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(54) Cyclone dust extractor

(57) A cyclone dust extractor 1 comprising a housing 3 defining a first cyclone separator 23 and a second cyclone separator 33 in series, a centrifugal fan 11 for producing cyclones within the cyclone separators 23,33 and a motor 9 for driving the fan 11, wherein at least one of the cyclone separators 23 has an inlet portion 27 and an outlet portion 31 which are separated by a wall 35. As a result, the outlet portion 31 of the first cyclone separator 23 can act as a third cyclone separator. Additionally, unwanted turbulence between the inlet flow and the outlet flow of the cyclone through the first cyclone separator 23 is avoided.

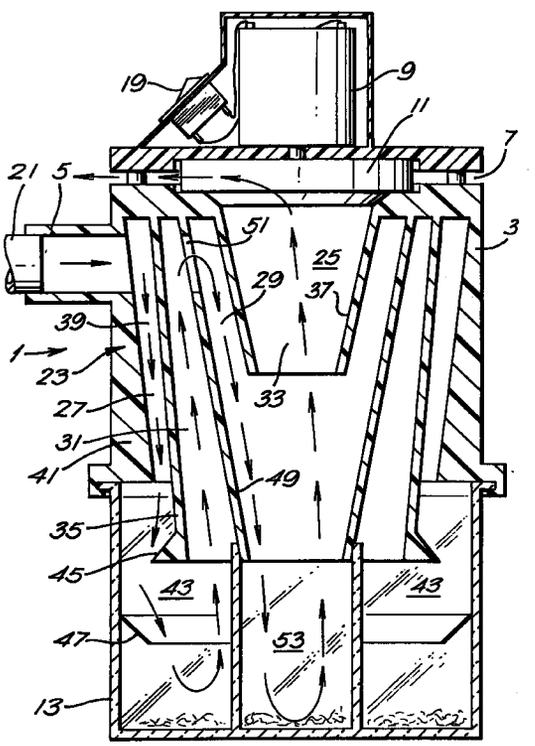

Fig. 3

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Description

This invention relates to dust extractors, and in particular to dust extractors which incorporate cyclone separators.

Cyclone separators have been known for many years. A large proportion of the known cyclone separators use a tangential input which causes an air flow to rotate around the interior of a cylindrical housing. The rotation of the air causes a "cyclone" action, which centrifugally throws heavier particles to the outside. The heavier particles are allowed to settle to the bottom of the separator whilst the cleaner air exits through the centre of the top of the separator.

To increase the efficiency of a dust extractor, dual cyclone arrangements have been devised, such as disclosed in EP-A-0042723 and EP-A-0557096. In these dust extractors (or vacuum cleaners), the inlet flow and the outlet flow of each cyclone separator travel within the same cavity within a housing. As a result, turbulence occurs between the two flows. Such turbulence reduces the efficiency of air flow within the cyclone arrangement.

In the light of the foregoing, the inventor of the present invention has devised a novel cyclone dust extractor which provides aims to improved efficiency over the prior art devices.

According to the present invention, there is provided a cyclone dust extractor comprising a housing defining a first cyclone separator and a second cyclone separator in series, a fan for producing cyclones within the cyclone separators and a motor for driving the fan, wherein at least one of the cyclone separators has an inlet portion and an outlet portion which are separated by a wall.

By providing a wall between the inlet flow and the outlet flow of a cyclone separator, less turbulence occurs in the separator and the efficiency of the separator is increased.

Preferably the outlet portion of the at least one cyclone separator acts as a third cyclone separator. In such an arrangement, the outlet portion of the at least one cyclone separator is preferably reverse rifled to assist in extracting dust from the air flow.

The end of the wall separating the inlet portion and the outlet portion of the at least one cyclone separator preferably includes a diffuser (or baffle) for assisting in separating the inlet cyclone from the outlet cyclone. More particularly, the diffuser can assist in directing the inlet flow away from the outlet flow.

Preferably the wall between the inlet portion and the outlet portion of the at least one cyclone separator defines an inlet passageway with an outer wall and an outlet passageway with an inner wall which both have cross-sectional areas which reduce on progressing along the passageways.

In a preferred embodiment, the inner wall of the outlet portion of the at least one cyclone separator acts as an outer wall for the second cyclone separator.

A dust collector may be situated between the inlet portion and the outlet portion of the first cyclone separator. Further, a collar is preferably provided in the dust collector to help discharge dust particles carried by the cyclone.

The dust collector preferably can be separated from the housing to discharge dust particles collected in the chamber or chambers of the collector.

The second cyclone separator preferably comprises four stages, a first stage accelerating the cyclone, a second stage decelerating the cyclone, a third stage accelerating the cyclone and a fourth stage decelerating the cyclone.

The fourth stage of the second cyclone separator may be situated within the dust collector. As a result, dust extracted by the second cyclone separator can be discharged from the dust extractor at the same time as that from the first cyclone separator.

The second cyclone separator preferably includes a frusto-conical outlet passageway communicating with the fan. The broader end of the frusto-conical outlet is adjacent the fan, thereby causing dust to be deposited in the cyclone separator before the air of the cyclone reaches the fan.

The housing is preferably provided with a tangential inlet port communicating with the first cyclone separator.

By virtue of the compact nature of a dust extractor according to the present invention, the extractor may be portable. Further, the extractor may include a belt clip for attaching the extractor to a belt of a user.

As a result of being extremely efficient, a dust extractor according to the present invention may be battery operated.

A specific embodiment of the present invention is now described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view from above and one side of a cyclone dust extractor according to the present invention;

Figure 2 is a perspective view from above and the other side of the cyclone dust extractor of Figure 1; and

Figure 3 is a sectional side view of the cyclone dust extractor of Figure 1.

With reference to the drawings, a cyclone dust extractor 1 according to the present invention comprises a housing 3 having an inlet 5 and an outlet 7, a motor 9 for driving a centrifugal fan 11, a dust collector 13 and a belt clip 15. The housing 3 includes a battery compartment 17 which accommodates a battery (not shown) for driving the motor 9 via switch gear 19. In use, the portable cyclone dust extractor 1 can be clipped onto a user's belt by means of the belt clip 15 and the motor 9 can be energised using the switch gear 19 to drive the centrifugal fan 11 to suck dust and debris into the dust extractor 1 via a hose 21 and the inlet 5. The dust and

debris is then separated from the air flow by means of cyclone separators within the housing 3 which will be described in more detail hereinafter.

When dust and debris has been separated from the air flow, it accumulates in the dust collector 13. Since the dust collector 13 can be separated from the housing 3, collected dust can be emptied from the collector 13 and deposited in any suitable waste disposal site. The collector 13 can then be reattached to the housing 3 for further use of the dust extractor 1.

With particular reference to Figure 3 of the drawings, the inlet 5 of the dust extractor 1 communicates with a first cyclone separator 23 and the outlet 7 communicates with a second cyclone separator 25 via the centrifugal fan 11. Each of the cyclone separators 23,25 has a respective inlet portion 27,29 and an outlet portion 31,33. In the case of the first cyclone separator 23, a wall 35 separates the inlet portion 27 from the outlet portion 31 along virtually the complete length of the two portions 27,31. In contrast, a frusto-conical wall 37 of the second cyclone separator 25 extends only part way into the second cyclone separator 25 such that the inlet 29 and outlet 33 portions of the separator 25 are not completely separated.

As mentioned above, the first cyclone separator 23 includes a dividing wall 35 between the inlet portion 27 and the outlet portion 31 of the separator 23. This wall 35 forms a first converging passageway 39 with the housing wall 41 as shown in Figure 3. As air is drawn in through the tangential inlet 5, the air rotates around the channel 39 within the housing 3 and proceeds down the passageway to the narrower end. The air therefore accelerates and, on exiting the end of the passageway 39 into a collection chamber 43, is immediately decelerated, thereby depositing large dust and debris particles in the collection chamber 43 of the dust collector 13. This action is typical of many prior art cyclone separators and is fundamental to the working thereof The wall 35 carries a diffuser 45 which directs the cyclonic air flow away from the outlet portion 31. A further collar 47 is provided in the collection chamber 43 against which large dust and debris particles collide, thereby assisting in removing the dust and debris from the air flow and depositing it in the collection chamber 43.

The outlet portion 31 of the first cyclone separator 23 carries the rotating air flow from the collection chamber 43 upwards towards the top of the housing 3. As the air rises, the passageway narrows, thereby accelerating the air flow. The wall 35 acts as an outer wall of the second portion 31, an inner wall 49 of which diverges and approaches the separating wall 35. Although not specifically shown in the drawings, reverse rifling may be formed on the walls 35,49 within the outlet portion 31 to assist in this process. Hence, this outlet portion 31 of the first cyclone separator 23 acts as a third cyclone separator.

On reaching the top of the outlet portion 31 of the first cyclone separator 23, the rotating air flow passes through an opening 51 and into the second cyclone separator 25. The air descends down the inside of the converging wall 49 and, on passing the end of the frusto-conical wall 37, decelerates which tends to cause further dust particles to drop out of the cyclone. This deceleration is caused by the sudden removal, as seen by the air, of the frusto-conical wall 37. This means there is thus a larger body of air free to move without the constraints of wall 37 and hence the deceleration is effected. From this point on, the air travels further down the second separator 25 constrained by converging wall 49. This converging wall 49 thus causes an acceleration of the air. This air, on reaching the end of converging wall 49 enters the collection chamber 53 where it is again decelerated. This causes dust particles to drop out of the cyclone. These particles fall into a second dust collection chamber 53, which is formed inside the first dust collection chamber 43. The cyclone continues down the second cyclone separator 25 and enters this second dust collection chamber 53 before rising again through an opening in the frusto-conical wall 37 and out of the outlet 7 via the fan 11.

On approaching the second dust collection chamber 53, the air flow is accelerated due to the tapering of the converging wall 49, as described above. Thus, on entering the dust collection chamber 53 the cyclone is allowed to expand, thereby decelerating and releasing further dust particles. Four stages therefore exist in the second cyclone separator 25, namely acceleration, followed by deceleration, followed by acceleration and subsequent deceleration of the cyclone.

As mentioned above, when sufficient dust and debris has been collected in the collection chambers 43,53 of the dust collector 13, the collector 13 can be disconnected from the housing 3 to be emptied. On re-engagement of the collector 13 with the housing 3, the cyclone dust extractor 1 is once again ready for action.

As will be appreciated, by using cyclone separators 23,33, there is no need for vacuum cleaner bags and the like which can get clogged and subsequently waste energy. Hence, the cyclone dust extractor 1 is particularly efficient and, consequently, suitable for use with a battery pack rather than a mains power source.

By virtue of the wall 35 between the inlet portion 27 and the outlet portion 31 of the first cyclone separator 23, as mentioned above there is effectively formed a third cyclone separator within the dust extractor 1. Hence, far improved extraction of dust and debris from an air sample results.

It will of course be understood that the present invention has been described above purely by way of example, and that modifications of detail can be made within the scope of the invention.

Claims

1. A cyclone dust extractor comprising a housing defining a first cyclone separator and a second cyclone separator in series, a fan for producing cyclones within the cyclone separators and a motor

for driving the fan, wherein at least one of the cyclone separators has an inlet portion and an outlet portion which are separated by a wall.

2. A dust extractor according to claim 1, wherein the outlet portion of the at least one cyclone separator acts as a third cyclone separator.

3. A dust extractor as claimed in claim 1 or claim 2, wherein the outlet portion of the at least one cyclone separator is reverse rifled to assist in extracting dust from the cyclone.

4. A dust extractor as claimed in any preceding claim, wherein the end of the wall separating the inlet portion and the outlet portion of the at least one cyclone separator includes a diffuser for assisting in separating the inlet cyclone from the outlet cyclone.

5. A dust extractor as claimed in any preceding claim, wherein the wall between the inlet portion and the outlet portion of the at least one cyclone separator defines an inlet passageway with an outer wall and an outlet passageway with an inner wall, the cross-sectional areas of the passageways reducing on progressing along the passageways.

6. A dust extractor as claimed in any preceding claim, wherein an inner wall of the outlet portion of the first cyclone separator acts as an outer wall for the second cyclone separator.

7. A dust extractor as claimed in any preceding claim, wherein a dust collection chamber is situated between the inlet portion and the outlet portion of the first cyclone separator.

8. A dust extractor as claimed in claim 7, wherein a collar is provided in the dust collection chamber to help discharge dust particles carried by the cyclone.

9. A dust extractor as claimed in claim 7 or claim 8, wherein the dust collection chamber can be separated from the housing to discharge dust particles collected in the chamber.

10. A dust extractor as claimed in any preceding claim, wherein the second cyclone separator comprises four stages, a first stage accelerating the cyclone, a second stage decelerating the cyclone, a third stage accelerating the cyclone and a fourth stage decelerating the cyclone.

11. A dust extractor as claimed in claim 10, wherein the fourth stage of the second cyclone separator is situated within a dust collection chamber.

12. A dust extractor as claimed in any preceding claim, wherein the second cyclone separator includes a frusto-conical outlet passageway communicating with the fan.

13. A dust extractor as claimed in any preceding claim, wherein the housing is provided with a tangential inlet port communicating with the first cyclone separator.

14. A cyclone dust extractor as claimed in any preceding claim, which is portable.

15. A dust extractor as claimed in claim 14, wherein a belt clip is provided on the outside of the housing.

16. A dust extractor as claimed in any preceding claim, which is powered by a battery carried in the housing.

17. A cyclone dust extractor substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

Fig. 1

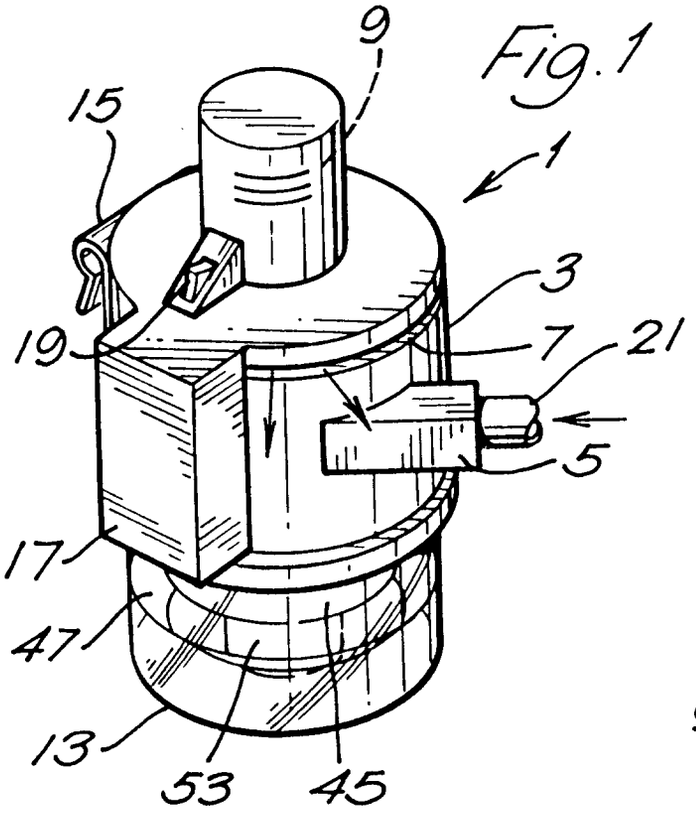
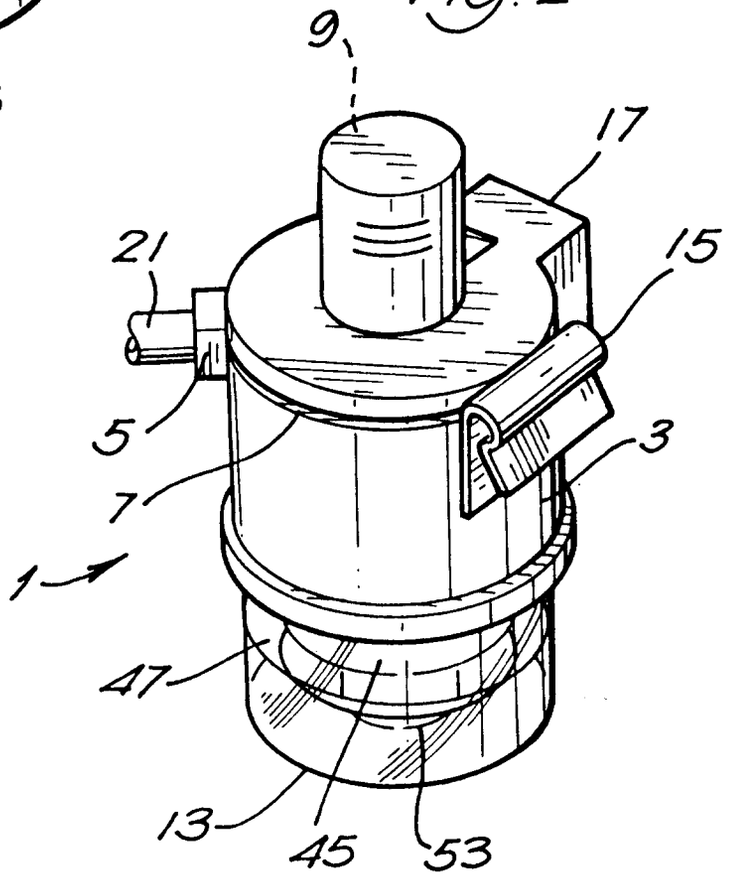


Fig. 2



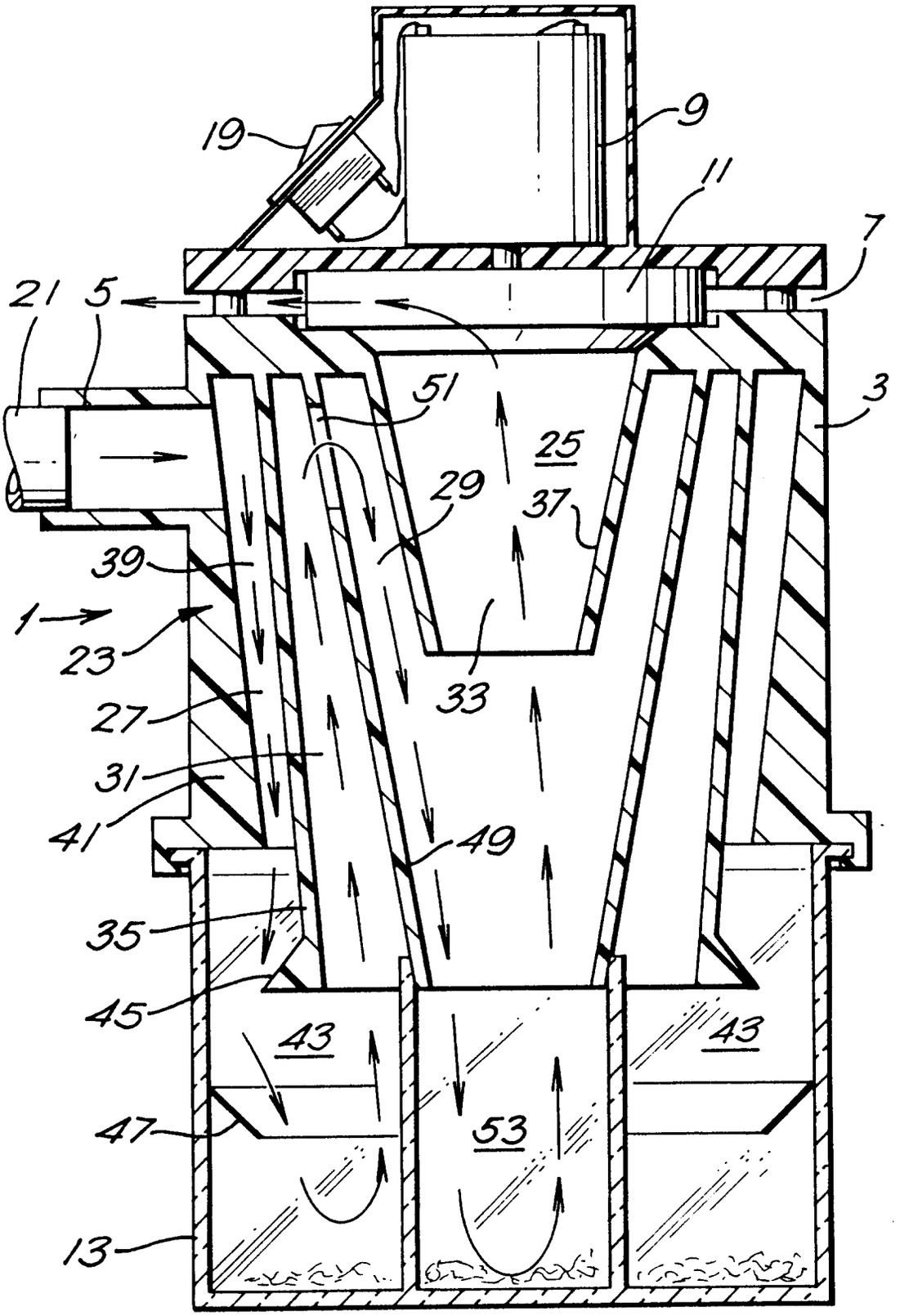


Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 1131

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US-A-5 090 976 (J. DYSON) * column 3, line 27 - column 5, line 13; figures *	1	A47L9/16
A	US-A-5 062 870 (J. DYSON) * column 4, line 19 - column 7, line 39; figures *	1	
A	US-A-4 853 008 (J.DYSON) * column 2, line 50 - column 3, line 65; figures *	1	
A	US-A-4 643 748 (J.DYSON) * column 3, line 11 - column 4, line 26; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 May 1996	Vanmol, M

CATEGORY OF CITED DOCUMENTS

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