agitators are independently powered.

[0012] In accordance with yet another aspect of the present invention, a method is disclosed for providing an improved floor cleaning apparatus. The method includes the steps of equipping the floor cleaning apparatus with a first agitator and a second agitator and independently driving those two agitators. The agitators may be driven at different speeds and/or in different directions.

[0013] Advantageously, the floor cleaning apparatus provides enhanced cleaning performance and a relatively low profile and compact nozzle assembly that is easily maneuvered over a surface to be cleaned and has the necessary clearance to be used under beds, chairs and the like.
In the following description there is shown and described a preferred embodiment of this invention, simply by way of illustration of one of the modes best suited to carry out the invention. As it will be realized, the invention is capable of other different embodiments and its several details are capable of modification in various, obvious aspects all without departing from the invention. Accordingly, the drawings and descriptions will be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawing incorporated in and forming a part of the specification, illustrates several aspects of the present invention, and together with the description serves to explain certain principles of the invention. In the drawing:

FIG. 1 is a perspective view of a floor cleaning apparatus of the present invention, illustrated in the form of an upright vacuum cleaner;

FIG. 2 is a transverse sectional view of the vacuum cleaner through the first agitator; and

FIG. 3 is a detailed cross-sectional view of the first agitator and gear drive showing the engagement therebetween.

Reference will now be made in detail to the present preferred embodiment of the invention, an example of which is illustrated in the accompanying drawing.

DETAILED DESCRIPTION OF THE INVENTION

Reference is now made to FIG. 1 showing a floor cleaning apparatus 10 of the present invention. As illustrated, that floor cleaning apparatus 10 takes the form of an upright vacuum cleaner. It should be appreciated, however, that the floor cleaning apparatus may also take the form of a canister vacuum cleaner, a hand-held vacuum cleaner or even an extractor.

The overall basic design of the floor cleaning apparatus 10 is generally well known in the art. In the typical arrangement, the floor cleaning apparatus 10 includes a housing 14 that comprises the nozzle assembly 16 and the canister assembly 18. The canister assembly 18 further includes the handle 20 and the hand grip 22. The hand grip 22 carries a control switch 24 for turning the floor cleaning apparatus 10 on and off. Of course, electrical power is supplied to the floor cleaning apparatus 10 from a standard electrical wall outlet through a cord (not shown). Alternatively, the floor cleaning apparatus 10 could be powered by an onboard battery.

At the lower portion of the canister assembly 18, rear wheels (not shown) are provided to support the weight of the floor cleaning apparatus 10. A second set of wheels (also not shown) allow the operator to raise and lower the nozzle assembly 16 through selective manipulation of the height adjustment switch 28. Such a height adjustment mechanism is well known in the art and is exemplified, for example, by the arrangement incorporated into the Kenmore Progressive vacuum cleaner currently available in the marketplace. To allow for convenient storage of the floor cleaning apparatus 10, a foot latch 30 functions to lock the canister assembly 18 in an upright position, as shown in FIG. 1. When the foot latch 30 is released, the canister assembly 18 may be pivoted relative to the nozzle assembly 16 as the floor cleaning apparatus 10 is manipulated to clean the floor.

The canister assembly 18 also carries an internal chamber 32 that houses a suction generator 33 (i.e. a state of the art fan and motor combination) and a dirt collection vessel 34 for removing dirt or dust entrained in the air stream as it passes from the nozzle assembly 16 to the suction generator. The canister assembly 18 may also carry a final filtration cartridge 48 to trap small particulates and prevent their reintroduction into the environment through the exhaust air stream.

The nozzle assembly 16 includes a nozzle and agitator cavity 36 that houses multiple rotating agitators 38. The agitators 38 shown are each independently and rotatably driven by a motor 40 and cooperating gear drive 42 housed within the agitator and described in greater detail below (see FIGS. 2 and 3). In the illustrated floor cleaning apparatus 10, the scrubbing action of the rotary agitators 38 and the negative air pressure created by the suction generator 33 cooperate to brush and beat dirt and dust from the nap of the carpet being cleaned and then draw the dirt and dust laden air from the agitator cavity 36 to the dirt collection vessel 34. Specifically, the dirt and dust laden air passes serially through a suction inlet and hose and/or an integrally molded conduit in the nozzle assembly 16 and/or canister assembly 18 as is known in the art. Next, it is delivered into the dirt collection vessel 34 held in the chamber 32. The vessel 34 serves to trap the suspended dirt, dust and other particles inside while allowing the now clean air to pass freely through the porous wall thereof and then through the suction generator 33, final filtration cartridge 48 and ultimately to the environment through the exhaust port 50.

As illustrated, the dirt collection vessel 34 takes the form of a dust or filter bag of a type well known in the art. Of course, it should be appreciated that the dirt collection vessel could also be a dirt cup or even a cyclonic separation chamber if desired. Essentially substantially any vessel capable of collecting dirt may be utilized.

Reference is now made to FIGS. 2 and 3 which show the mounting of the agitator motor 40 and associated gear drive 42 in one of the agitators 38 in detail. As shown, the agitator 38 is mounted for rotation relative to the nozzle assembly 16. Specifically, a first end of the agitator 38 includes an end cap 52 which is supported on bearings 54 on a stub shaft 55 held in mounting block 56 keyed into slot 58 in the side of the nozzle assembly 16. An end cap 60 at the opposite end of the agitator 38 is supported on bearings 62 mounted on the housing 64 of the motor 40. As should be appreciated, the motor 40 is fixed to the nozzle assembly 16 by means of the mounting block 66 fixed to the motor housing 64 and keyed in the slot 68 in the side of the nozzle assembly.

The motor 40 drives a shaft 70 including gear teeth 72. The drive shaft 70 extends through a bearing 74 held in the hub 76 of the planetary gear set carrier 78. In the most preferred embodiment a fan 80 is keyed or otherwise secured to the distal end of the drive shaft 70.

The planetary gear set carrier 78 includes three stub shafts 82 that each carry a planetary gear 84. Each of the
planetary gears 84 include teeth that mesh with the gear teeth 72 of the drive shaft 70. Additionally, the planetary gears 82 mesh with the teeth of an annular gear 86 that is fixed to the agitator motor housing 64 by pin or other means. Thus, it should be appreciated that as the drive shaft 70 is driven by the motor 40, the planetary gears 84 are driven around the annular gear 86, thereby causing the planetary gear set carrier 78 to rotate. Planetary gear set carrier 78 also includes a drive ring 88 and associated rubber drive boot 87 which includes a series of spaced channels 89 that receive and engage axial ribs 91 projecting inwardly radially from the inner wall of the agitator 38. Thus, the rotation of the planetary gear set carrier 78 is transmitted by the drive ring 88 and drive boot 87 directly to and causes like rotation of the agitator 38. The rubber drive boot 87 provides the necessary damping to insure the smooth transmission of power to the agitator. Simultaneously with the rotation of the planetary gear set carrier 78 and agitator 38, the drive shaft 70 also drives the fan 80 at a ratio of between 4-1 to 10-1 (e.g. 6-1) with respect to the agitator 38. The resulting rapid rotation of the fan 80 helps to ensure proper cooling of the agitator motor 40 during its operation.

[0029] More specifically, the floor cleaning apparatus 10 of the present invention incorporates a novel air cooling system or circuit, which will now be described in detail. Specifically, air is drawn into the floor cleaning apparatus 10 through a vent 90 at the upper rear face of the nozzle assembly 16 by operation of the suction generator 33 (note action arrow A in FIG. 2). Specifically, the air first passes through a filter (not shown) of foam rubber or other appropriate material into the illumination compartment 94 defined between the upper transparent window 96 and the lower transparent window 98 which allow viewing of the operation of the agitator 38. This air then passes over and around the light source 100 so as to provide cooling thereto (note action arrows B in FIG. 2). Next, the air is drawn through the passageway 102 in the nozzle assembly 16 and around and through an opening 104 in the end cap 52 (note action arrow C). The air then moves through the lumen of the agitator 38 to the fan 80 driven by means of the agitator drive motor 40 (note action arrows D). The fan 80 forces the air through openings 106 in the planetary gear set carrier 78 (see also FIG. 3) and then around the annular gear 86 before it passes through the housing 64 of the motor 40 (note action arrows E and F).

[0030] After passing over the windings and other internal components (not shown) of the agitator motor 40 for purposes of heat exchange and cooling, the air passes through the passageway 108 into the manifold 110 (note action arrow G). Manifold 110 includes an outlet (not shown) in fluid communication with the agitator cavity 36. Of course, as noted above, the agitator cavity 36 is in direct fluid communication with a suction inlet 44 that leads through the hose 46 into the dirt collection vessel 34 in chamber 32.

[0031] While only one agitator 38 has been illustrated and described in detail, it should be appreciated that both agitators 38 have identical structures: that is, each agitator 38 has its own drive motor. As a result, the agitators 38 are independently driven. The agitators 38 may be driven by their individual, independent internal motors in different directions and/or at different speeds as desired to provide the greatest cleaning efficiency. Thus, design flexibility and performance are all maximized.

The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. For example, while two agitators are illustrated, it should be appreciated that three or even more could be provided.

[0033] The embodiment was chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally and equitably entitled.

1. A floor cleaning apparatus, comprising:
   a nozzle assembly;
   a canister assembly;
   a suction generator carried on one of said nozzle assembly and said canister assembly;
   a dirt collection vessel carried on one of said canister assembly and said nozzle assembly;
   a first agitator having a first internal drive motor carried on said nozzle assembly; and
   a second agitator having a second internal drive motor carried on said nozzle assembly.

2. The floor cleaning apparatus of claim 1, wherein said canister assembly is pivotally connected to said nozzle assembly.

3. The floor cleaning apparatus of claim 1, wherein said dirt collection vessel is a filter bag.

4. The floor cleaning apparatus of claim 1, wherein said dirt collection vessel is a dirt cup.

5. The floor cleaning apparatus of claim 1, wherein said dirt collection vessel is a cyclonic airflow chamber.

6. The floor cleaning apparatus of claim 1, wherein said floor cleaning apparatus is a device selected from a group consisting of an upright vacuum cleaner, a canister vacuum cleaner, a hand-held vacuum cleaner and an extractor.

7. A floor cleaning apparatus, comprising:
   a nozzle assembly;
   a canister assembly;
   a suction generator carried on one of said nozzle assembly and said canister assembly;
   a dirt collection vessel carried on one of said canister assembly and said nozzle assembly;
   a first agitator carried on said nozzle assembly;
   a first agitator drive motor connected to said first agitator;
   a second agitator carried on said nozzle assembly; and
   a second agitator drive motor connected to said second agitator.
8. A method of providing an improved floor cleaning apparatus, comprising:
   equipping said floor cleaning apparatus with a first agitator and a second agitator; and
   independently driving said first and second agitators.
9. The method of claim 8 including driving said first and second agitators at different speeds.
10. The method of claim 9, including driving said first and second agitators in different directions.
11. The method of claim 8 including driving said first and second agitators in different directions.
12. The method of claim 8 including providing said first agitator with a first internal drive motor and said second agitator with a second internal drive motor.
13. The method of claim 12 including driving said first and second agitators at different speeds.
14. The method of claim 13, including driving said first and second agitators in different directions.
15. The method of claim 12 including driving said first and second agitators in different directions.