

Description

Title: Friction braking device

5 **Technical field**

[0001] The present disclosure relates to the field of friction braking devices.

10 **Prior art**

[0002] The invention relates to a friction braking device designed to be provided, for example, on a road or rail vehicle, or even a stationary rotor machine such as a wind turbine or an industrial machine.

[0003] Such a braking device is disclosed, in particular, in the document FR 3 057 040 B1 in the name of the applicant. This braking device conventionally comprises a so-called floating caliper designed to be mounted on a fixed caliper support, and two pads mounted on either side of a brake disk secured to a wheel of a vehicle or a rotor of a stationary machine, for example. The device comprises, in particular, a so-called inner pad, displaced in translation by a piston and designed to be supported by a first surface of the disk, and a so-called outer pad, designed to be supported by the second surface of the disk, opposing the first surface. The piston comprises a part which is subjected to the pressure of a hydraulic fluid, for example oil, exerted in a pressure chamber. The increase in the pressure in said chamber causes the axial displacement of the piston relative to the caliper and thus pushes back the inner

pad against the first surface of the disk. Simultaneously, the rear part of the floating caliper pushes back the outer pad against the second surface of the disk. The disk is thus braked by a resistive torque
5 due to the friction of the pads on the corresponding surfaces.

[0004] When the pressure in the chamber reduces, the piston is retracted and the floating caliper is displaced
10 so as to release the pads. These pads can then be separated from the disk during the rotation thereof, due to a slight distortion naturally present in the disk.

[0005] Each pad comprises a shoe and a friction lining.
15 The lining is designed to come into contact with the disk, wearing gradually over time due to abrasion. The abrasion of the linings generates particles and dust which can be harmful. In order to limit the emission of such particles it is known to provide means which enable
20 the emitted particles to be collected and suctioned. To achieve this, each pad comprises a groove formed in the lining and located in the vicinity of a lateral edge of the pad, and a suction port leading into said groove and leading axially into the shoe, opposite the groove. A
25 pipe makes it possible to connect each suction port to a suction and filtration device.

[0006] In order to limit the release of particles outside of the device, it is necessary that the
30 connection between each suction pipe and each suction port of the pads is sealed. In the case of the inner pad, the corresponding suction pipe can be sealingly supported directly by the suction port. However, in the case of the

outer pad, the rear part of the piston has a significant thickness which makes it difficult for the suction pipe to be sealingly supported directly by the suction port of the outer pad.

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[0007] As a result, it is necessary to find a solution to seal the connection between the outer pad and the respective suction pipe.

10 **Summary**

[0008] The present disclosure improves the situation.

[0009] To this end, the invention proposes a friction
15 braking device comprising a caliper, at least one pad movable in translation along an axis relative to the caliper, said pad being intended to cooperate with a brake disk, said pad comprising at least one particle suction region that comprises a suction port,
20 characterized in that the device further comprises a suction pipe attached to the caliper, the caliper comprising a suction port capable of being sealingly supported by the pad opposite the suction port of said pad, so as to connect said suction pipe and said suction
25 region of the second pad.

[0010] The seal between the suction pipe and the pad is thus ensured due to the sealed support between the suction port of the caliper and the suction port of the
30 pad. This limits the number of parts in the braking device.

[0011] It is noted that the suction port of the caliper can be capable of being sealingly supported by the suction port of the second pad in the case of braking, i.e. when the pad is pushed against the disk. Particles
5 are produced and, as a result, they have to be suctioned in such braking phases. It is thus also in these phases that a seal has to be ensured between the suction pipe and the suction port of the pad.

10 **[0012]** Outside the braking phases, such a seal is always ensured, which makes it possible to suction the particles after the braking, at least during a so-called cleaning phase, immediately after the braking phases.

15 **[0013]** The suction pipe can comprise a first end which is attached directly or indirectly to the caliper and a second end which is designed to be connected to a suction and filtration device. It is noted that, due to the attachment of the suction pipe to the caliper, this
20 avoids the situation where the suction pipe exerts forces on the pad. More specifically, instead of attaching the suction pipe directly to the pad, the suction port of the caliper is provided, via which the particles resulting from the braking are suctioned by the suction pipe.

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[0014] According to one aspect, said suction port of the pad can have a diameter which is smaller than the diameter of the suction port of the caliper. Thus it is guaranteed that a maximum number of particles emitted during the
30 cooperation between the pad and the brake disk are suctioned by the suction pipe. More specifically, if the suction port of the caliper had the same diameter or a smaller diameter than that of the suction port of the

pad, the risk of the accumulation of particles at the interface between the two suction ports would be very high.

5 **[0015]** According to one aspect, a first end part of the suction port of the caliper can comprise a substantially annular shoulder which is shaped to receive said suction pipe.

10 **[0016]** The seal between the caliper and the suction pipe is thus improved, given that the suction pipe is partially introduced into the suction port of the caliper. This limits the risk that the particles are expelled toward the outside of the braking device at the
15 interface between the caliper and the suction pipe.

[0017] Said first end part corresponds, in particular, to the end part of the suction port of the caliper which opposes the pad. Due to the shoulder, the diameter of the
20 suction port of the caliper increases at its first end part. The suction pipe can thus be received in the suction port of the caliper while guaranteeing that a channel of the suction pipe, in which the particles flow, can have a diameter which is equal to or greater than that of the
25 suction port of the caliper. Thus the risk is limited of the accumulation of particles at the interface between the suction port of the caliper and the suction pipe.

[0018] The suction pipe can be received, in particular,
30 in a clamped or fitted manner in said shoulder.

[0019] According to one aspect, said suction pipe is implemented in the continuation of a floating cast part

of the caliper. In particular, the second pipe can be made in one piece with the floating cast part of the caliper.

5 **[0020]** According to one aspect, said suction pipe can be attached to the caliper from at least one removable connecting member. The suction pipe can thus be replaced easily in the case of wear. For example, the suction pipe can be attached to the caliper by screws.

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[0021] According to one aspect, the suction port of the pad can be included in a first face of the pad, the first face of the pad being metallic and being sealingly supported by a first metallic face of the caliper into
15 which the suction port of the caliper leads. The seal between the pad and the caliper is thus ensured by a metal-to-metal contact.

[0022] According to one example, the caliper is a
20 floating caliper capable of being axially displaced in translation relative to a caliper support, the device comprising a first pad, called the inner pad, and a second pad, called the outer pad, the first pad being actuated directly by a piston, the second pad being actuated
25 directly by a rear part of the floating caliper, a first suction pipe being capable of being connected to a particle suction region of the first pad, a second suction pipe being capable of being connected to a particle suction region of the second pad, and each of
30 the particle suction regions of the first pad and the second pad respectively comprising a suction port.

[0023] In such a configuration with a floating caliper, a single piston makes it possible to actuate simultaneously the first pad directly and the second pad indirectly by means of the floating caliper. The
5 particles emitted by each pad are suctioned by a dedicated pipe.

[0024] In this case, the second pad corresponds to that against which the suction port of the caliper is
10 sealingly supported as explained above.

[0025] The present document also relates to a braking system comprising a brake disk and a friction braking device of the aforementioned type.
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[0026] The present document also relates to a vehicle comprising a braking system of the aforementioned type.

[0027] The present document also relates to a stationary
20 rotor machine comprising a braking system of the aforementioned type.

Brief description of the drawings

25 [0028] Further features, details and advantages will become apparent by reading the detailed description below and by examining the accompanying drawings, in which:

Fig. 1

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[0029] [Fig. 1] shows a schematic perspective view of a friction braking device according to an exemplary embodiment.

Fig. 2

[0030] [Fig. 2] shows a schematic side view of the
5 friction braking device of figure 1.

Fig. 3

[0031] [Fig. 3] shows a further schematic perspective
10 view of the friction braking device of figure 1.

Fig. 4

[0032] [Fig. 4] shows a schematic front sectional view
15 of the friction braking device of figure 1.

Fig. 5

[0033] [Fig. 5] shows a partial schematic view of a
20 lateral section of the friction braking device of figure
1 showing a pad of said device.

Description of embodiments

25 [0034] Figure 1 shows a schematic perspective view of
an example of the friction braking device 10. The device
10 can be used in a braking system, for example in a road
vehicle or rail vehicle, but also in a stationary rotor
machine such as a wind turbine or industrial machine.

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[0035] The friction braking device 10 comprises a
caliper 12. In figures 1 to 5, the caliper 12 is a
floating caliper and it can be displaced in translation

relative to a caliper support (not illustrated) on which it is mounted.

[0036] The caliper 12 comprises a fixed part 13A and a
5 floating cast part 13B visible in figure 2.

[0037] The device 10 further comprises a piston 14 mounted on the caliper 12. The piston 14 can comprise a part subjected to the pressure of a hydraulic fluid, for
10 example oil, exerted in a pressure chamber. The increase in the pressure in said chamber causes the displacement of the piston 14 relative to the caliper in an axial direction A. "Axial" or "axially" is understood to mean hereinafter substantially parallel to the direction A.

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[0038] A first pad 16, also called the inner pad, is provided in the device 10. In particular, the pad 16 can be arranged in a housing 17 (visible in figure 4) provided in a front part 19 of the caliper 12. The pad 16 is
20 mounted, for example, directly axially opposite the piston 14. In particular as is visible in figure 4, the pad 16 can be in contact with the piston 14. As will be detailed hereinafter, the pad 16 is designed to cooperate with a brake disk (not illustrated).

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[0039] The first pad 16 comprises a shoe 18 (also called a "backing plate") and a lining 20.

[0040] The shoe 18 comprises an external face 22 and an
30 internal face 24 axially opposing one another. The external face 22 is supported by the piston 14 and/or the caliper 12.

[0041] A thickness of the shoe 18 is between, for example, 3 mm and 5 mm. The "thickness of the shoe" is understood to mean in this case the dimension of the shoe 18 in the axial direction A.

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[0042] The shoe 18 is preferably produced in metallic material.

[0043] The lining 20 is attached to the internal face 24 of the shoe 18. The lining 20 is formed by a friction material, commonly called "Ferodo".

[0044] The lining 20 comprises a friction face 26 which axially opposes the face of the lining 20 which is attached to the shoe 18. The friction face 26 is designed, during the braking phases, to be axially supported by a first face of the brake disk which rotates about an axis substantially parallel to the axial direction A. In particular, the friction face 26 is supported by the first face of the brake disk when the piston 14 is displaced in the direction A moving toward the brake disk.

[0045] The lining 20 and the disk release particles resulting from the abrasion when the friction face 26 is supported by the brake disk during the braking phase. This causes the wear of the lining 20 and the disk. The thickness (i.e. the axial dimension) of the lining 20 thus reduces progressively during the service life of the pad 16.

[0046] As illustrated in figure 4, the pad 16 comprises a particle suction region 28. The particle suction region

28 comprises a suction port 30 formed by a first cavity 32 arranged in the shoe 18 and a groove 34 arranged in the lining 20. The suction port extends, for example, substantially axially.

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[0047] The first cavity 32 passes through the shoe 18 between its external face 22 and its internal face 24 opposite at least one portion of the groove 34 of the lining 20. The groove 34 extends axially between the friction face 26 and the second face of the lining 20. In other words, the depth of the groove 34 is equal to the thickness of the lining 20. The particles released by abrasion can also be collected in the groove 34, then suctioned through the cavity 32 of the shoe 18.

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[0048] In order to suction the particles collected in the groove 34, the device comprises a first suction pipe 60. The first suction pipe 60 comprises a first end 62 and a second end 63 opposing one another.

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[0049] The first end 62, visible in particular in figure 5, is capable of being sealingly supported, directly or indirectly, against the first pad 16. Advantageously, the end 62 is capable of being sealingly supported opposite the suction port 30 of the pad 16. Thus the suction pipe 60 is connected to the suction region 28 of the pad 16. This limits the risk of the ejection to the outside of particles formed by the abrasion of the pad 16 and the disk when they are in contact with one another.

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[0050] Advantageously, the end 62 of the suction pipe 60 is sealingly supported by the pad 16 during the braking phase. More specifically, as explained above, during the

braking phases, the pad 16 is axially supported by the brake disk and thus the particles are formed by abrasion.

5 **[0051]** Outside the braking phases, the seal between the suction pipe 60 and the pad 16 is ensured, at least during a cleaning phase immediately after the braking phase. This permits the particles to be suctioned after the braking.

10 **[0052]** The second end 63 of the pipe 60 in turn is designed to be connected to suction means (not illustrated). The suction means are, for example, a suction and filtration device. Such a device is configured to suction the particles formed by the
15 abrasion of the pad 16 and the brake disk when they come into contact with one another.

[0053] In the non-limiting exemplary embodiment illustrated in the figures, the suction pipe 60 is
20 attached to the piston 14. The pipe 60 is thus attached to the piston 14 and not to the pad 16, so that the pipe 60 does not exert any axial force on the pad 16. This avoids the situation where the pad 16 is moved closer toward or separated from the brake disk in an
25 uncontrolled manner, which reduces the risk of premature wear of the pad 16 and permits the braking torque to be controlled in a more comprehensive manner.

[0054] When the pipe 60 is attached to the piston, its
30 end 62 is advantageously capable of being sealingly supported by the pad 16 opposite the suction port 30. Thus the first suction pipe 60 and the suction region 30 of the pad 16 are connected.

[0055] The pipe 60 can be attached directly to the piston 74. For example, the pipe 60 can be made of the same material as the piston 14.

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[0056] Alternatively, the pipe 60 can be attached indirectly to the piston 14, for example via an additional part 74. The additional part 74 is, for example, a support which is attached to the piston 14,
10 for example, by screwing, riveting or welding.

[0057] The end 62 of the pipe 60 is secured to the support 74. The support 74 can comprise a port (not visible in the figures) located opposite the end 62 of
15 the pipe 60. The support 74 is thus capable of being sealingly supported by the pad 16 so that the suction port 30 of the pad 16 and the port of the support 74 are opposite one another.

[0058] In an alternative, not illustrated, the pipe 60 could be directly attached to the pad 16. As above, the end 62 of the pipe 60 is thus capable of being sealingly supported by the first pad 12, opposite the suction port 30. Thus the first suction pipe 60 and the suction region
20 30 of the pad 16 are connected.
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[0059] As is visible in the figures, the caliper can also comprise an arm 78 extending in an L-shape, which permits the pipe 60 to be attached to the caliper 12.

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[0060] A second pad 36, also called the outer pad, is provided in the device 10. The second pad 36 can be arranged in a housing 37 provided in a rear part 39 of

the caliper 12. As emerges from the figures, in particular figure 4, the second pad 36 is axially opposite the first pad 16. A space 21 which is designed to receive the brake disk is formed between the two pads
5 16, 36.

[0061] The second pad 36 comprises a shoe 38 and a lining 40. The shoe 38 and the lining 40 are respectively similar or identical to the shoe 18 and the lining 20 described
10 above. They are not described below in detail for reasons of concision. It is noted that only the second pad 36 comprises a suction region 48 comprising a suction port 50 which is formed by a first cavity 52 and a groove 54, respectively similar or identical to the first cavity 32
15 and the groove 34 of the first pad 16. The suction port 50 extends, for example, substantially axially.

[0062] It is also noted that the second pad 36, in particular the friction face of its lining 40, is
20 designed to be axially supported by a second face of a brake disk axially opposing the first face of the disk during the braking phases. As in the case of the inner pad 16, this support causes the abrasion of the lining 40 and the disk, thus generating particles.

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[0063] As can be seen in figures 4 and 5, the second pad 36 comprises a first face 42 which is axially supported by a first face 56 of the caliper 12. The first face 42 of the second pad 36 is similar or identical to the
30 external face 22 of the shoe 18 of the first pad 16. The first face 42 of the pad 32 and the first face 56 of the caliper 12 are advantageously metallic.

[0064] Advantageously, when the caliper 12 is a floating caliper, the second pad 36 is mounted on a guide and slides (not illustrated). Thus the movement of the second pad 36 of the brake disk is caused by an axial displacement of the caliper 12, in particular its rear part 39, relative to the caliper support. Such an axial displacement of the rear part 39 of the caliper 12 causes the sliding of the second pad 36 on the guide and the slides on which it is mounted. The second pad 36 is thus actuated directly by the rear part 39 of the floating caliper 12. Also in this configuration with a floating caliper, a single piston, in this case the piston 14, makes it possible to actuate simultaneously the first pad 16 directly and the second pad 36 indirectly by means of the floating caliper.

[0065] The suction port 50 of the second pad 36 can be included in the first face 42 of the pad 36.

[0066] The rear part 39 of the caliper 12 can comprise a suction port 80, visible in figure 5. The suction port 80 passes through the rear part 39 of the caliper 12 between the first face 56 and the outside of the caliper 12. For example, the suction port 80 extends substantially axially.

[0067] Advantageously, when the face 42 of the pad 36 and the face 56 of the caliper 12 are in contact, the suction port 50 of the pad 36 and the suction port of the caliper 12 are aligned. In particular, the suction port 80 of the caliper 12 is capable of being sealingly supported by the second pad 36 opposite the suction port 50. Since the first face 42 of the pad 32 and the first

face 56 of the caliper 12 are metallic, the seal between the second pad 32 and the caliper 12 is thus provided by a metal-to-metal contact. Due to this seal between the pad 32 and the caliper 12, the particles generated by the abrasion of the pad 32 and the disk during the braking phases can be suctioned by suction means, while limiting the particles released into the environment, as will be detailed below.

10 **[0068]** The suction port 80 of the caliper 12 can be capable of being sealingly supported by the suction port 50 of the second pad 36 in the case of braking, when the particles are produced by abrasion. Outside the braking phases, the pad 36 is pushed back toward the rear part 15 39 which also makes it possible to keep the seal between the second pad 32 and the caliper 12. This makes it possible to suction the remaining particles during the cleaning phases.

20 **[0069]** As figure 5 shows, the diameter D1 of the suction port 50 of the second pad 36 can be a smaller diameter than the diameter D2 of the suction port 80 of the caliper 12. This guarantees that a maximum number of particles emitted during the cooperation between the second pad 36 and the brake disk are suctioned by the suction means. 25 More specifically, if the suction port 80 of the caliper 12 had the same diameter or a smaller diameter than that of the suction port 50 of the second pad 36, the risk of the accumulation of particles at the interface between the two suction ports 50, 80 would be very high. 30

[0070] In order to connect the suction ports 50, 80 to the suction means, a second suction pipe 90 is provided

in the device 10. The second pipe can be implemented in the continuation of the floating cast part 13B.

[0071] The second pipe 90 comprises a first end 92 and
5 a second end 93.

[0072] The first end 92 of the pipe 90 is attached directly or indirectly to the caliper 12. In the figures, the first end 92 is directly connected to the suction
10 port 80 of the floating caliper 12. This makes it possible to connect the pipe 90 indirectly to the suction region 48 of the second pad 36. The particles generated by the abrasion of the pad 36 and the disk can thus be displaced from the suction region 48 of the pad 36 to the pipe 90
15 via the port 80 of the caliper.

[0073] In particular, the first end 92 is at least partially mounted so as to be clamped or fitted in the port 80. The seal between the caliper 12 and the suction
20 pipe 90 is thus improved, which limits the risk that the particles are expelled toward the outside of the device 10 at the interface between the caliper 12 and the second suction pipe 90.

[0074] In the non-limiting example of the figures, the
25 suction port 80 comprises a shoulder 82 at an end part 81 opposing the second pad 36. Due to the shoulder 82, the diameter D2 of the suction port 80 of the caliper 12 increases at its end part 81 relative to the remainder
30 of the port 80.

[0075] The shoulder 82 is, for example, substantially annular. Advantageously, the shoulder 82 is shaped to

receive the second suction pipe 90, in particular the first end 92 thereof. The end 92 of the pipe 90 can be received, in particular, in a clamped or fitted manner in the end part 81 of the port 80.

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[0076] As the diameter of the suction port 80 of the caliper 12 increases at its first end part 81 due to the shoulder 82, the suction pipe 90 can be received in the suction port 80 of the caliper while guaranteeing that a
10 channel 94 of the suction pipe, in which the particles flow, has a diameter which is equal to or greater than that of the suction port 80 of the caliper. Thus the risk is limited of the accumulation of particles at the interface between the suction port 80 of the caliper 12
15 and the second suction pipe 90.

[0077] Due to the attachment of the suction pipe 90 on the caliper 12, this avoids the situation where the second suction pipe 90 exerts forces on the second pad
20 36.

[0078] The second end 93 of the pipe 90 is designed to be connected to the suction means. As indicated above, such means can be a suction and filtration device. It is
25 noted that the first pipe 60 and the second pipe 90 can be connected to the same suction and filtration device or to separate suction and filtration devices.

[0079] The second suction pipe 90 preferably consists
30 entirely of one or more rigid parts. For example, the second suction pipe can be produced in a floating cast part of the caliper.

[0080] As can be seen clearly from figure 3, the shape of the pipe 90 can comprise an elbow 95. This elbow 95 makes it possible to place the end 93 of the pipe 90 on the same side of the caliper 12 as the end 63 of the pipe 60. Thus it is simpler to connect the two pipes 60, 90 to the same suction and filtration device.

[0081] As is also visible in figure 5, the second suction pipe 90 can also be attached to the caliper 12 by at least one removable connecting member 96. The pipe 90 can thus be easily replaced in the case of wear. The removable connecting member 96 is, for example, a screw.

[0082] It is noted that after the friction of the pads 16, 36 on the brake disk, these pads 16, 36 are separated from the disk due to a slight distortion (not illustrated) present in the disk. In particular, the pads 16, 36 are moved away from the disk during its rotation.

[0083] In the case of the floating caliper illustrated in the figures, the separation of the pads 16, 36 from the brake disk is produced when the piston 14 is retracted (and thus moved away from the front pad 16) and the caliper 12 is displaced relative to the caliper support so as to move away from the outer pad 36. The pads 16, 36 are thus released, which permits their displacement in a direction moving them away from the brake disk due to the slight distortion of the disk.

[0084] The present disclosure is not limited to the exemplary embodiments, which are described above only by way of example, but it encompasses all of the variants which a person skilled in the art could envisage within

the desired scope of protection. For example, as illustrated in the figures, each of the pipes 60, 90 can comprise a connection piece 120. Preferably such connection pieces 120 are not provided in the device 10
5 which is designed to be installed in a vehicle or in a stationary rotor machine. These connection pieces 120 are solely used when the device 10 is used to carry out experimental tests in order to measure the negative pressure in the pipe which carries the connection pieces.

Claims

[Claim 1] A friction braking device (10) comprising a caliper (12), at least one pad (36) movable in translation along an axis (A) relative to the caliper (12), said pad (36) being intended to cooperate with a brake disk, said pad (36) comprising at least one particle suction region (48) that comprises a suction port (50), characterized in that the device (10) further comprises a suction pipe (90) attached to the caliper (12), the caliper (12) comprising a suction port (80) capable of being sealingly supported by the pad (36) opposite the suction port (50) of said pad (36), so as to connect said suction pipe (90) and said suction region (48) of the second pad (36).

[Claim 2] The device (10) as claimed in claim 1, wherein said suction port (50) of the pad (36) has a diameter (D1) which is smaller than the diameter (D2) of the suction port (80) of the caliper (12).

[Claim 3] The device (10) as claimed in one of the preceding claims, wherein a first end part (81) of the suction port (80) of the caliper (12) comprises a substantially annular shoulder (82) which is shaped to receive said suction pipe (90).

[Claim 4] The device (10) as claimed in one of the preceding claims, wherein said suction pipe (90) is attached to the caliper (12) by at least one removable connecting member (96).

[Claim 5] The device as claimed in one of the preceding claims, wherein said suction pipe (90) is implemented in the continuation of a floating cast part (13B) of the caliper (12).

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[Claim 6] The device (10) as claimed in one of the preceding claims, wherein the suction port (50) of the pad (36) is included in a first face (42) of the pad (36), the first face (42) of the pad (36) being metallic and being sealingly supported by a first metallic face (58) of the caliper (12) into which the suction port (80) of the caliper (12) leads.

[Claim 7] The device (10) as claimed in one of the preceding claims, wherein the caliper (12) is a floating caliper capable of being axially displaced in translation relative to a caliper support, the device (10) comprising a first pad (16), called the inner pad, and a second pad (36), called the outer pad, the first pad (16) being actuated directly by a piston (14), the second pad (36) being actuated directly by a rear part (39) of the floating caliper (12), a first suction pipe (60) being capable of being connected to a particle suction region (28) of the first pad (16), a second suction pipe (90) being capable of being connected to a particle suction region (48) of the second pad (36), and each of the particle suction regions (28, 48) of the first pad (16) and the second pad (36) respectively comprising a suction port (30, 50).

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[Claim 8] A braking system comprising a brake disk and a friction braking device (10) as claimed in one of the preceding claims.