System for suctioning braking particles with preemptive control

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, without excluding stationary machines such as wind turbines or industrial machines.

Background and Prior Art

In such systems, for example as described 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 the friction braking is actually activated, by the driver or by a system of the vehicle.

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 turbine 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 of a vehicle is proposed, in a hybrid or electric vehicle, the suction system comprising:

at least one negative-pressure source (for example a turbine or other means), at least one suction mouth connected by a pneumatic circuit to the negative-pressure source, and a control unit configured to control the negative-pressure source,

characterized in that the suction system further comprises a stream of information originating from a computer that controls a motor-generator of a driving/braking system of the vehicle,

and wherein the control unit is configured to control the negative-pressure source preemptively before the actual activation of the friction braking, the control unit controlling the negative-pressure source at least as a function of the activation of electromagnetic braking.

With these arrangements, in the case of an electric or hybrid vehicle, where generally a phase of electromagnetic braking with energy recovery precedes a phase of dissipative friction braking, the information triggering the electromagnetic braking is advantageously used to initialize the suction phase of the suction system preemptively before the friction braking phase which generally begins later, from several hundred milliseconds to several seconds after the electromagnetic braking begins, depending on the case.

Here, the term "hybrid vehicle" denotes a vehicle comprising a drivetrain with both a combustion engine and an electric motor. In the present document, the term "hybrid vehicle" covers all available solutions which can be termed hybrids, from "micro hybrid" to "full hybrid", according to the level of electric power available and according to the level of autonomy available.

The term "electric vehicle" is to be understood here to mean a vehicle with zero emissions resulting from combustion, in other words without a combustion engine.

The term "suction mouth" is to be understood here to mean a primary particle capture zone, for example a groove formed in the friction material or a slot in the immediate vicinity of at least one edge of the friction material.

The particles originate from a friction material, which is typically part of a brake pad or an equivalent member.

The term "negative-pressure source" is to be understood here to mean either a turbine specific to the function of suctioning braking particles, or a negative-pressure source preexisting in the vehicle and selectively used to suction particles towards a collection filter.

In addition, the system may comprise at least one filter (2) to collect the suctioned particles.

In addition, the pneumatic circuit may comprise at least a first conduit (3) connecting the suction mouth to the filter (2). The first conduit is located downstream of the suction mouth in the particles' path which goes from the suction mouth to the filter.

According to an advantageous arrangement, the filter (2) is interposed between the first conduit (3) and the negative-pressure source (1). The negative-pressure source suctions the particles through the filter which is then at a negative pressure relative to the external ambient pressure.

According to an alternate reverse arrangement, it is the negative-pressure source which is interposed between the first conduit and the filter, in which case the particles are suctioned and then they are blown into the filter (filter at positive pressure).

In various examples relating to the system, use may possibly further be made of one or more of the following arrangements, individually or in combination.

According to a preferred option, the negative-pressure source is formed by a turbine

a significant volume of air), the ploy of preemptive anticipation makes it possible to have sufficient negative pressure when friction braking begins.

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, in a hybrid or electric vehicle, the suction system comprising:
at least one negative-pressure source (for example a turbine or other means), at least one suction mouth (83), at least one pneumatic circuit connecting the suction mouth to the negative-pressure source, and a control unit (6) configured to implement the steps of:
- receiving one or more items of information from a computer that controls a motor-generator of a driving/braking system of the vehicle,
- establishing conditions for preemptive control of the negative-pressure source, as a function of at least one electromagnetic braking signal,
- controlling the negative-pressure source according to the preemptive control conditions.

With these arrangements, in the case of an electric or hybrid vehicle, where generally a phase of electromagnetic braking with energy recovery precedes a phase of dissipative friction braking, the information triggering the electromagnetic braking is advantageously used to initialize the suction phase of the suction system preemptively before the friction braking phase which generally begins later, from several hundred milliseconds to several seconds after the start of electromagnetic braking, depending on the case.

In various examples relating to the method, use may further possibly be made of one or more of the following arrangements, individually or in combination.

According to one option, the control unit is further configured to receive one or more items of information from a friction braking control system of the vehicle. Thus, even if the information corresponding to preemptive anticipation is not received, then the suction system is still started up as soon as the information from activation of the friction braking is present or received. For example, in the case of emergency braking, friction braking is applied as soon as possible and the preemptive anticipation information for electromagnetic braking does not arrive before the information for friction braking.

According to one option, the control unit is further configured to take into account a rapid release of the foot from the accelerator pedal. This makes it possible, for example, to anticipate an emergency braking phase in which friction braking must be applied as soon as possible.

According to one option, the control unit is further configured to take into account control signals controlling the fuel injectors of the combustion engine. As a result, a decrease in the control time of the injectors reflects a substantial probability of subsequent braking, and activation of the system for suctioning braking particles can be anticipated.

According to one option, the control unit is further configured to take into account a map containing areas with a high probability of braking, and/or areas of long descent (mountain pass). An additional source of information is thus used to contribute to anticipating the need to suction braking particles.

According to one option, the control unit is further configured to take into account information coming from an environment and hazard recognition system, which can comprise cameras, lidars, in particular those with obstacle detection functionality. This contributes to anticipating the need to suction braking particles.

According to one option, the control unit is further configured to receive information on the current speed of the vehicle, so as to be able to reduce or discontinue the controlling of the turbine in the event that the vehicle is at zero speed. This makes it possible to refine the control logic and avoid unnecessary suction phases, for example when the vehicle is at a red light with the foot on the brake.

According to one option, the control unit is further configured to extend the activation of the suction system by a predetermined time after one of the following events: release of the friction brake or stopping of the vehicle speed (zero speed maintained). This timed extension makes it possible to further optimize the particle capture rate.

In an example, the present disclosure also relates to a method for controlling a system for suctioning friction braking particles from a braking system of a vehicle, in a vehicle with a conventional combustion engine, the suction system comprising at least one negative-pressure source, at least one suction mouth (83), at least one pneumatic circuit connecting the suction mouth to the negative-pressure source, and a control unit (6) configured to determine conditions for preemptive control of the negative-pressure source, the conditions for preemptive control comprising one or more of the following conditions: the vehicle's presence in a map region containing areas with a high probability of braking, the vehicle's presence in a long downhill road segment.

The above conditions for preemptive control may further comprise a rapid lifting of the foot from the accelerator pedal, a downward change in the control signals controlling the fuel injectors of the combustion engine.

The above conditions for preemptive control may also include hazard information coming from an environment recognition system, which may comprise cameras, lidars, in particular those with obstacle detection functionality.

The invention also relates to a system for a vehicle with a conventional combustion engine, configured to implement the method described in the preceding paragraphs.

Description of figures

CLAIMS

1. System for suctioning braking particles from a friction braking system of a vehicle, in a hybrid or electric vehicle, 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 configured to control the negative-pressure source, characterized in that the suction system further comprises a stream of information originating from a computer that controls a motor-generator of a driving/braking system of the vehicle, and wherein the control unit is configured to control the negative-pressure source preemptively before the actual activation of the friction braking, the control unit controlling the negative-pressure source at least as a function of the activation of electromagnetic braking.

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

3. System according to claim 2, wherein the pneumatic circuit comprises a first conduit connecting the suction mouth to the filter, the filter interposed between the first conduit and the negative-pressure source.

4. System according to one of claims 1 to 3, wherein the negative-pressure source is formed by a turbine driven by an electric motor.

5. System according to one of claims 1 to 4, wherein the suction system further comprises a stream of information originating from an electrodynamic braking computer, and the control unit is configured to control the negative-pressure source according to activation of an electrodynamic braking.

6. System according to one of claims 1 to 5, wherein there is provided at least a second conduit connecting the filter to the negative-pressure source, preferably in a centralized configuration, namely a filter and a turbine being connected to at least four suction mouths.

7. 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 to the negative-pressure source, and a control unit configured to implement the steps of:
- receiving one or more items of information from a computer that controls a motor-generator of a driving/braking system of the vehicle,
- establishing conditions for preemptive control of the negative-pressure source, as a function of at least one electromagnetic braking signal,
- controlling the negative-pressure source according to the conditions for preemptive control.

8. Method according to claim 7, wherein the control unit is further configured to receive one or more items of information from a friction braking control system of the vehicle.

9. Method according to one of claims 7 to 8, wherein the control unit is further configured to take into account a rapid release of the foot from the accelerator pedal.

10. Method according to one of claims 7 to 9, wherein the control unit is further configured to receive information on the current speed of the vehicle, so as to be able to reduce or discontinue the controlling of the turbine in the event that the vehicle is at zero speed.

11. Method according to one of claims 7 to 10, wherein the control unit is further configured to extend the activation of the suction system by a predetermined time after one of the following events: release of the friction brake or stopping of the vehicle speed (zero speed maintained).

12. Method according to one of claims 7 to 11, wherein the control unit is further configured to take into account a map containing areas with a high probability of braking, and/or areas of long descent.