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(54) Title: METHODS, DEVICE AND VALVE FOR CLEANING A SEPARATOR FILTER

(57) Abstract: A method of cleaning a filter in a separator device for separating particles contained in an air stream is disclosed, the separator device comprising a vacuum source arranged to normally draw air through the filter, the method comprising simultaneously putting output air from the vacuum source in communication with a clean side of the filter and with the surrounding environment. Also disclosed is a separator device for separating particles contained in an air stream, an electromagnetic valve for use in a separator device, as well as a method of controlling a valve arranged to provide a reverse airflow through a filter in a separator device for separating dust/debris from an air stream.



WO 2009/041890 A2

METHODS, DEVICE AND VALVE FOR CLEANING A SEPARATOR FILTERTechnical field

The present document relates to a method of cleaning a filter in a separator device e.g. of the type described in WO2005/118111A1. The present document is further concerned with a separator device comprising, as
5 well as with an electromagnetic valve for use in such a separator device, and a method for controlling the valve.

The methods and devices described herein are particularly suitable for separators arranged to separate particles, such as dust/debris resulting from cutting, grinding and/or polishing of stone or stone-like materials.
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Background

During abrasive processes, such as for example grinding and/or polishing of hard floor surfaces, considerable amounts of residual particles are generated. For process efficiency as well as for health reasons, these
15 particles need to be efficiently removed.

An arrangement for the collection of abrasive material is known from WO2005/118111A1.

This document discloses a device for collecting particles, wherein a particle containing airflow is passed through several separation units in the form of, in turn, a cyclone separator, a coarse filter, and a micro filter unit.
20

The separation units are arranged in a common casing, and the air stream is passed through the device by means of a vacuum arrangement, wherein the suction side of a fan brings particle-laden air through an inlet at the top of the cyclone separator.

25 The function of such separator devices is well known in the art; when the air stream circulates down inside the cone shaped side wall of the cyclone, particles are deposited as the air speed is reduced. The air flow then raises upwards again along the axis of the cyclone, where after, to further reduce the number of particles, it is passed through a coarse filter arranged above the cyclone separator. Finally, the air flow is passed through a micro
30 filter arranged to collect smaller particles still present in the air stream.

It is necessary to clean especially the coarse filter regularly to prevent it from blocking and/or becoming inefficient. A known way to do remove

particles from the coarse filter, is by blocking the inlet to the separator device whereupon atmospheric air is allowed to rush backwards through the system, thus shaking the filter in order to dedust it.

In the above mentioned document, this is done by blocking the inlet to the cyclone separator, followed by simultaneous blocking of a valve arranged in the air passageway leading from the clean side of the coarse filter unit to the micro filter, and opening of an inlet for atmospheric air, situated between the valve and the clean side of the coarse filter, whereupon atmospheric air rushes in toward the clean side of the coarse filter and dislodges particles that have collected on the opposite side of it.

DE10101219A1 discloses a filter cleaning method, wherein output air from the vacuum source is put in direct communication with a clean side of the filter and with the surrounding environment. However, in some applications, this type of filter cleaning is not powerful enough to properly clean the filter.

Hence, there is a need for improved and/or alternative ways of cleaning the filter.

Summary

In view of the above, an objective of the present document is to provide an improved, or at least alternative, solution for cleaning a filter in a separator device for separating particles contained in an air stream.

According to a first aspect of the present solution, there is provided a method of cleaning a filter in a separator device for separating particles contained in an air stream, the separator device comprising a vacuum source arranged to normally draw air through the filter, the method comprising

simultaneously putting output air from the vacuum source in communication with a clean side of the filter and with the surrounding environment. The vacuum source output air is directed to a buffer compartment which is put in communication with the clean side of the filter.

By "normally" is meant during normal operation of the separator device, that is, when particle-laden air is drawn through the separator device to separate particles contained in the air stream.

By "simultaneously putting in communication with" is understood arranging that the outlet air may flow from the vacuum source outlet to the clean side of the filter as well as through a passageway leading to the surrounding environment.

The outlet air hitting the clean side of the filter shakes it, and thus causes particles stuck on the opposite, "dirty" side of the filter to dislodge.

This solution is advantageous in that it benefits from the overpressure that builds up in the vacuum source outlet, and thus results in a more
5 vigorous shaking of the filter compared to for example a solution, whereby the filter is shaken by letting surrounding environment stream towards it.

Moreover, since the air passageway leading the surrounding environment remains open, the solution is advantageous in that no additional valve is needed for blockage of such a passageway.

10 By directing the output air to a buffer compartment, which is arranged between the output side of the vacuum source and the clean side of the filter, a greater amount of overpressurised air may be built up, thus adding to the force with which the output air hits the filter when they are put in communication.

15 The size of the buffer compartment may be selected with due consideration to the amount of compressed air needed to effectively clean the filter.

The method may comprise putting output air in connection with the filter via a valve.

20 This provides a convenient way of controlling the connection between the output air and the filter by opening/closing of the valve.

The valve may be an electromagnetic valve.

This provides ways of controlling the valve, by for example a control device connected to a vacuum source comprising an engine.

25 The method may comprise blocking an air intake of the separator device in order to build up an underpressure on the dirty side of the filter.

By "underpressure" is understood negative pressure, that is pressure below atmospheric pressure.

30 By "dirty" is understood the side of the filter which is on the inlet side for the particle-containing air stream during normal operation of the separator device. It is on this side of the filter that particles collect when separated from the air stream as it passes the filter.

The underpressure helps causing a more severe shaking of the filter, and thus a more thorough cleaning of it, since more particles may be
35 dislodged.

The valve may automatically be opened at a predetermined level of underpressure.

This provides a convenient solution for controlling the valve.

The valve may be opened only when the speed of an engine of the vacuum source has reached a predetermined value.

By "speed of an engine" is understood revolutions per time unit.

5 The valve may during a start-up phase be closed regardless of the underpressure, and, during normal operation of the separator device, the valve may be opened at a predetermined level of underpressure.

The method may comprise setting of a timing control in a control device to clean the filter at a predetermined time interval.

10 Such, the cleaning of the filter may be repeated at suitable intervals, e.g. every 30, 60 or 120 seconds. By setting the timing control in such a way that the air intake is blocked in connection with some of the cleaning runs for example, a more thorough cleaning of the filter may be performed at longer intervals, and a lighter cleaning may be performed more often. This may
15 provide an efficient overall filter cleaning procedure.

According to a second aspect of the present solution, there is provided a separator device for separating particles contained in an air stream, comprising a vacuum source, a filter, and a passageway for leading output air from the vacuum source to the surrounding environment, comprising an outlet
20 branch from the vacuum source for simultaneously putting output air from the vacuum source in communication with a clean side of the filter and with the surrounding environment. The branch comprises a buffer compartment arranged to be put in communication with the clean side of the filter.

By "simultaneously put in communication with" is understood an
25 arrangement such that the output air from the vacuum source may flow from the vacuum source outlet to the clean side of the filter, as well as to the surrounding environment. This does not exclude the possibility that the output air is constantly in communication with the surrounding environment, and that only a branch leading back towards the filter is opened when cleaning of the
30 filter is to be performed. The buffer compartment may increase the over pressure that builds up in the branch and thus improve the shaking of the filter during cleaning.

The separator device may comprise a cyclone separator.

35 The outlet branch may comprise a valve for putting the output air in communication with the clean side of the filter.

The separator device may comprise means for blocking an air inlet of the separator device, in order to build up an underpressure.

This may be for example a valve or a sliding valve.

5 The valve may be arranged to automatically open when the underpressure reaches a predetermined level.

The valve may be electromagnetic.

The separator device may comprise a converter for opening and closing of the valve, in the form of a control device providing a control signal to the valve.

10 The valve may be openable only when the speed of an engine of the vacuum source reaches a predetermined value.

This may provide a convenient way of controlling the valve.

The control device may be arranged to open the valve at a predetermined time interval.

15 According to a third aspect of the present solution, there is provided an electromagnetic valve for use in a separator device, comprising a valve body in the form of a disc arranged to rest against a valve seat.

The valve body may comprise sealing material.

The valve seat may be a grid.

20 By "grid" is understood any suitable grid known in the art such as for example a net, netting, trellis, or wire net.

The electromagnetic valve may comprise a tension spring for prestressing the valve body against the valve seat.

25 A spring mounted buffer may be arranged to catch the valve body when it dislodges from the valve seat due to the under pressure.

The electromagnetic valve may comprise an electromagnet holding the valve in a closed position.

According to a fourth aspect of the present solution there is provided a method of controlling a valve arranged to provide a reverse airflow through a filter in a separator device for separating dust/debris from an air stream, the method comprising providing control signals to a valve actuator, wherein a first control signal is provided during a normal operation phase of the separator device, said first control signal causing the valve to remain closed as long as it is subjected to a predetermined level of underpressure, and to open if said predetermined level of underpressure is exceeded, and wherein a second control signal is provided during a start-up phase of the separator

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device, said second control signal causing the valve to remain closed also when said predetermined level of underpressure is exceeded.

The valve actuator may comprise an electromagnet and said first and second control signals may be provided as different potentials applied to said
5 electromagnet. According to a fifth aspect of the present solution there is provided a method of controlling a valve arranged to provide a reverse airflow through a filter in a separator device for separating dust/debris from an air stream, the method comprising: opening the valve so that said reverse airflow is obtained from an outlet side of a vacuum source arranged to create said
10 stream of air, while said outlet side of the vacuum source is maintained in communication with the environment of the separator device.

Brief description of the drawings

The above, as well as additional objects, features and advantages of
15 the present solution, will be better understood through the following illustrative and non-limiting detailed description of embodiments of the present solution, with reference to the appended drawing, wherein:

Fig. 1 is a schematic sectional view of a separator device according to the present solution.

20 Fig. 2 is a schematic sectional side view of an electromagnetic valve according to the present solution.

Fig. 3 is a schematic perspective view of a detail of the valve shown in fig. 2.

25 Fig. 4 is a schematic perspective view of another detail of the valve shown in fig. 2.

Detailed description of embodiments

Fig. 1 shows a schematic sectional side view of a separator device 1 according to the present solution, comprising an air inlet 6 for particle-laden
30 air, leading to a cyclone separator 10 arranged for primary separation of particles in the air stream in known ways, and to a "dirty" side of a filter 2, which may be a coarse filter. From the opposite, "clean", side of the filter 2, there is an air passageway 11 leading to a second filter 12 in the form of a micro filter, on the clean side of which there is arranged a vacuum source 3,
35 arranged to draw the particle-laden air through the cyclone separator 10 and the filters 2, 12, during normal operation of the separator device 1. The vacuum source has an outlet 8 for output air that has passed through the

separator device 1. Also comprised in the separator device 1 is a branch 9 of the outlet 8, leading to a buffer compartment 4, and another branch leading to the surrounding environment. Between the buffer compartment 4 and the clean side of the filter 2, there is a valve 5. The valve 5 is controlled by a control device 7, connected to, inter alia, the vacuum source 3 and the valve 5.

During normal operation of the separator device 1, a particle-laden air stream is drawn, by means of the vacuum source 3, through the inlet 6 of the separator device 1. Particles are separated in, in turn, the cyclone separator 10, the filter 2 and the micro filter 12 in a known way, whereafter the cleaned output air stream is released through the outlet 8 and into the surrounding environment. During this operation of the separator device 1, an over pressure is built up in the outlet branch 9 and the buffer compartment 4, and the valve 5 is in its closed position.

According to the present solution, the filter 2 may be cleaned by opening the valve 5. This will allow output air from the vacuum source 3 to flow towards the clean side of the filter 2 while the air passageway to the surrounding environment remains open. As this reverse air flow takes the form of a burst of air, it shakes the filter 2, such that at least some of the particles that have collected on the opposite, dirty, side of the filter 2 will dislodge from the filter 2 and fall by gravity to the bottom of the separator, whereafter they may be collected in e.g. a (not shown) collecting bag arranged for example at the bottom of the separator device 1.

Due to the overpressure built up in the branch 9 and the compartment 4, which adds to the force of the shaking of the filter, and to the fact that the outlet 8 leading to the surrounding environment is kept open, and no additional valve is needed in this outlet, this cleaning method provides an efficient way of dislodging particles that has collected on the filter 2, without rendering the separator complex.

A more thorough cleaning of the filter may be performed by also blocking the inlet 6 before the valve 5 is opened. This causes an underpressure to build up inside the separator device 1, such that the burst of air shaking of the filter 2 brought on by the opening of the valve 5 becomes more powerful, which may cause more particles to dislodge.

Blocking the inlet 6 may be done by hand (e.g. by blocking the suction nozzle or a valve, or automatically, for example by means of a sliding valve or any other suitable valve or method known in the art.

The cleaning of the filter 2 may be controlled by the control device 7, in such a way that it is performed at suitable intervals of time. For example, the “lighter” cleaning may be performed at shorter intervals than the more “thorough” cleaning comprising blocking the inlet 6 of the separator device 1 as described above. The control of the cleaning of the filter 2 may be performed by setting a timing control in the control device 7.

The valve 5 may be an electromagnetic valve. The control device 7 may then use for example the speed of an engine of the vacuum source as an input parameter for controlling the valve. For example, the valve may be arranged to be opened only when a predetermined number of revolutions per time unit is achieved by the engine.

Moreover, the valve may be arranged to be automatically opened at a certain level of underpressure, which will automatically open the valve 5 during the more thorough cleaning procedure comprising blocking of the inlet 6.

The control of the valve 5 may comprise providing control signals to a valve actuator, which may have the form of an electromagnet, wherein a first control signal is provided during a normal operation phase of the separator device 1, which control signal causes the valve 5 to remain closed as long as it is subjected to a predetermined level of underpressure, and to open if the predetermined level of underpressure is exceeded (i.e. there is a stronger under pressure), and wherein a second control signal is provided during a start-up phase of the separator device 1, the second control signal causing the valve 5 to remain closed also when said predetermined level of underpressure is exceeded.

Fig. 2 shows, in a schematic, sectional side view, a valve 5 which may be arranged in a separator device 1 and used in a method for cleaning a filter 2 according to the present solution.

The valve 5 comprises a valve body 51 in the form of a disc arranged to rest on a valve seat 52 in the form of a grid. 23.

The valve 5 further comprises tension springs 53 for prestressing the valve body 51 against the valve seat 52, and spring mounted buffers 54 are arranged to catch the valve body 51 when it dislodges from the valve seat 5.

Also comprised in the valve 5 is an electromagnet 55 holding the valve 5 in a closed position. Thus, the disk may be of a magnetic material, such that the electromagnet may interact directly with it.

The first and second control signals mentioned above may be provided as different potentials applied to the electromagnet 55, thus providing different forces retaining the disc against the valve seat.

5 The disc may comprise sealing material for sealing against the valve seat.

 The spring buffers 53 may be any suitable resilient element known in the art.

10 In the illustrated embodiment, the valve 5 is arranged such that the disk is movable in the compartment 4, away from the valve seat. The electromagnet is thus arranged to draw the disk with a predetermined force towards the valve seat.

15 The solution has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

CLAIMS

1. A method of cleaning a filter (2) in a separator device (1) for separating particles contained in an air stream, the separator device comprising a vacuum source (3) arranged to normally draw air through the filter, the method comprising:
simultaneously putting output air from the vacuum source (3) in communication with a clean side of the filter (2) and with the surrounding environment;
wherein the vacuum source (3) output air is directed to a buffer compartment (4), which is put in communication with the clean side of the filter (3).
2. The method as claimed in claim 1, wherein the output air is put in connection with the filter (2) via a valve (5).
3. The method as claimed in claim 2, wherein the valve (5) is an electromagnetic valve.
4. The method as claimed in any one of the preceding claims, comprising blocking an air intake (6) of the separator device (1) in order to build up an underpressure on the dirty side of the filter.
5. The method as claimed in claim 4, wherein the valve (5) is automatically opened at a predetermined level of underpressure.
6. The method as claimed in claim 5, wherein the valve (5) is opened only when the speed of an engine in the vacuum source (3) has reached a predetermined value.
7. The method as claimed in claim 6, wherein the valve (5) during a start-up phase is closed regardless of the underpressure, and wherein, during normal operation of the separator device (1), the valve (5) is opened at a predetermined level of underpressure.

8. The method as claimed in any of the preceding claims, comprising setting of a timing control in a control device (7) to clean the filter at a predetermined time interval.

5 9. A separator device (1) for separating particles contained in an air stream, comprising a vacuum source (3), a filter (2), and a passageway(8) for leading output air from the vacuum source (3) to the surrounding environment, wherein an outlet branch (9) from the vacuum source (3) is provided for simultaneously putting output air from the vacuum source (3) in
10 communication with a clean side of the filter (2) and with the surrounding environment, and wherein

 said branch (9) comprises a buffer compartment (4) arranged to be put in communication with the clean side of the filter (2).

15 10. The separator device (1) as claimed in claim 9, further comprising a cyclone separator (10).

 11. The separator device (1) as claimed in any one of claims 9 -10, wherein the outlet branch (9) comprises a valve (5) for putting the output air in
20 communication with the clean side of the filter (2).

 12. The separator device (1) as claimed in any one of claims 9-11, comprising means for blocking an air inlet (6) of the separator device, in order to build up an underpressure.

25 13. The separator device (1) as claimed in claim 11 and 12, wherein the valve (5) is arranged to automatically open when the underpressure reaches a predetermined level.

30 14. The separator device (1) as claimed in any one of claim 11-13, wherein the valve (5) is electromagnetic.

 15. The separator device (1) as claimed in claim14, comprising a converter for opening and closing of the valve, in the form of a control device
35 (7) providing a control signal to the valve.

16. The separator device (1) as claimed in claim 15, wherein the valve (5) is openable only when the speed of an engine of the vacuum source (3) reaches a predetermined value.

5 17. The separator device (1) as claimed in any of one of claims 15 and 16, wherein the control device (7) is arranged to open the valve at a predetermined time interval.

10 18. An electromagnetic valve (5) for use in a separator device (1) as claimed in any one of claims 10-17, comprising a valve body (51) in the form of a disc arranged to rest against a valve seat (52).

15 19. The electromagnetic valve (5) as claimed in claim 18, wherein the valve body (51) comprises sealing material.

20 20. The electromagnetic valve (5) as claimed in any one of claims 18 and 19, wherein the valve seat (52) is a grid.

20 21. The electromagnetic valve (5) as claimed in claim any one of claims 18-20, comprising a tension spring (53) for prestressing the valve body (51) against the valve seat (52).

25 22. The electromagnetic valve (5) as claimed in any one of claims 18-21, wherein a spring mounted buffer (54) is arranged to catch the valve body (51) when it dislodges from the valve seat (52) due to the under pressure.

30 23. The electromagnetic valve (5) as claimed in any one of claims 18-22, comprising an electromagnet (55) holding the valve (5) in a closed position.

35 24. A method of controlling a valve (5) arranged to provide a reverse airflow through a filter (2) in a separator device (1) for separating dust/debris from an air stream, the method comprising

 providing control signals to a valve actuator,

 wherein a first control signal is provided during a normal operation phase of the separator device (1), said first control signal causing the valve (5) to remain closed as long as it is subjected to a predetermined level of

underpressure, and to open if said predetermined level of underpressure is exceeded, and

wherein a second control signal is provided during a start-up phase of the separator device (1), said second control signal causing the valve (5) to remain closed also when said predetermined level of underpressure is exceeded.

25. The method as claimed in claim 24, wherein the valve actuator comprises an electromagnet (55) and said first and second control signals are provided as different potentials applied to said electromagnet (55).

26. A method of controlling a valve (5) arranged to provide a reverse airflow through a filter (2) in a separator device (1) for separating dust/debris from an air stream, the method comprising:

opening the valve (5) so that said reverse airflow is obtained from an outlet side of a vacuum source (3) arranged to create said stream of air, while said outlet side of the vacuum source (3) is maintained in communication with the environment of the separator device (1).

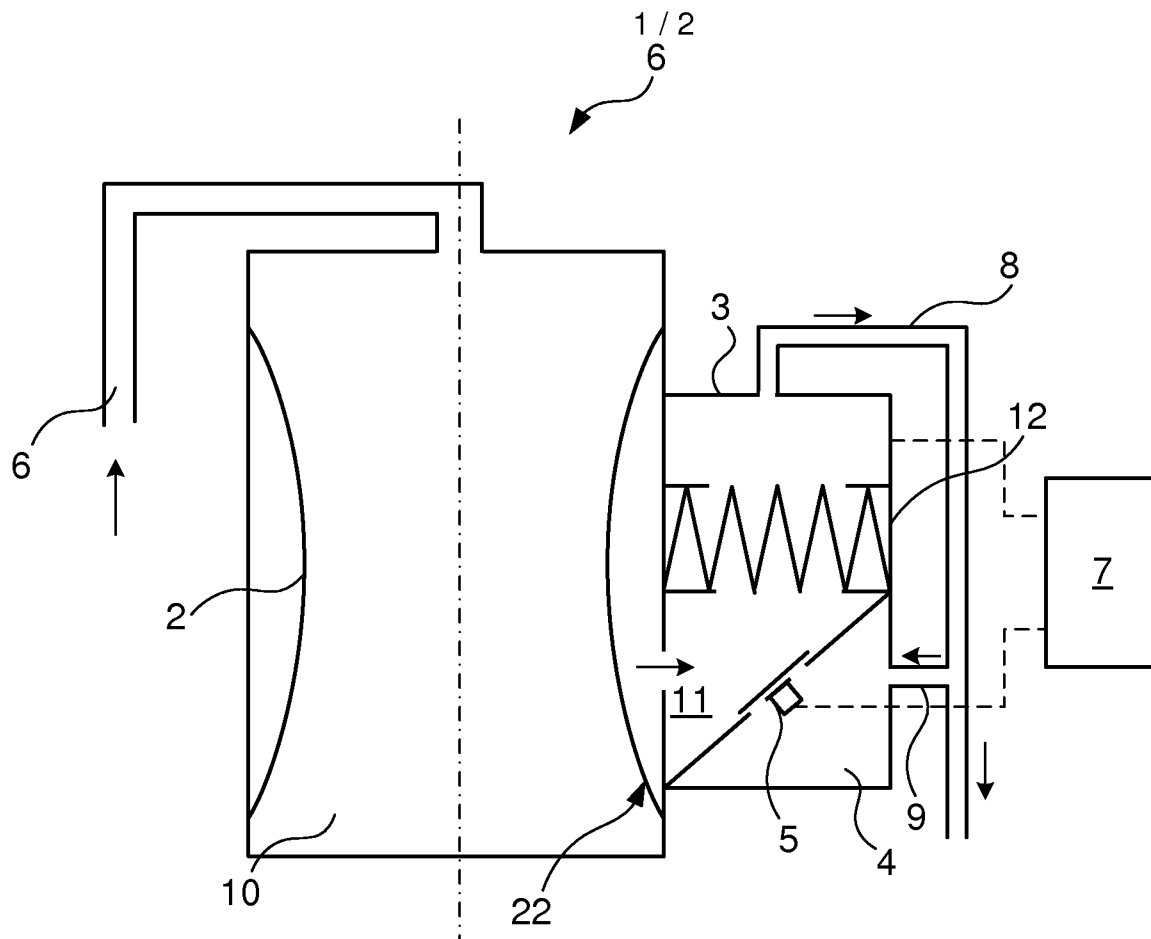


Fig. 1

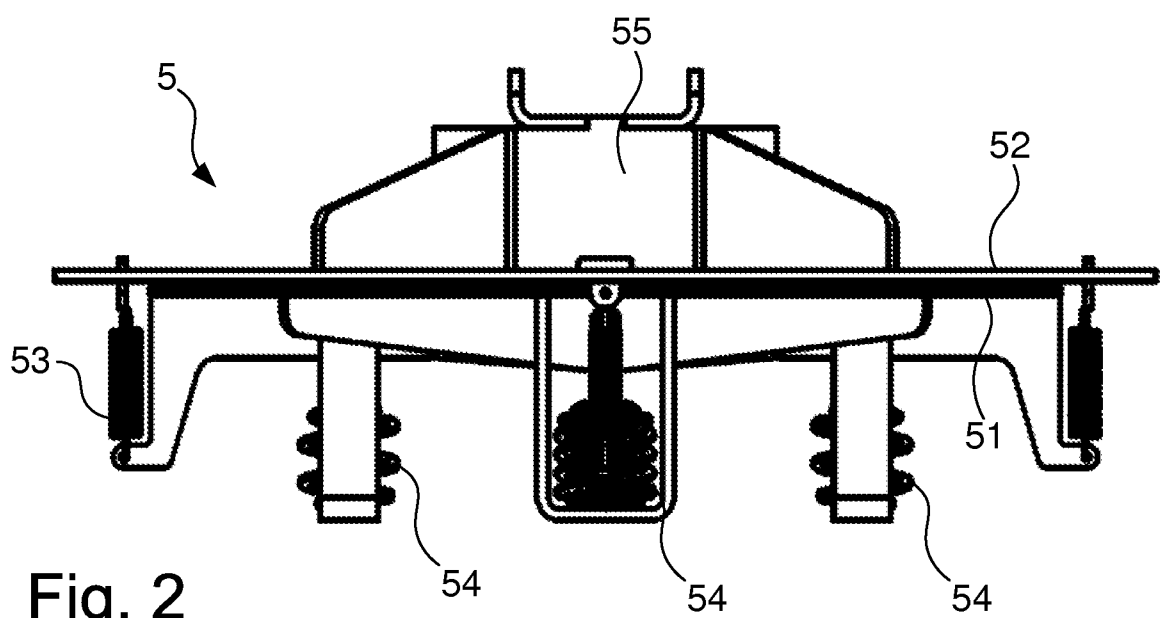


Fig. 2

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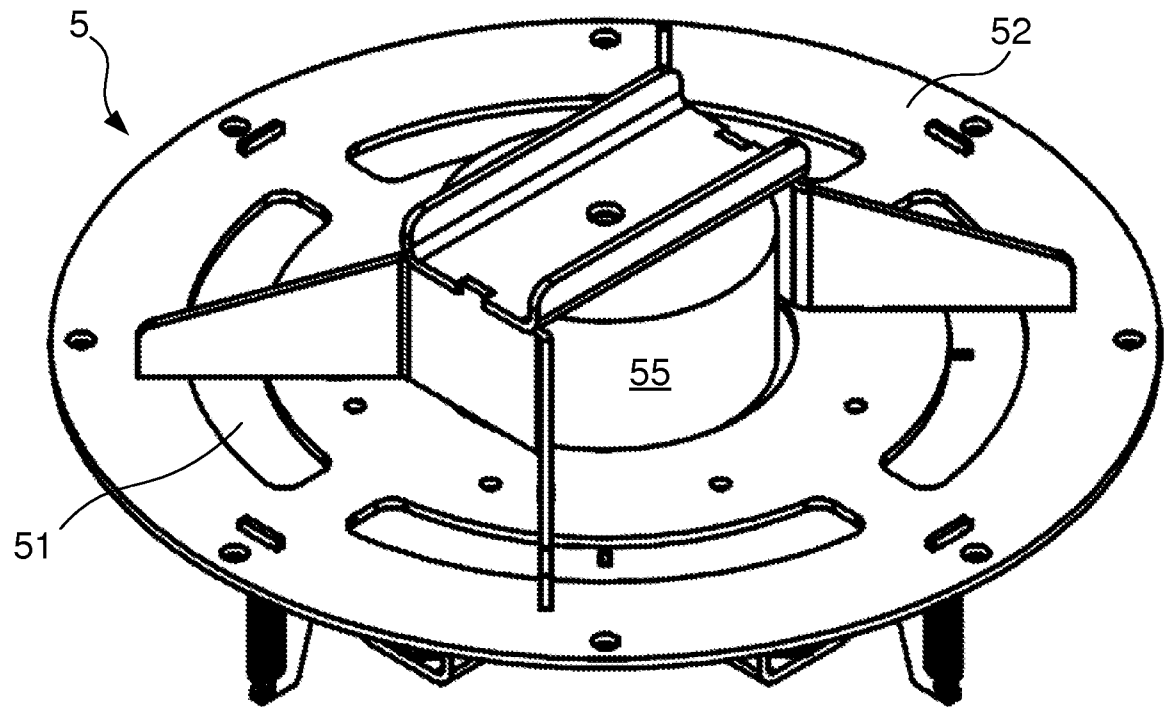


Fig. 3

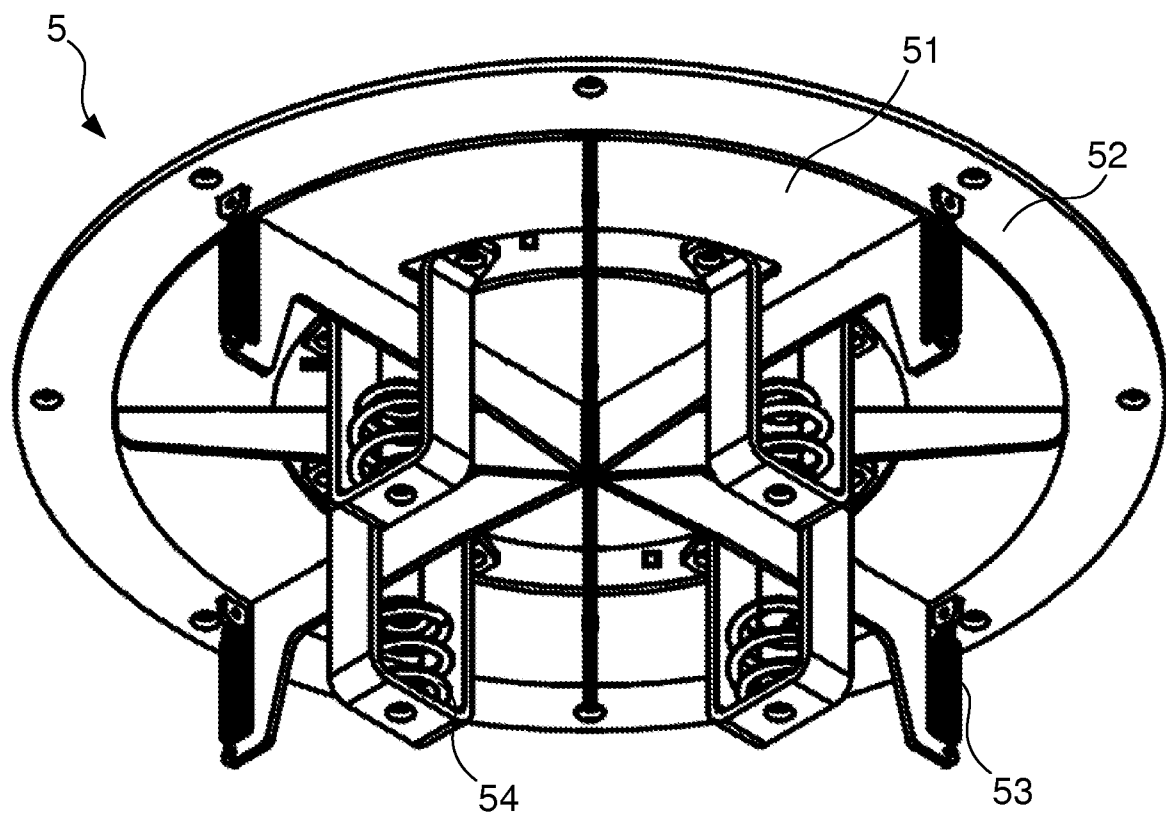


Fig. 4