System for suctioning braking particles with negative pressure maintained

Technical field

The invention relates to systems for suctioning braking particles in friction braking systems. Such friction braking systems can be fitted to road or rail vehicles. Such friction braking systems can also be fitted to stationary rotor machines such as wind turbines or industrial machines.

Background and Prior Art

In such systems, as described for example in document DE4240873, a suction turbine and a particle collection filter are provided. The particles from abrasion are thus gradually accumulated in the collection filter.

The reasonable conventional solution is to activate the suction turbine only when friction braking is actually activated, by the driver or by a system of the vehicle or even generally the control system of the machine.

However, the inventors have noticed that the time required to establish the desired negative pressure in the conduit and suction mouth is not negligible and that, as a result, at the very beginning of the braking phase the negative pressure could still be insufficient for capturing the braking particles correctly.

In other words, if the negative-pressure source (the turbine or other equivalent means) is activated at the moment friction braking begins, the negative pressure can sometimes take too long to establish and the capture rate is not optimal. Furthermore, continuous controlling of the turbine is not desirable either, considering the electrical consumption of the turbine motor and the noise generated by the operation of the turbine.

The object of the present invention is to propose an improved solution relating to capture performance at the very beginning of the friction braking phase.

Summary

To this end, in an aspect, a system for suctioning braking particles from a friction braking system is proposed, the suction system comprising:

at least one negative-pressure source, at least one suction mouth connected by a pneumatic circuit to the negative-pressure source, and a control unit,

characterized in that the suction system further comprises closure means arranged on the pneumatic circuit, the closure means being able to isolate from external atmospheric pressure at least a first portion of the pneumatic circuit, the control unit being configured to control the closure means according to a predetermined logic in order to isolate from the external atmospheric pressure the first portion of the pneumatic circuit during certain phases between two actual uses of the negative-pressure source.

The term *"closure means"* is to be understood to mean any suitable means for interrupting the possibility of air traveling in the circuit at a location of interest, namely a

the control of the negative-pressure source (for example the turbine), and the control of the solenoid valves which enable closing the pneumatic circuit in order to maintain a negative pressure therein between two braking sequences.

According to one option, the predetermined negative-pressure setpoint during the suction phase is selected within a range of 20 to 40 millibars below ambient pressure. Advantageously, this is an optimal range for efficiently capturing the braking particles while maintaining a reasonable and inexpensive sizing and moderate dimensions for the elements of the system.

Advantageously, by clever sequencing of the controlling of the solenoid valves, it is possible to maintain a negative-pressure level (DPR2) between two actual braking phases that is at least equal to the setpoint.

In another aspect, the present disclosure also relates to a method for controlling a system for suctioning friction braking particles from a braking system of a vehicle, the suction system comprising at least one negative-pressure source (a turbine or the like), at least one suction mouth, at least one pneumatic circuit (3,30) connecting the suction mouth and the negative-pressure source, closure means comprising a first valve and at least one second valve, the closure means being arranged on the pneumatic circuit in order to isolate selectively from external atmospheric pressure at least a first portion of the pneumatic circuit with a first valve arranged in the vicinity of the suction mouth and at least a second valve, and a control unit configured to implement the steps of:

al- closing the first valve (51)

a2- closing the second valve (52),

so as to isolate from the external atmospheric pressure the first portion of the pneumatic circuit until ~~the~~ a next actual use of the negative-pressure source,

b- stopping ~~the~~ activation of the negative-pressure source (turbine or other),

z- waiting for a new occurrence of ~~the~~ a need to activate the negative-pressure source,

c0- activating the negative-pressure source (turbine or other),

cl- opening the first valve (51)

c2- opening the second valve (52).

With these arrangements, it is possible to maintain a negative pressure in the first portion of the pneumatic circuit during an interval of time between two actual activations of the negative-pressure source. This advantageously allows not waiting during the time required to reactivate the negative-pressure source at the very start of a new friction braking phase. In fact, the negative pressure prevailing in the first portion of the pneumatic circuit is placed in communication with the suction mouth without waiting for complete activation of the negative-pressure source.

In various examples relating to the method, use may further

CLAIMS

1. System for suctioning braking particles from a friction braking system, the suction system comprising:

at least one negative-pressure source, at least one suction mouth, at least one pneumatic circuit connecting the suction mouth and the negative-pressure source, and a control unit, characterized in that the suction system further comprises closure means arranged on the pneumatic circuit, the closure means being able to isolate from external atmospheric pressure at least a first portion of the pneumatic circuit, the control unit being configured to control the closure means according to a predetermined logic in order to isolate from the external atmospheric pressure the first portion of the pneumatic circuit during certain phases between two actual uses of the negative-pressure source.

2. System according to claim 1, further comprising at least one filter to collect the suctioned particles.

3. System according to one of claims 1 to 2, wherein the closure means comprise at least a first valve arranged in the vicinity of the suction mouth and at least a second valve arranged in the vicinity of the negative-pressure source.

4. System according to claim 3, wherein several suction mouths are provided for the at least one filter, the system further comprising additional valves, such that a valve is provided in the vicinity of each suction mouth.

5. System according to one of claims ~~1 to~~3 or 4, wherein said first valve and said second valve are solenoid valves, and preferably the additional valves are additional solenoid valves.

6. System according to claim 5, wherein the control unit is configured to control individually each of the first and second ~~solenoid~~ valves, and where appropriate to control individually the additional solenoid valves.

7. System according to one of claims 1 to 6, wherein the negative-pressure source is formed by a turbine driven by an electric motor.

8. System according to one of claims 1 to 7, wherein the control unit is further configured to control the negative-pressure source selectively, in a manner coordinated with the controlling of the closure means.

9. Method for controlling a system for suctioning friction braking particles from a braking system of a vehicle, the suction system comprising:

at least one negative-pressure source, at least one suction mouth, at least one pneumatic circuit connecting the suction mouth and the negative-pressure source, closure means comprising a first valve and at least one second valve, the closure means being arranged on the pneumatic circuit in order to isolate selectively from external atmospheric pressure at least a first portion of the pneumatic circuit with ~~a~~ the first valve arranged in the vicinity of the suction mouth and ~~at least a~~ the second valve, and a control unit configured to implement the steps of:

al- closing the first valve

a2- closing the second valve,

so as to isolate from the external atmospheric pressure the first portion of the pneumatic circuit until ~~the~~ a next actual use of the negative-pressure source,

b- stopping ~~the~~ activation of the negative-pressure source (turbine or other),

z- waiting for a new occurrence of ~~the~~ a need to activate the negative-pressure source,

c0- activating the negative-pressure source (turbine or other),

cl-opening the first valve

c2- opening the second valve.

10. Method according to claim 9, wherein the opening of the first valve precedes the opening of the second valve, in other words steps **cl**- and **c2**- are carried out in chronological order, during activation of the negative-pressure source.

11. Method according to one of claims 9 to 10, wherein said first valve and said second valve are solenoid valves and their opening and closing is controlled by the control unit,

preferably with individual control so as to be able to carry out steps **cl**- and **c2**- with a timing staggered ~~according to the~~in chronological order ~~established in claim 9~~.

12. Method according to claim 9, wherein the closing of the first valve precedes the closing of the second valve, in other words steps a1- and a2- are carried out in chronological order, before or during deactivation of the negative-pressure source.