[0005] Each pad includes a base and a friction lining. The lining is intended to be in contact with the disc, becoming worn by abrasion over time. The abrasion of the linings generates dust particles that can be harmful. In order to limit the emission of such particles it is known to provide means for collecting and aspirating the particles emitted. To this end each pad includes a groove in the lining near a lateral edge of the pad and a suction port opening into said groove and opening axially into the base, opposite the groove. A flexible pipe connects each suction port to a suction and filtration device.

[0006] In operation the flexibility of the pipes enables compensation of any axial movement of the pads caused by movement of the piston and/or progressive wear of the pads. However, such pipes have a spring effect tending to apply an unwanted axial force to the pads, this axial force possibly tending to move the pads toward or away from the disc in an uncontrolled manner. This can cause premature wear of the pads or lead to incomplete control of the braking torque.

Summary

[0007] The present disclosure improves this situation.

[0007a] In an aspect, the present disclosure refers to a friction braking device (10) including a caliper (12), at least one pad (16) mobile in translation along an axis (A) relative to the caliper (12), said at least one pad (16) being intended to cooperate with a brake disc, and at least one piston (14) movably mounted on the caliper (12) and capable of moving said at least one pad (16) axially in translation, said at least one pad (16) including at least one particle suction zone (28) that includes a suction port (30), wherein the friction braking device (10) further includes a suction pipe

(60) fixed to the piston (14), said suction pipe (60) including an end (62) which sealingly contacts said at least one pad (16), opposite said suction port (30) of the at least one pad (16), and in such a manner as to connect said suction pipe (60) and said suction zone (28) of the pad (16).

[0008] This disclosure proposes a friction braking device including a caliper, at least one pad mobile in translation along an axis of movement relative to the caliper, said pad being intended to cooperate with a brake disc, and at least one piston movably mounted on the caliper and capable of moving said pad axially in translation, said pad including at least one particle suction zone that includes a suction port, characterized in that the device further includes a suction pipe fixed to the piston, said suction pipe including an end adapted to contact said pad in a sealed manner, opposite said suction port of the first pad, in such a manner as to connect said suction pipe and said suction zone of the pad.

[0009] Thus the suction pipe is fixed to the piston and not to the at least one pad, with the result it does not exert an axial force on the corresponding pad. This avoids the aforementioned disadvantages of the prior art.

[0010] The suction pipe can be fixed to the piston directly or indirectly, that is to say via an additional part. The end of the suction pipe can be directly or indirectly in contact against said pad in a sealed manner.

[0011] The corresponding end of the suction pipe can be in contact against the pad in a sealed manner in the event of braking, that is to say when the piston is bearing on the pad so as to push it axially toward the disc. Particles are produced and consequently must be aspirated in such braking phases. It is therefore also in these phases that a seal must be provided between the pipe and the suction zone of the pad by bearing engagement in a sealed manner.

[0012] The seal is still provided between braking phases, which makes it possible to aspirate particles after braking, at least during a so-called cleaning phase immediately following the braking phases.

[0013] The suction pipe can have a first end fixed directly or indirectly to the piston and a second end intended to be connected to a suction and filtration device.

[0014] In the present text “axial” is to be understood as meaning “substantially parallel to said axis of movement”.

[0015] In accordance with one example, the end of the suction pipe can be rigidly connected to a support, said support being fixed onto the piston. Said support can take the form of a metal sheet. Said support can include a central opening through which the piston passes. Said support can be fixed, for example screwed, riveted or welded, to the piston.

[0016] In accordance with one example, said support can include a port facing a corresponding end of the pipe, said support being adapted to come to bear in a sealed manner on the pad so that the suction port in the pad and the port in the support face one another.

[0017] In accordance with one example, the suction pipe can include at least one rigid portion, fixed to the piston, and a flexible portion adapted to allow the axial movement of the piston.

[0018] Also, in contrast to the prior art, the suction pipe can be not flexible over its entire length, which reduces the spring effect of the suction pipe on the pad. Indeed, thanks to the axially extendable flexible portion the suction pipe can compensate axial movement of the pad, but since the first rigid portion is the one fixed to the piston, the spring effect exerted on the pad and on the piston is limited. The residual torques in the braking device are therefore reduced compared to the prior art.

[0019] Note moreover that, thanks to the reduced length of the flexible portion, the suction pipe can be more resistant to heat. Indeed, the rigid portion can have a melting point higher than that of the flexible portion.

[0020] Here by “rigid portion” is meant a part of the suction pipe the axial dimension of which is not modified when the piston moves the pad axially. Here by “flexible portion” is meant a part of the suction pipe that is adapted to have its axial dimension modified when the piston moves the pad axially.

[0021] The rigid portion can be fixed directly to the piston. For example, said rigid portion can be in one piece with the piston. Alternatively, the rigid portion can be fixed indirectly to the piston. For example, the rigid portion can be fixed to said support.

[0022] The suction pipe can include two rigid portions and at least one flexible portion located between said rigid portions. The flexible portion can

therefore contract between the first rigid portion and the second rigid portion when the piston is retracted.

[0023] In particular, said flexible portion can be axially extendable. Said flexible portion can be made of an elastomer material, for example rubber. The flexible portion can therefore exhibit elastic behavior.

[0024] An arm extending substantially in an L shape can fix the suction pipe, in particular one of its rigid portions, to the caliper.

[0025] In accordance with one example the flexible portion can include at least one bellows.

[0026] Thanks to the bellows, which includes pleats, the flexible portion can follow axial movement of the corresponding pad (induced by the piston and the runout of the disc) without being subjected to high traction forces that risk leading to rupture of the flexible portion. Alternatively, the flexible portion could be replaced by a telescopic flexible or rigid portion.

[0027] In accordance with one example the caliper can be a floating caliper capable of being moved axially in translation relative to a caliper support, the device including a first so-called interior pad and a second so-called exterior pad, the first pad being actuated directly by the piston, the second pad being actuated directly by a rear portion of the floating caliper, a first suction pipe being capable of being connected to a suction zone of the first pad, a second suction pipe being capable of being connected to a suction zone of the second pad.

[0028] Such a configuration with a floating caliper makes it possible to actuate both the first pad directly and the second pad indirectly via the floating caliper.

[0029] Particles emitted by each pad are aspirated via a dedicated suction

pipe.

[0030] In accordance with one example the rear portion of the floating caliper can include a suction port, the second suction pipe being connected to said suction port of the floating caliper, said suction port of the floating caliper being capable of coming to bear in a sealed manner on the second pad opposite the suction port of said second pad in such a manner as to connect said second suction pipe and said suction zone of the second pad.

[0031] As before, the suction port of the caliper can be adapted to come to bear in a sealed manner on the suction port of the second pad when particles are produced.

[0032] The second pipe can consist entirely of one or more rigid portions and have no flexible portion. For example the second suction pipe can be produced in a floating casting of the caliper. In particular the second pipe can be in one piece with the floating casting of the caliper.

[0033] The seal between the second suction pipe and the second pad is therefore assured thanks to the sealed bearing engagement between the suction port of the caliper and the suction port of the second pad. This therefore limits the number of components in the braking device.

[0034] The second suction pipe can have a first end fixed directly or indirectly to the caliper and a second end intended to be connected to a suction and filtration device. Note that thanks to fixing the second suction pipe to the caliper the second suction pipe is prevented from exerting a force on the second pad. Indeed, instead of fixing the second suction pipe directly onto the second pad the suction port of the caliper through which particles generated by braking are aspirated is provided by the second suction pipe.

[0035] The suction port of the second pad can have a diameter less than the diameter of the suction port of the caliper. This guarantees that a

maximum quantity of particles emitted during cooperation between the second pad and the brake disc are aspirated by the second suction pipe. Indeed, if the suction port of the caliper had the same diameter as or a diameter less than that of the suction port of the second pad the risk of particles accumulating at the interface between the two suction ports would be very high.

[0036] In some examples, a first part of the suction port of the caliper includes a substantially annular shoulder shaped to receive said suction pipe.

[0037] This improves the seal between caliper and the second suction pipe, given that the second suction pipe is partially inserted in the suction port of the caliper. This limits the risk of particles being expelled to the exterior of the braking device at the interface between the caliper and the second suction port.

[0038] Said first end portion corresponds in particular to the end portion of the suction port of the caliper opposite the second pad. Thanks to the shoulder the diameter of the suction port of the caliper is increased in its first end portion. The second suction pipe can therefore be received in the suction port of the caliper while guaranteeing that a passage in the suction pipe in which the particles flow can have a diameter equal to or greater than that of the suction port of the caliper. This limits the risk of particles accumulating at the interface between the suction port of the caliper and the second suction pipe.

[0039] The second suction pipe can in particular be a snug fit or a tight fit in said shoulder.

[0040] Said second suction pipe can be fixed to the caliper using at least one removable connecting member. The second suction pipe can therefore be replaced easily in the event of wear. For example the second suction pipe can be screwed to the caliper.

[0041] The suction port of the second pad can be in a first face of the second pad, the first face of the second pad being made of metal and coming to bear in a sealed manner on a metal first face of the caliper onto which the suction port of the caliper opens. The seal between the second pad and the caliper is therefore assured by a metal-to-metal contact.

[0042] In accordance with one example the caliper can be a so-called fixed caliper, the device including a first so-called interior pad on the vehicle side and a second so-called exterior pad on the rim side, each pad being actuated directly by at least one piston, a first suction pipe being capable of being connected to a suction zone of the first pad, a second suction pipe being capable of being connected to a suction zone of the second pad.

[0043] In such a fixed caliper configuration each pad is actuated by at least one dedicated piston.

[0044] As before, particles emitted by each pad are aspirated via a dedicated pipe.

[0045] In accordance with one example each suction pipe can be fixed to the corresponding piston, each suction pipe including an end adapted to come to bear in a sealed manner against the corresponding pad, opposite said suction port of the corresponding pad, in such a manner as to connect the suction pipe and said suction zone of the corresponding pad.

[0046] The present document also concerns a braking system including a brake disc and a friction braking device of the aforementioned type.

[0047] The present document also concerns a vehicle including a braking system of the aforementioned type.

[0048] The present document also concerns a stationary machine including