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(54) Abstract Title
Dust collecting device for a vacuum cleaner

(57) A cyclone dust collecting device for a vacuum cleaner (1 Fig 1) is mounted on a telescopic extension pipe (3 Fig 1). The cyclone dust collecting device includes a cyclone body 20 for generating a swirling flow of air and contaminants drawn therein, and a cyclone housing (30 Fig 2), engaged with the cyclone body, for separating the contaminants from the air by guiding the swirling flow. The cyclone body 20 includes a central grille 22. The cyclone housing (30 Fig 2) includes a cylindrical cyclone cover 31 which engages the cyclone body 20, one end of which is slanted and closed by a spiral wall 32, and the other end of which is open. The cyclone housing (30 Fig 2) also includes a dust collecting container 39 engaging a lower portion of the slanted end of the cyclone cover 31, the container 39 having a generally conical closed end portion, the other end portion being cylindrical and with a slanted open end corresponding to the slanted end of the cyclone cover 31. Normal cleaning can be performed regardless of the position of the vacuum cleaner. When discarding collected contaminant, the falling of contaminants from a grille 22 of the device is largely avoided, and the grille is protected from accidental breakage.

FIG.3

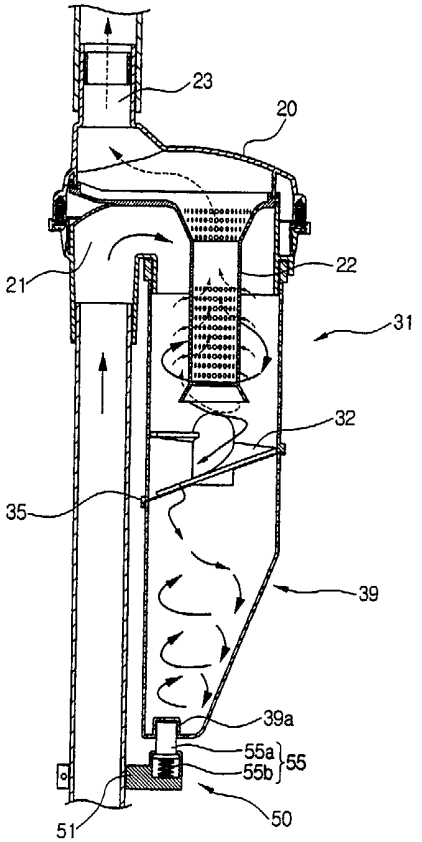

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FIG. 1

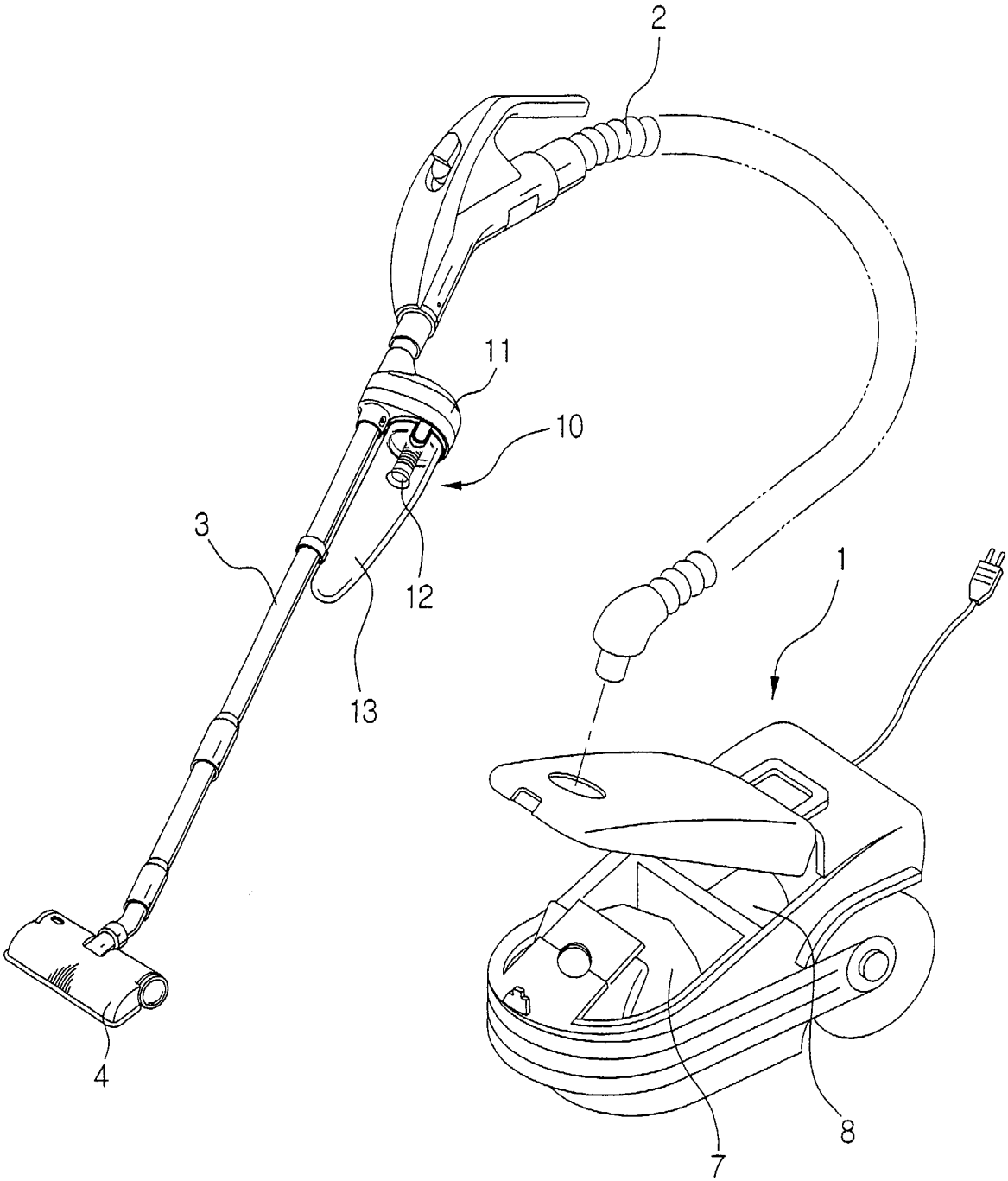


FIG.2

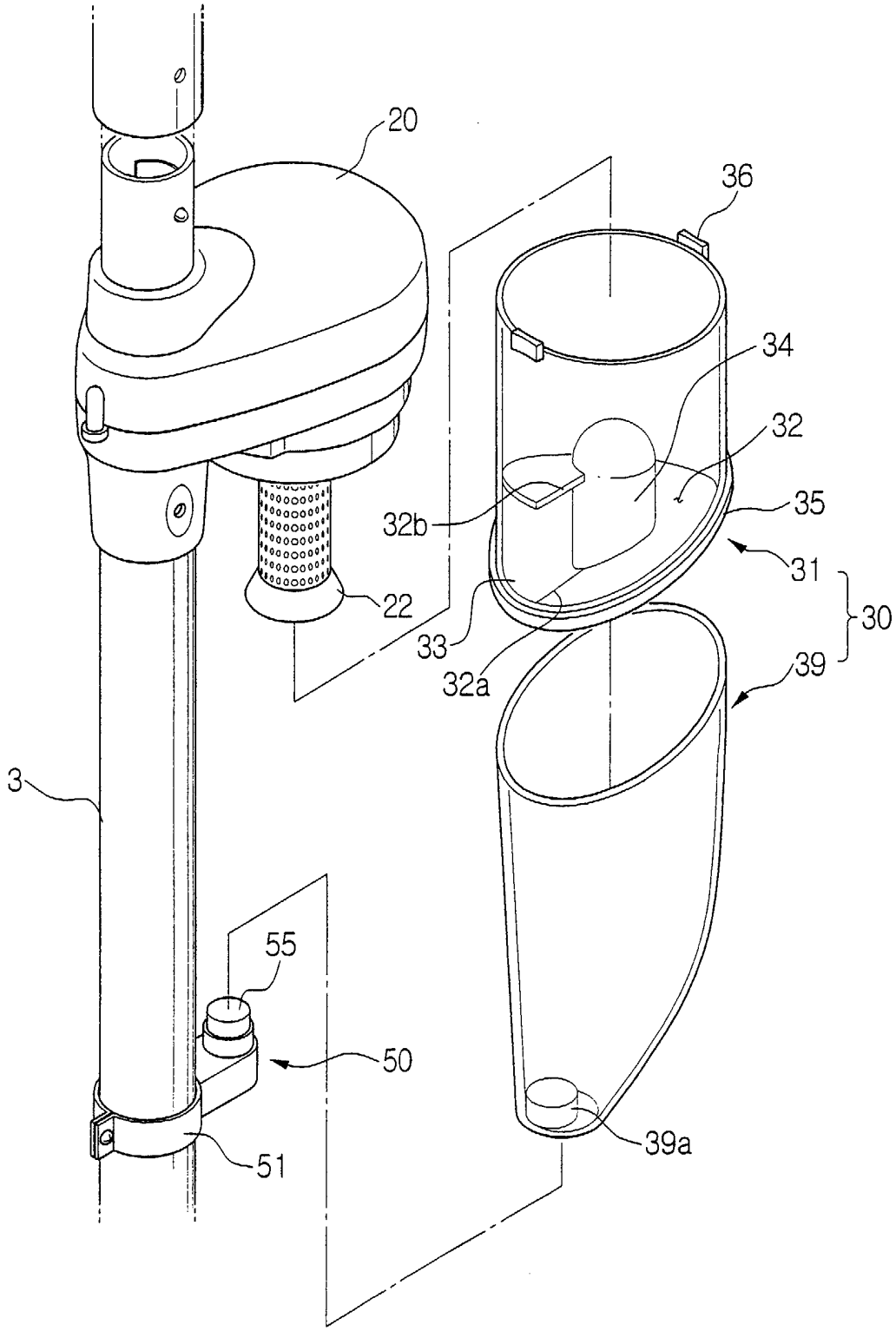


FIG.3

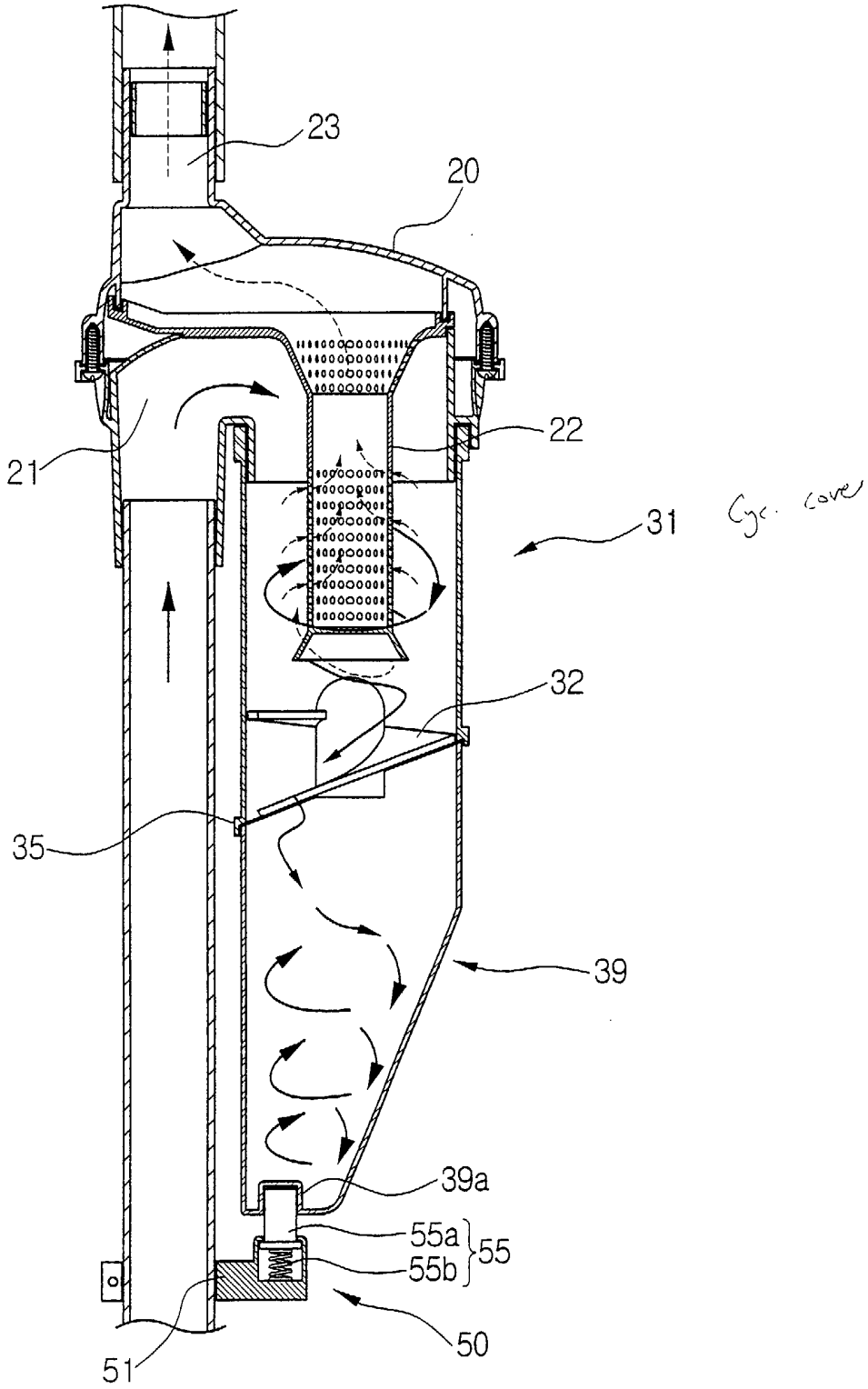


FIG.4

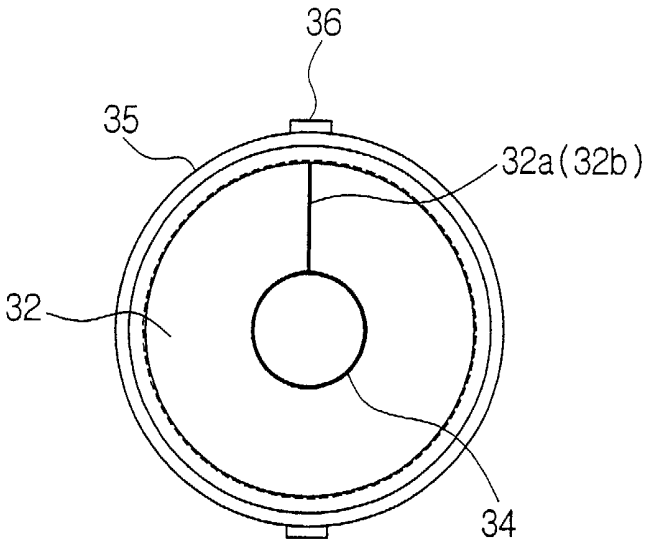


FIG.5A

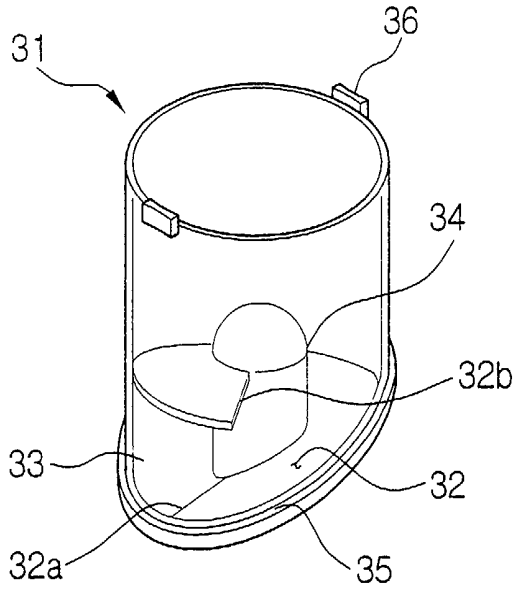


FIG.5B

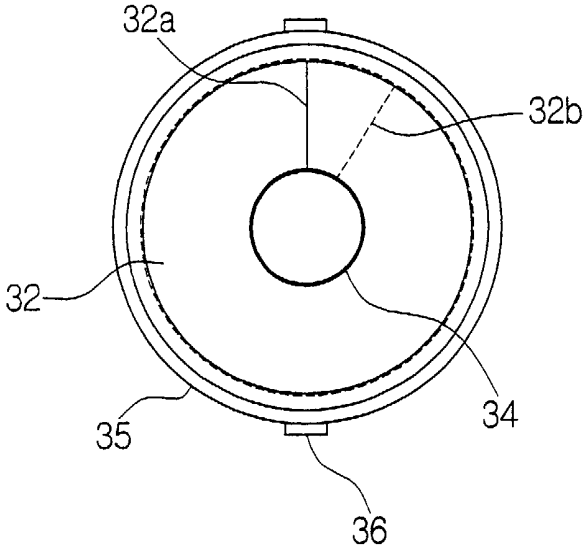
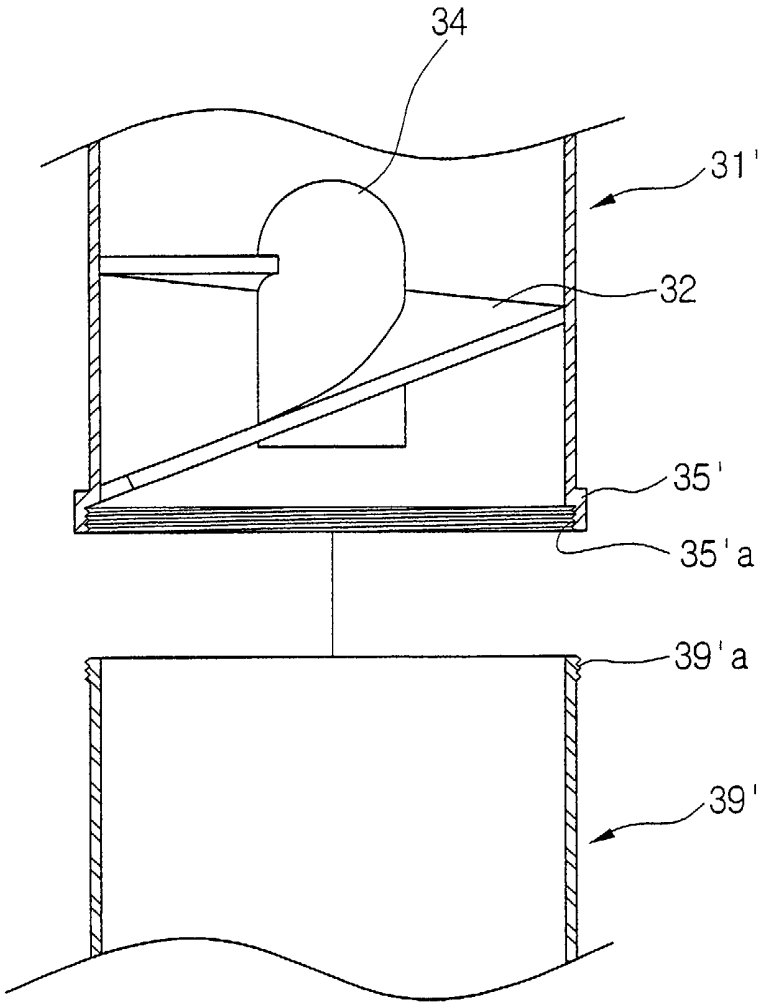


FIG.6



DUST COLLECTING DEVICE FOR A VACUUM CLEANER

The present invention relates to a dust collecting device for a vacuum cleaner, and more particularly to a cyclone dust collecting device for a vacuum cleaner.

Generally, cyclone dust collecting devices separate particles from a fluid by using centrifugal force. Due to their simple structure and ability to withstand high-temperature and high-pressure environments, cyclone dust collecting devices have been widely used in industry for some time. Further, such cyclone dust collecting devices are employed in vacuum cleaners, firstly to filter, and then to collect, contaminants in the form of relatively large particles, such as pieces of tissue, vinyl, hair, and the like, from air that is drawn in through a cleaner brush. The cyclone dust collecting device avoids the need for these larger contaminants to be filtered out by a disposable paper filter inside a dust collecting chamber, thereby extending the life of the disposable paper filter.

In the drawings, Figure 1 is a perspective view of an exemplary vacuum cleaner equipped with a conventional cyclone dust collecting device.

As shown in Figure 1, a vacuum cleaner having a conventional cyclone dust collecting device 10 includes a cleaner body 1, a brush 4 for drawing in contaminants, a flexible hose 2 and a telescopic extension pipe 3 for connecting the brush 4 to the cleaner body 1, a paper filter 7 for filtering out contaminants, and a fan motor 8 for generating a suction force. The cyclone dust collecting device 10 is mounted on a connection portion between the telescopic extension pipe 3 and the flexible hose 2, and is provided to filter out large particle contaminants.

The cyclone dust collecting device 10, for the vacuum cleaner, draws in air and contaminants through the brush 4 with a suction force generated by the fan motor 8 obliquely into a cyclone housing 13. Various kinds of relatively large particle contaminants, such as pieces of tissue, vinyl, hair, and the like, are separated from the

air by the centrifugal force, caused by a vortex of air. These large particle contaminants are then collected in the cyclone housing 13. When clean air reaches the bottom of the cyclone housing 13, the air reverses direction and turns into a rising air flow which is expelled to the cleaner body 1, through the flexible hose 2.

During operation of the vacuum cleaner, the orientation of the cyclone dust collecting device 10 may change, either intentionally or unintentionally. That is, the cyclone dust collecting device 10 may be tilted or turned upside-down when cleaning higher locations, thereby causing the contaminants collected in the cyclone housing 13 of the cyclone dust collecting device 10, such as tissue, vinyl, hair, and the like, to fall toward a grille 12 of the cyclone dust collecting device 10. When such reverse flow of contaminants occurs, the contaminants can block the grille 12 of the cyclone dust collecting device 10, thereby decreasing the cleaning efficiency of the vacuum cleaner, or disabling its operation. Therefore, blockage of the grille due to a reverse flow of contaminants should preferably be prevented.

Further, since the cyclone housing 13 can be separated from the cyclone body 11 to enable a user to discard the contaminants that have collected in the cyclone housing 13, the grille 12 of the cyclone body 11 will be exposed. Accordingly, the local area may get dirty, because of contaminants falling from the grille. Furthermore, the exposed grille 12 can break if mishandled.

According to a first aspect of the present invention, there is provided a cyclone dust collecting device for a vacuum cleaner, the dust collecting device comprising: a cyclone body for connection to a telescopic extension pipe of the vacuum cleaner, the cyclone body being arranged to generate a swirling vortex from an inflow of air and contaminants; and a cyclone housing detachably engaged with the cyclone body, the cyclone housing having a spiral partition dividing the interior of the cyclone housing into an upper space for separating the contaminants from the air by guiding the swirling vortex of air, and a lower space for receiving the contaminants that have been separated from the air.

According to a second aspect of the present invention, there is provided a vacuum cleaner comprising: a cleaner body; a telescopic extension pipe coupled to the cleaner body via a flexible hose; a cyclone dust collecting device mounted to the telescopic extension pipe, the cyclone dust collecting device including: a cyclone body mounted on the telescopic extension pipe, the cyclone body generating a swirling vortex from an inflow of air and contaminants; a cyclone housing detachably engaged with the cyclone body, the cyclone housing having a spiral partition dividing the interior of the cyclone housing into an upper space for separating the contaminants from the air and a lower space for receiving the contaminants that have been separated from the air.

According to a third aspect of the present invention, there is provided a particle collecting apparatus for a vacuum cleaner, the particle collecting apparatus comprising:

an upper portion which is connectable to a cyclone body of the vacuum cleaner and arranged to receive an inflow of air and particles from the cyclone body; and

a lower portion for receiving and retaining the particles from the upper portion;

wherein the upper portion and the lower portion are separated by a partition, the partition being arranged such that the particles are substantially prevented from returning from the lower portion to the upper portion.

The dust collecting device disclosed in this specification reduces the effects of contaminants blocking the grille, substantially regardless of the orientation of the cyclone dust collecting device. It is possible to avoid hindering the operation of the vacuum cleaner, to prevent contaminants from falling off the grille of a cyclone body. The exposure of the grille to damage when collected contaminants are discarded is also reduced.

In the preferred embodiment, a cyclone dust collecting device for a vacuum cleaner, includes a cyclone body connected to a telescopic extension pipe of the vacuum cleaner. The cyclone body generates a swirling vortex from an inflow of air and contaminants that have been drawn in. The cyclone dust collecting device may further include a cyclone housing detachably engaged with the cyclone body. The cyclone housing may have a spiral partition dividing an interior of the cyclone housing into an upper space

for separating contaminants from the air by guiding the vortex of air, and a lower space for receiving the contaminants that have been separated from the air.

The cyclone housing may include a cyclone cover having a cylindrical shape, an open upper end engaged with the cyclone body, and a lower slanted end, slanted by a spiral partition. The cyclone housing may further include a dust collecting container detachably engaged with a lower portion of the slanted end of the cyclone cover, for receiving contaminants that have passed through the spiral partition.

An engagement portion may extend from the lower slanted end of the cyclone cover. The engagement portion can be press-fitted with the upper open end of the dust collecting container.

The spiral partition may include a dome-shaped protrusion formed on a centre thereof. The spiral partition may include first and second ends which align with each other in a vertical plane or a plane parallel to or containing the axis of the cover, or may overlap one another in such a plane.

Supporting means may be provided to support the cyclone housing elastically with respect to the telescopic extension pipe and to prevent separation of the cyclone housing from the cyclone body.

The supporting means may include a fixture member mounted to the telescopic extension pipe, an insertion member movably disposed on the fixture member, and inserted in a recess formed on a lower end of the cyclone housing, and an elastic member for biasing the insertion member into engagement with the recess.

The cyclone housing may include a cyclone cover having a cylindrical shape, an open upper end engaged with the cyclone body, and a lower slanted end which is slanted at a predetermined angle with respect to the spiral partition. The cyclone housing may further include a dust collecting container having an open end engaged with the lower

portion by a screw. The dust collecting container can receive contaminants that have passed through the spiral partition.

The cyclone body may further include a grille defining an air suction path and an air exhaust path. The grille has a plurality of fine holes formed therein, through which air flows.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a vacuum cleaner having a conventional cyclone dust collecting device;

Figure 2 is an exploded perspective view of a preferred cyclone dust collecting device in accordance with the present invention;

Figure 3 is a cross-sectional view of the cyclone dust collecting device shown in Figure 2;

Figure 4 is a bottom view of a cyclone cover for the cyclone dust collecting device shown in Figure 2;

Figures 5A and 5B are, respectively, a perspective view and a bottom view of the cyclone cover, showing the case where there is provided an overlap in a spiral surface of the cyclone cover of the cyclone dust collecting device; and

Figure 6 shows an alternative screw-coupled connection between a dust collecting container and the cyclone cover of the cyclone dust collecting device of Figure 2.

Referring to Figures 2 and 3, a cyclone dust collecting device has a cyclone body 20 and a cyclone housing 30. The cyclone housing 30 includes a cyclone cover 31 and a dust collecting container 39. Here, a support part 50 is provided on the telescopic extension

pipe 3 of the vacuum cleaner to support the dust collecting container 39 such that the dust collecting container 39 does not detach from the cyclone cover 31 during a cleaning process.

The cyclone body 20 is connected to the telescopic extension pipe 3 of the vacuum cleaner and includes an inflow air passage 21 for obliquely guiding air and contaminants which are drawn in through the brush 4 (see Figure 1), a grille 22 for filtering the air inside the cyclone cover 31, and an outflow air passage 23 for guiding the air that is drawn in through the grille 22 to a cleaner body 1.

The cyclone cover 31 has a cylindrical shape, and is connected to a lower portion of the cyclone body 20. The cylindrical shape of the cyclone cover 31 induces the air that is drawn in from the inflow air passage 21 of the cyclone body 20 into a vortex. One end of the cyclone cover 31 has a plurality of engagement protrusions 36 formed therein for connection with the cyclone body 20. The other end of the cyclone cover 31 is slanted and closed by a spiral surface 32. The spiral surface 32 may be formed in various curve forms such as a spiral curve, a helical curve, and so on. The slant end of the cyclone cover 31 is formed by terminating the wall of the cylindrical cyclone cover 31 on the same slant as that of the applied spiral surface 32. Since the spiral surface 32 begins at a point which coincides with the slanted end, and extends towards the open end of the cyclone cover 31, a through-hole 33 is defined between the starting point 32a, and ending point 32b, of the spiral surface 32 to guide contaminants into the dust collecting container 39. The spiral surface 32, as shown in Figures 2 and 4, may be formed with the starting point 32a coincident, in a circumferential direction with the ending point 32b or, as shown in Figures 5A and 5B, the spiral surface 32 may be formed with the ending point 32b extended further over the starting point 32a, such that a portion of the spiral surface 32 overlaps itself. Accordingly, the size of the through-hole 33 is determined by the pitch or angle of the spiral surface 32, and the diameter of the cyclone cover 31. Further, a cylindrical hub or pole 34 having one-third, or one-fourth of the diameter of the cyclone cover 31 is provided at the centre of the spiral surface 32. It is preferable that the end of the cylindrical pole 34 which faces the open end of the

cyclone cover 31, has a dome shape. This is so that air, and contaminants entrained in the air, can be guided outside the cyclone cover 31.

Further, an engagement part 35 having a step shape is formed around a lower end of the slanted end of the cyclone cover 31. The engagement part 35 secures the cyclone cover 31 to the dust collecting container 39.

The dust collecting container 39 is coupled to the engagement part 35 of the cyclone cover 31. The dust collecting container 39 has a substantially cylindrical shape and a closed lower end. The open end of the dust collecting container 39 is slanted to correspond with the slanted end of the cyclone cover 31, so that the cyclone cover 31 and the dust collecting container 39 are flush, and form a straight line when engaged with each other. Further, a recess 39a is formed in the lower portion of the closed end of the dust collecting container 39, to receive the support part 50 for supporting the dust collecting container 39.

Preferably, to reduce the swirling vortex of air from the cyclone cover 31, and also to assist a user in mounting the dust collecting container 39 to the telescopic extension pipe 3, the closed end of the dust collecting container 39 is slightly tapered to have a smaller area than that of the open end which corresponds to the slanted end of the cyclone cover 31.

A recess 39a, formed on the lower portion of the closed end of the dust collecting container 39, has a size and shape which correspond to an insertion part 55 of the support part 50. The recess 39a receives the insertion part 55 of the support part 50 to secure the dust collecting container 39 to the telescopic extension pipe 3.

The support part 50 further includes a fixture member 51 which is mounted to the telescopic extension pipe 3. A circular clamp of a size corresponding to the outer diameter of the telescopic extension pipe 3 is provided at one end of the fixture member 51 to engage the telescopic extension pipe 3. The insertion part 55 is mounted to the other end of the fixture member 51.

The insertion part 55 includes a pin 55a, which is inserted in the recess 39a of the dust collecting container 39, and a compression coil spring 55b for biasing the pin 55a outwards. The pin 55a and the compression coil spring 55b have appropriate lengths to allow the dust collecting container 39 to be smoothly separated from the engagement part 35 of the cyclone cover 31, when a user holds and presses down the dust collecting container 39, and such as to prevent separation of the dust collecting container 39, from the cyclone cover 31, during a normal cleaning process.

A further example of a means or method of engaging the dust collecting container 39 with the cyclone cover 31 is shown in Figure 6. Referring to Figure 6, an engagement part 35' of a cyclone cover 31' is not formed along the periphery of the slanted end, but formed along the inner periphery of the lower end of the cyclone cover 31'. The engagement part 35' of the cyclone cover 31' is formed with a female screw thread 35a', and the outer periphery of the open end of the dust collecting container 39' is formed with a male screw thread 39b' for engagement with the female screw thread 35a'. Accordingly, the dust collecting container 39' is connected to the cyclone cover 31' when the engagement part 35' of the cyclone cover 31' is screwed to the dust collecting container 39'. In this engaging method, the support part 50 can be omitted.

The operation of the above-described cyclone-collecting device will now be described in detail.

In use, air and contaminants are drawn into the vacuum cleaner through the brush 4 and flow into the cyclone dust collecting device through the inflow air passage 21 of the cyclone body 20. As the air and contaminants enter the cyclone cover 31, they form a swirling vortex of air and contaminants. Larger particle contaminants contained in the air are separated from the air by centrifugal force and then drop to the bottom of the cyclone cover 31. Most of the air which is free of contaminants collides with the spiral surface 32 of the cyclone cover 31, and reverses direction forming a rising air stream. The rising air stream is expelled to the cleaner body 1 through the grille 22 and the

outflow air passage 23. Accordingly, the device is mounted so as to match the rotation direction of the swirling air flow, with the spiral rotation direction.

After the contaminants have been separated from the air by centrifugal force, the air drops down, but keeps moving along the spiral surface 32 of the cyclone cover 31 in a swirling air flow manner, to be exhausted into the dust collecting container 39 by means of the through-hole 33. Since the contaminants are blocked by the spiral surface 32 of the slanted cyclone cover 31, the contaminants in the dust collecting container 39 are not discharged through the cyclone cover 31, but rotated in the swirling air flow within the dust collecting container 39.

The cyclone cover 31 induces the air into a swirling vortex in co-operation with the cyclone body 30, and separates contaminants from the air using centrifugal force. The through-hole 33 formed by the spiral surface 32 guides the separated contaminants into the dust collecting container 39. The dust collecting container 39 serves as a receptacle where the separated contaminants are collected. That is, since a separation part for separating contaminants from the air is maintained separate from a dust collecting part for collecting the contaminant separated from the sucked air, the contaminant separated by the centrifugal force does not flow in the reverse direction towards the grille 22 of the cyclone body 20 and, therefore, the contaminant cannot block the grille 22.

Next, a method for emptying the dust collecting container 39 which is filled with contaminants, will be described.

Initially, the user holds the dust collecting container 39 and presses down on the lower portion of the dust collecting container 39, which is removably mounted on the support part 50, to compress the compression coil spring 55b. This also disengages the engagement part 35 of the dust collecting container 39, from the cyclone cover 31. The user can then remove the dust collecting container 39 from the support part 50. After emptying the dust collecting container 39, the user inserts the insertion pin 55a, of the support part 50, into the recess 39a provided in the lower portion of the dust collecting container 39. Then, the user presses down on the dust collecting container 39 to

compress the coil spring 55b, and fits the upper portion of the dust collecting container 39 in alignment with the engagement part 35 of the cyclone cover 31. When the user releases the dust collecting container 39, the coil spring 55b will expand, urging the dust collecting container 39 into engagement with the engagement part 35 of the cyclone cover 31. Thus, the dust collecting container 39 is supported at one end by the engagement part 35, and at the other end by the support part 50.

Further, in the case of a screw-engagement structure, such as that illustrated in Figure 6, rotation of the dust collecting container 39' counterclockwise separates the dust collecting container 39' from the engagement part 35' of the cyclone cover 31'. The dust collecting container 39' is re-engaged with the cyclone cover 31' by rotating the dust collecting container 39' clockwise.

As explained above, the cyclone dust collecting device for a vacuum cleaner, in accordance with the described preferred embodiment, acts to improve the cleaning efficiency of the vacuum cleaner, even when the orientation of the cyclone dust collecting device changes during operation. Furthermore, the device provides an improved and safe way of emptying the contents of the dust collecting container, by preventing the dispersal of contaminants from the grille and protecting the grille.

CLAIMS

1. A cyclone dust collecting device for a vacuum cleaner, the dust collecting device comprising:

a cyclone body for connection to a telescopic extension pipe of the vacuum cleaner, the cyclone body being arranged to generate a swirling vortex from an inflow of air and contaminants; and

a cyclone housing detachably engaged with the cyclone body, the cyclone housing having a spiral partition dividing the interior of the cyclone housing into an upper space for separating the contaminants from the air by guiding the swirling vortex of air, and a lower space for receiving the contaminants that have been separated from the air.

2. A cyclone dust collecting device according to claim 1, wherein the cyclone housing comprises:

a cyclone cover having a cylindrical shape, an open upper end, and a lower slanted end, the open upper end being engaged with the cyclone body, the lower slanted end being slanted by the spiral partition; and

a dust collecting container detachably engaged with a lower portion of the slanted end of the cyclone cover, the dust collecting container being arranged to receive contaminants that have passed through the spiral partition.

3. A cyclone dust collecting device according to claim 2, further comprising an engagement portion extending from the lower slanted end of the cyclone cover, the engagement portion being capable of engaging an open upper end of the dust collecting container to secure the dust collecting container thereto.

4. A cyclone dust collecting device according to any preceding claim, wherein the spiral partition includes a dome-shaped protrusion formed on a centre thereof.

5. A cyclone dust collecting device according to any preceding claim, wherein the spiral partition has a first edge and a second edge, the first and second edges being aligned in a vertical plane.

6. A cyclone dust collecting device according to any of claims 1 to 4, wherein the spiral partition has a first edge portion and a second edge portion, the first and second edge portions overlapping each other in a vertical plane.

7. A cyclone dust collecting device according to any preceding claim, further comprising supporting means for supporting the cyclone housing with respect to the telescopic extension pipe and preventing separation of the cyclone housing from the cyclone body.

8. A cyclone dust collecting device according to claim 7, wherein the supporting means comprises:

a fixture member mountable on the telescopic extension pipe;

an insertion member movably disposed on the fixture member, the insertion member being received in a recess formed in a lower end of the cyclone housing when the cyclone housing is coupled to the cyclone body; and

an elastic member for biasing the insertion member into engagement with the recess.

9. A cyclone dust collecting device according to any preceding claim, further comprising supporting means for elastically supporting the cyclone housing with respect to the telescopic extension pipe, and preventing separation of the cyclone housing from the cyclone body.

10. A cyclone dust collecting device according to claim 9, wherein the supporting means comprises:

a fixture member mountable on the telescopic extension pipe;

an insertion member movably disposed on the fixture member, the insertion member being received in a recess formed in a lower end of the cyclone housing, when the cyclone housing is coupled to the cyclone body; and

an elastic member for biasing the insertion member into engagement with the recess.

11. A cyclone dust collecting device as claimed in claim 1, wherein the cyclone housing comprises:

a cyclone cover having a cylindrical shape, an open upper end, and a lower slanted end, the open upper end being engaged with the cyclone body, the lower slanted end being slanted at a predetermined angle with respect to the spiral partition; and

a dust collecting container having an open end engaged with the lower portion by a screw means, the dust collecting container being arranged to receive the contaminants that have passed through the spiral partition.

12. A cyclone dust collecting device as claimed in claim 1, wherein the cyclone body includes a grille, the grille defining an air suction path and an air exhaust path, and having a plurality of fine holes formed therein through which air may flow.

13. A vacuum cleaner comprising:

a cleaner body;

a telescopic extension pipe coupled to the cleaner body via a flexible hose;

a cyclone dust collecting device mounted to the telescopic extension pipe, the cyclone dust collecting device including:

a cyclone body mounted on the telescopic extension pipe, the cyclone body generating a swirling vortex from an inflow of air and contaminants;

a cyclone housing detachably engaged with the cyclone body, the cyclone housing having a spiral partition dividing the interior of the cyclone housing into an upper space for separating the contaminants from the air and a lower space for receiving the contaminants that have been separated from the air.

14. A vacuum cleaner according to claim 13, wherein the cyclone housing includes:

a cyclone cover having a cylindrical shape, an open upper end, and a lower slanted end, the open upper end being engaged with the cyclone body, the lower slanted end being slanted by the spiral partition; and

a dust collecting container detachably engaged with a lower portion of the slanted end of the cyclone cover, the dust collecting container being arranged to receive contaminants that have passed through the spiral partition.

15. A vacuum cleaner according to claim 14, further comprising an engagement portion extending from the lower slanted end of the cyclone cover, the engagement portion being capable of engaging an open upper end of the dust collecting container to secure the dust collecting container thereto.

16. A vacuum cleaner according to any of claims 13 to 15, wherein the spiral partition includes a dome-shaped protrusion formed on a centre portion thereof.

17. A vacuum cleaner according to any of claims 13 to 16, wherein the spiral partition has a first edge and a second edge, the first and second edges being aligned in a vertical plane.

18. A vacuum cleaner according to any of claims 13 to 16, wherein the spiral partition has a first edge portion and a second edge portion, the first and second edge portions overlapping each other in a vertical plane.

19. A vacuum cleaner according to any of claims 13 to 18, further comprising supporting means for supporting the cyclone housing with respect to the telescopic extension pipe, and preventing separation of the cyclone housing from the cyclone body.

20. Particle collecting apparatus for a vacuum cleaner, the particle collecting apparatus comprising:

an upper portion which is connectable to a cyclone body of the vacuum cleaner and arranged to receive an inflow of air and particles from the cyclone body; and

a lower portion for receiving and retaining the particles from the upper portion;

wherein the upper portion and the lower portion are separated by a partition, the partition being arranged such that the particles are substantially prevented from returning from the lower portion to the upper portion.

21. Apparatus according to claim 20, wherein the partition comprises a sloping member arranged such that particles are able to pass from the upper portion to the lower

portion due a circular flow, and such that particles are unable to return from the lower portion to the upper portion in the event that the particle collecting apparatus is inverted.

22. Apparatus according to claim 20 or claim 21, wherein the partition comprises a generally spiral member.

23. A vacuum cleaner comprising:

a cleaner body for generating a suction force;

a cleaner pipe which is attached to the cleaner body; and

a particle collecting apparatus according to any of claims 20 to 22, the particle collecting apparatus being arranged to receive an inflow of air and particles from the cleaner pipe.

24. A cyclone dust collecting device, constructed and arranged substantially as herein described with reference to the Figures 2 to 6 of the accompanying drawings.

25. A vacuum cleaner, constructed and arranged substantially as herein described with reference to the Figures 2 to 6 of the accompanying drawings.

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Application No: GB 0118381.3
Claims searched: 1-19, 24-25
Examiner: Nicholas Mole
Date of search: 2 October 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): A4F (FFD, FSCW) B2P (P10B2A3)

Int Cl (Ed.7): A47L (9/16, 9/10)

Other: Online: WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0489565 A	(NOTETRY)	
A, P	WO 01/05291 A (SHARP) and WPI abstract no. 2001-112661		
X, P	WO 00/74547 A	(LG ELECTRONICS) see esp. figures and page 8 lines 3-13	1, 5 at least
A	US 5350432	(LEE)	
A	US 5145499	(DYSON)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.