

DESCRIPTION

Title: Particle collecting system

5 Field of the disclosure

The invention relates to a particle collecting system that is intended to be provided in braking means.

10 Prior art

Document FR 3 116 001 discloses a particle collecting system provided in a friction braking device.

The friction braking device comprises a disk rotating about a shaft and pads
15 which are intended to clamp and brake the disk by means of friction. During the braking phase, the abrasion of the pads causes particles to be emitted, which need to be filtered and collected.

To do this, the collecting system comprises a suction pipe provided with a filter and with a fan which is located downstream of the filter, said pipe being connected to
20 the braking device. Air and particles are thus sucked in through the pipe, the air being filtered by the filter such that the particles are collected on the surface of the filter.

The collecting system further comprises vibration generation means associated with the filter, and a collection tray located below the filter.

In this way, it is possible to remove the layer of particles that have accumulated
25 on the surface of the filter by vibrating the filter, with the particles that are detached from the filter being collected in the collection tray, under the action of gravity.

An operation of this kind for unclogging or cleaning the filter increases the lifetime of said filter and increases the volume of air and particles that can be filtered again.

30 However, such vibration generation means may be relatively expensive and complex to implement.

Presentation of the disclosure

In order to overcome the aforementioned problems, the present document proposes a system for collecting particles that is intended to be provided in braking means, comprising at least one suction pipe for sucking in particles, a collection chamber into which the suction pipe opens, said collection chamber being provided with at least a first filter and with at least a second filter, each capable of filtering the particles coming from the suction pipe and opening into the chamber, at least a first and a second device for generating a flow of air, which devices are capable of generating:

- at least one flow of air from the interior of the chamber toward the exterior of the chamber, through the first filter and/or the second filter, respectively, in a collecting operating mode, and/or
- at least one flow of air from the exterior of the chamber toward the interior of the chamber, through the first filter or the second filter, respectively, in an unclogging operating mode.

The system is configured so that each device for generating a flow of air is controlled independently of each other device for generating a flow of air. Thus, it is possible to use the system in a more versatile way and optimum suction is ensured at all times, with it being possible to unclog each of the filters in an appropriate manner (for example without requiring unclogging of another filter that might not need unclogging).

In a particle collecting phase, it is possible to generate a flow of air from the chamber toward the exterior of the chamber, through the first filter and/or the second filter. The particles are thus collected on the first filter and/or on the second filter.

In order to avoid a drop in suction and collecting performance, the collecting system also allows efficient unclogging of each of the filters. To do this, a flow of air is generated from the exterior of the chamber toward the interior of the chamber, through at least one of the filters, such that the particles accumulated on the surface of the filter become unstuck from the corresponding filter and fall back into the chamber.

The first filter and the second filter may be formed by a single filtering part or structure. In such a case, the first filter may be formed by a first zone of said filtering structure and the second filter may be formed by a second zone of said filtering structure.

The first and second devices for generating a flow of air may be situated, respectively, downstream of the first filter and the second filter with respect to the collection chamber.

5 The terms “upstream” and “downstream” are defined with respect to the direction of circulation of the flow of air in the collecting operating mode.

In other words, each device for generating a flow of air may be arranged between the corresponding filter and the external environment.

At least one of the devices for generating a flow of air may be a fan.

The first and second devices for generating a flow of air may each be a fan.

10 The control means may be capable of varying the speed of each fan independently. This variation may be gradual, for example continuous, from a zero rotation speed to a maximum rotation speed.

The system may comprise a collection tray capable of collecting the particles coming from the first and second filters in the unclogging operating mode.

15 The collection tray may be situated below the collection chamber. The chamber may thus comprise an opening in the lower part, opening into the collection tray. Sealing means may be provided between said opening of the chamber and the collection tray.

20 The system may comprise means for estimating the pressure drops and/or the degree of clogging of the first filter and/or the second filter.

Such means allow a precise estimation of the need to unclog one and/or the other of the filters.

As a variant, the unclogging modes may be triggered after a certain operating period.

25 Said means for estimating the pressure drops and/or the degree of clogging may comprise at least one upstream pressure sensor and at least one downstream pressure sensor for at least one of said filters.

30 As a variant, said downstream and downstream pressure sensors may be replaced by at least one differential pressure sensor capable of measuring a difference in pressure between the upstream and downstream sides of at least one of said filters.

The terms “upstream” and “downstream” are defined with respect to the direction of circulation of the flow of air in the collecting or filtering phase. Thus, the

upstream side of the filter faces toward the collection chamber and the downstream side of the filter faces toward the external environment.

It is thus possible to calculate a difference in pressure between the upstream side and the downstream side of a filter in order to estimate the degree of clogging of the filter. Indeed, the more the filter is clogged, the more significant the pressure difference.

A first discharge pipe opening into the chamber may extend downstream of the first filter, with a second discharge pipe opening into the chamber extending downstream of the second filter.

The downstream end of the first discharge pipe and the downstream end of the second discharge pipe may be connected to one another.

Said downstream ends may be capable of opening into an external environment or of being isolated from said external environment, for example by means of a solenoid valve.

The suction pipe for sucking in the particles may comprise at least one solenoid valve or non-return valve.

The solenoid valve may be closed during the unclogging operating mode and may be open during the collecting operating mode.

Such a solenoid valve is not obligatory. It will be noted that, in the absence of a solenoid valve, the suction pipe may be dimensioned so as to generate more significant pressure drops than the filters.

Such a particle collecting system may be intended to be provided in a friction braking device and may be provided in a vehicle, for example a road or rail vehicle, or a stationary rotor machine, such as a wind turbine or an industrial machine.

The suction pipe may comprise a first end connected to a friction braking device and a second end opening into the collection chamber.

The friction braking device may comprise at least one disk capable of pivoting about a shaft and braking means comprising at least one brake pad, capable of bearing on the disk so as to brake its rotation by means of friction.

At least one filter may be a surface filter, that is to say a filter that clogs preferably, or even only, in its outermost layer, in particular the outer layer situated on

the collection chamber side. Said filter may comprise a surface layer of cellulose nanofibers or of PTFE (polytetrafluoroethylene).

The present document also relates to a method for operating a system for collecting particles according to one of the preceding claims, comprising:

- 5 - at least one collecting phase in which at least one flow of air is generated by at least one of the devices for generating a flow of air, from the chamber toward the external environment, through the first filter and/or the second filter, and
- at least one unclogging phase in which at least one flow of air is generated by at least one of the devices for generating a flow of air, from the external
10 environment toward the chamber, through respectively the first filter or the second filter, in an unclogging operating mode.

If there is at least a first fan situated downstream of the first filter and at least a second fan situated downstream of the first filter, then:

- in the collecting phase, the first fan and the second fan may be started
15 so as to discharge the air coming from the collection chamber toward the exterior, through the first filter and/or the second filter. The particles are then collected by the corresponding filter or filters;
- in the unclogging phase, only one of the fans may be started, for example the first fan, such that the air is sucked into the collection chamber through
20 the second filter in such a manner that the particles are detached from the second filter and fall under the effect of gravity into the bottom of the collection chamber. It is then possible to unclog the first filter, by starting only the second fan, for example.

It will be noted that it is possible to carry out the unclogging phase by having both fans started, as long as one of the fans generates a greater negative pressure
25 than the other fan, for example.

In such a case, the air comprising the particles and present in the collection chamber is not at risk of emerging through the suction pipe, since a negative pressure is generated in the collection chamber during the unclogging phase.

The unclogging phase may have a duration of between 5 seconds and 1 minute,
30 for example, for each filter.

The duration of the unclogging phase may be shortened if the degree of unclogging of the filter has been reached.

The collecting phase may be performed in particular in the event of braking of the braking device.

The unclogging phase may be performed in particular when the disk of the braking device has stopped rotating.

5 When the vehicle is at a standstill, with the pads clamping onto the disk, the pneumatic resistance of the suction pipe increases.

This is advantageous since the flow rate of air sucked in through the suction pipe decreases while the flow rate of air sucked in through the filter that is to be unclogged increases.

10 Conversely, when the pads are unclamped from the disk, the pneumatic resistance of the suction pipe decreases.

This tends to increase the flow rate of air sucked in through the suction pipe. This higher flow rate of the air makes it possible to clean the pneumatic pipes by extracting a greater thickness of the dust deposited on the surface of the pipes.

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Brief description of the figures

Other features and advantages of the present disclosure will become apparent in the following detailed description, with reference to the appended drawings, in which:

20 [Fig. 1] is a schematic view of a particle collecting system according to the present document, provided in a braking device, said view illustrating in particular a particle collecting phase,

[Fig. 2] is a view corresponding to figure 1, illustrating an unclogging phase of a first filter of the collecting system,

25 [Fig. 3] is a view corresponding to figure 1, illustrating an unclogging phase of a second filter of the collecting system,

[Fig. 4] is a view corresponding to figure 1, illustrating a variant embodiment of the collecting system.

30 Detailed description of the disclosure

Figure 1 shows a particle collecting system 1 intended to be provided in a braking device 2.

The braking device 2 conventionally comprises a disk 3 capable of rotating about a shaft 3a. The disk 3 is coupled in rotation to the wheel of a vehicle or to the rotor of a machine, for example. The braking device 2 further comprises two brake pads 4 arranged on either side of the disk 3, capable of clamping the disk 3 so as to brake same and/or so as to prevent same from rotating, and capable of releasing the disk 3. Each pad 4 may comprise a sole and a lining.

In operation, during a phase of braking the disk 3, the abrasion of the linings of the pads 4 causes particles to be emitted that need to be filtered and collected.

To do this, the collecting system 1 comprises a suction pipe 5 comprising a first end 6 connected to the braking device 2, and a second end 7 opening into a collection chamber 8.

The collection chamber 8 may be open at the lower part and open into a collection tray (not shown since figure 1 is illustrated in plan view). It will be noted that in this figure, the disk is illustrated schematically from the side in order to make representation easier.

The collection chamber 8 may also be connected to an external environment 9, through respectively a first filter 10 and a first discharge pipe 11, and through a second filter 12 and a second discharge pipe 13.

The first discharge pipe 11 may be provided with a first fan 14. The second discharge pipe 13 may be provided with a second fan 15.

The collecting system 1 further comprises means for controlling the fans 14, 15, which means are capable of independently controlling the starting and stopping and the rotation speeds of each of the fans 14, 15, and thus the flow rate of air and/or the negative pressure in each of the first and second discharge pipes 11, 13. The control means may be software and/or hardware (intensity variator, switch, program, programmable automaton, etc.). They may be connected to a central controller of a vehicle. They are configured to control each fan independently.

Each filter 10, 12 may be a surface filter, that is to say a filter that clogs preferably, or even only, in its outermost layer (outer layer situated toward the center or internal volume of the collection chamber into which the suction pipe 5 opens). These are filters comprising for example a surface layer of cellulose nanofibers or of PTFE (polytetrafluoroethylene).

Figure 1 illustrates a collecting operating mode of the system. In this mode, at least one fan 14, 15, for example the two fans 14, 15, are started so as to create a negative pressure downstream of the filter or filters 10, 12 in question, so as to create a suction flow of air and of particles 16, through, successively, the suction pipe 5 of the collection chamber 8 and the discharge pipe or pipes 11, 13. During such an operating mode, the particles 16 are retained by the corresponding filter or filters 10, 12, for example on the external surface of said filter or filters 10, 12, situated on the collection chamber 8 side, that is to say opposite the pipes 11, 13.

Such an operating mode may be used in a braking phase of the braking device 2, for example.

Figure 2 illustrates a mode for unclogging the first filter 10. In this operating mode, the first fan 14 may be stopped while the second fan 15 generates a negative pressure, such that air circulates through the first pipe 11, the first filter 10, the collection chamber 8, the second filter 12 and the second pipe 13 successively.

It will be noted that the diameter of the suction pipe 5 is relatively small such that the pneumatic resistance of the suction pipe 5 is greater than the combined pneumatic resistance of the first filter 10, the stopped fan 14 and the first pipe 11. Air is therefore preferably sucked into the chamber 8 through the first pipe 11, even though a low flow rate of air can be sucked in through the suction pipe 5.

The air passing through the first filter 10 allows the particles 16 to be separated from the upstream external surface of the first filter 10, such that these particles 16 fall back into the chamber 8, then into the collection tray.

The first filter 10 can thus be unclogged.

Figure 3 illustrates a mode for unclogging the second filter 12.

As previously, in this operating mode, the second fan 15 may be stopped while the first fan 14 generates a negative pressure, such that air circulates through the second pipe 13, the second filter 12, the collection chamber 8, the first filter 10 and the first pipe 11 successively.

Here, again, the pneumatic resistance of the suction pipe 5 is greater than the combined pneumatic resistance of the second filter 12, the stopped fan and the second pipe 13. Air is therefore preferably sucked into the chamber 8 through the second pipe, even though a low flow rate of air may be sucked in through the suction pipe 5.

The air passing through the second filter 12 allows the particles 16 to be separated from the upstream external surface of the second filter 12, such that these particles 16 fall back into the chamber 8, then into the collection tray.

The second filter 12 can thus be unclogged.

- 5 Figure 4 illustrates a variant embodiment that differs from the embodiment set forth previously in that the downstream end of the first pipe and the downstream end of the second pipe are connected to one another. A solenoid valve allows a passage between said pipes and the external environment to be blocked or released.

- 10 When the solenoid valve blocks the discharge toward the external environment, the fans operate in a closed circuit. However, the fans used may have a better performance by blowing air rather than by sucking in air, which allows the unclogging pressure to be increased.

CLAIMS

1. A system (1) for collecting particles (16) that is intended to be provided in braking means (2), comprising:
 - 5 – at least one suction pipe (5) for sucking in particles (16);
 - a collection chamber (8) into which the suction pipe (5) opens, said collection chamber (8) being provided with at least a first filter (10) and with at least a second filter (12), each capable of filtering the particles (16) coming from the suction pipe (5) and opening into the chamber (8);
 - 10 – at least a first and a second device (14, 15) for generating a flow of air, which devices are configured to be controlled independently of one another and are capable of generating:
 - 15 ○ at least one flow of air from the interior of the chamber (8) toward the exterior of the chamber (8), through the first filter (10) and/or the second filter (12), respectively, in a collecting operating mode, and/or
 - at least one flow of air from the exterior of the chamber (8) toward the interior of the chamber (8), through the first filter (10) or the second filter (12), respectively, in an unclogging operating mode.
2. The system (1) as claimed in claim 1, wherein the first and second devices (14, 20 15) for generating a flow of air are situated, respectively, downstream of the first filter (10) and the second filter (12) with respect to the collection chamber (8).
3. The system (1) as claimed in either claim 1 or claim 2, wherein at least one of the devices for generating a flow of air is a fan (14, 15).
4. The system (1) as claimed in any of claims 1 to 3, comprising a collection tray 25 capable of collecting the particles (16) coming from the first and second filters (10, 12) in the unclogging operating mode.
5. The system (1) as claimed in any of claims 1 to 4, comprising means for estimating the pressure drops and/or the degree of clogging of the first filter (10) and/or the second filter (12).
- 30 6. The system (1) as claimed in claim 5, wherein said means for estimating the pressure drops and/or the degree of clogging comprise at least one upstream pressure sensor and at least one downstream pressure sensor for at least one of said filters (10, 12).

7. The system (1) as claimed in one of claims 1 to 5, wherein a first discharge pipe (11) opening into the chamber (8) extends downstream of the first filter (10), a second discharge pipe (13) opening into the chamber (8) extends downstream of the second filter (12), the downstream end of the first discharge pipe (11) and the downstream end of the second discharge pipe (13) being connected to one another, said downstream ends being capable of opening into an external environment (9) or of being isolated from said external environment (9).
8. The system (1) as claimed in any of claims 1 to 7, wherein the suction pipe (5) for sucking in the particles (16) comprises at least one solenoid valve.
9. A method for operating a system (1) for collecting particles (16) as claimed in any of claims 1 to 8, comprising:
- at least one collecting phase in which at least one flow of air is generated by at least one of the devices (14, 15) for generating a flow of air, from the chamber (8) toward the external environment (9), through the first filter (10) and/or the second filter (12), and
 - at least one unclogging phase in which at least one flow of air is generated by at least one of the devices (14, 15) for generating a flow of air, from the external environment (9) toward the chamber (8), through the first filter (10) or the second filter (12), respectively, in an unclogging operating mode.