



(43) International Publication Date
29 June 2006 (29.06.2006)

PCT

(10) International Publication Number
WO 2006/067816 A1

(51) International Patent Classification:
F16D 65/12 (2006.01)

(21) International Application Number:
PCT/IT2004/000726

(22) International Filing Date:
24 December 2004 (24.12.2004)

(25) Filing Language: Italian

(26) Publication Language: English

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

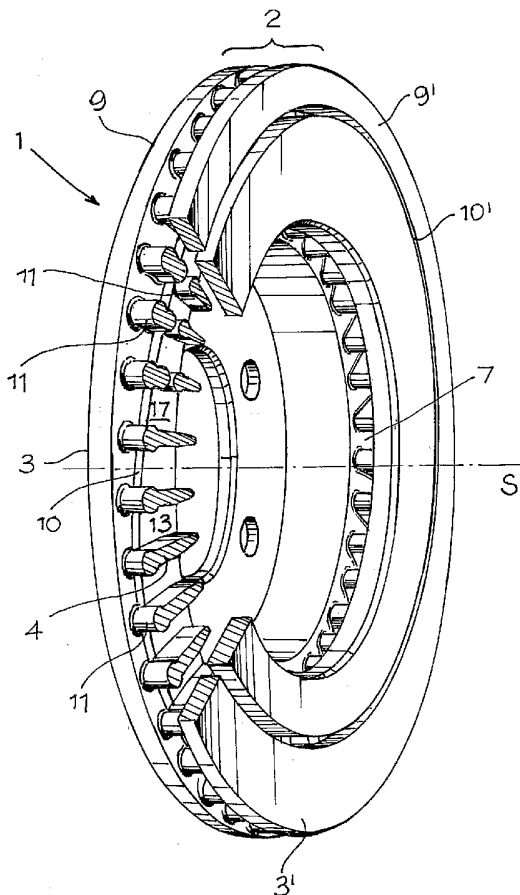
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

(54) Title: BRAKING BAND OF DISC BRAKE



(57) Abstract: A braking band (2) of a disc-brake disc (1) unusually capable of silent braking comprises at least two plates (3, 3') connected together by connecting elements (4), in which the air space between the plates (3, 3') forms an inner air duct (7) to cool the braking band (2). At least one of the plates (3, 3') has on its surface (8, 8') defining the air ducts (7) at least one groove (10, 10') extending along at least a portion of an orbit around the axis of symmetry (s) of the disc (1) and whose cross-section becomes wider towards said air duct. The connecting elements (4) have an elongate cross-section and at their radial outer side an enlarged diameter (11).



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DESCRIPTION**"Braking band of disc brake"**

[0001]. The embodiment subject of the present invention is a braking band of a self-ventilated disc-brake disc.

5 [0002]. A known type of disc-brake disc with self-ventilated braking band substantially comprises a support bell to be connected for example to a vehicle's wheel hub.

[0003]. A connector connects said bell to the braking
10 band, which cooperates with the callipers to exercise the braking action on the vehicle.

[0004]. Notoriously, during the braking operation, the brake lining's friction action on the disc provokes the disc's increase in temperature, at times excessive as
15 well as damaging, due to the dissipation of the vehicle's kinetic energy as a result of the friction.

[0005]. Said braking band thus typically comprises at least two parallel plates separated by connecting elements which fix them together.

20 [0006]. The space between said plates forms a air duct.

[0007]. Thanks to the circulation of air between the plates the disc is cooled both on the outer sides, as with a solid disc, and on the inner sides of said braking band.

[0008]. As known, during the braking action said discs are subject to vibrations, which may result in annoying squealing.

[0009]. A known approach for preventing this noise due
5 to brake disc vibrations, for example presented in document WO 02/097292, consists of the embodiment of a disc braking band comprising at least two plates connected together by connecting elements in the form of fins extending substantially radially to the axis of
10 symmetry, in which the air space between the plates forms an inner air duct to cool said braking band, and in which at least one of the plates, on one of its surfaces defining said air ducts, has at least one groove extending along at least a portion of an orbit around the
15 disc's axis of symmetry and having a section which becomes wider for a predominant part of its depth towards said air duct.

[0010]. By changing the brake disc's local stiffness in this way its dynamic characteristics can be changed, so
20 as to shift the brake disc's natural frequencies away from the frequencies excited by braking.

[0011]. However, this known braking band leads to structural problems relating to the disc's acoustic behaviour and also its thermal and mechanical behaviour.

[0012]. In fact, the presence of a non-uniform cooling zone, for example near the regions of overlap, that is the intersection between the channels and the fins, leads to the onset of heat cracking, particularly manifested
5 through radial and peripheral breaking of the material constituting the braking band and fins, especially at the zone of maximum band eccentricity.

[0013]. For this reason there are known problems due to inefficient heat exchange between the cooling fluid (air)
10 and the braking band, especially along the circumference defined by the radial distance of the groove intersections, that is, in the portion of the fins' radial interruption.

[0014]. Furthermore, in the region of intersection of
15 the eccentric grooves there is a poorly controllable air vortex, also depending on the number of revolutions of the disc itself and the type and condition of the pads.

[0015]. The vortex generated leads to the production of noise, caused by a different phenomenon to that related
20 to the vibration and frequency resonance excited by the disc mass, related instead to the vortical air flow at the intersection of the grooves.

[0016]. Furthermore, the noise generated is of a periodic type and is in itself annoying.

[0017]. Scope of the present invention is thus to propose a braking band for a disc-brake disc which has structural and functional characteristics such as to permit silent braking and overcome said problems cited
5 with reference to the known art, that is to say a braking band which is substantially insensitive to the vibrations generated by the vortical air flow and furthermore does not present thermal cracking.

[0018]. The scope is achieved by a device in accordance
10 with claim 1.

[0019]. The claims dependent on this describe embodiments.

[0020]. The characteristics and advantages of the device according to the present invention are evident
15 from the description reported below of a preferred, non limiting embodiment, with reference to the attached drawings, wherein:

[0021]. - figure 1 shows a partially sectioned, axonometric view of a self-ventilated brake disc;

20 [0022]. - figure 2 shows a front view of a preferred embodiment of a brake disc according to the invention;

[0023]. - figure 3 shows a front view in partial cross-section of an embodiment of a brake disc according to the invention;

[0024]. - figure 4 shows a radial cross-section of the disc of figure 3 on the line IV-IV;

[0025]. - figure 5 shows a radial cross-section of the disc of figure 2 on the line V-V; and

5 [0026]. - figure 6 shows a radial cross-section of the disc of figure 2 on the line VI-VI.

[0027]. With reference to figure 1, the number 1 indicates a disc-brake disc overall.

[0028]. Disc 1 extends around an axis of symmetry s.

10 [0029]. Said axis of symmetry s also constitutes the axis of rotation of brake disc 1.

[0030]. The brake disc 1 comprises a braking band 2 comprising at least two plates 3 and 3', connected by connecting elements 4.

15 [0031]. Said braking band 2 is supported by a bell 5 through a connector 6.

[0032]. The bell 5 is placed at the centre of brake disc 1 and is connectable through a means of connection to a vehicle hub.

20 [0033]. The brake plates 3, 3' comprise an outer surface 9, 9' and an inner surface 8, 8' opposite the outer surface 9, 9'.

[0034]. The outer surfaces 9, 9' of plates 3, 3' are the brake disc's friction surfaces. The inner surfaces 8,

8' of plates 3, 3' define at least one air duct 7.

[0035]. As can be seen from the drawings, at least one of the inner surfaces 8, 8' has one or more grooves 10, 10' which widen on passing from the outer surface 9,9' to
5 the air duct 7.

[0036]. In particular, the cross-section shape of the groove 10, 10' widens for a predominant portion of its depth towards the air duct 7.

[0037]. According to a preferred embodiment, the
10 grooves 10, 10' extend along surfaces 8, 8' with different depths.

[0038]. Favourably, the grooves 10, 10' define in cross-section a cavity with trapezoid shape.

[0039]. This particular form allows the structural
15 discontinuities to be concentrated deliberately along the desired lines.

[0040]. In an embodiment of the present invention the oblique sides of said trapezium form an angle of between 15° and 90° with the longer base.

20 [0041]. Preferably, said oblique sides form an angle of between 45° and 90° with the longer base.

[0042]. Still more preferably, said oblique sides form an angle of 85° with the longer base of said trapezium.

[0043]. Favourably, in cross-section said grooves

present the shape of an isosceles trapezium.

[0044]. According to an aspect of the invention the grooves 10, 10' extend across said surface 8, 8', that is to say the entire thickness of plates 3, 3' is involved.

5 [0045]. In accordance with a preferred embodiment at least one of said grooves 10, 10' extends substantially along at least a portion of an orbit around the axis of symmetry s of brake disc 1.

[0046]. The term "orbit" is intended to define a
10 generic trajectory around the axis of symmetry s of the braking band, which does not leave said lateral surfaces 8, 8' 9, 9' and which preferably has a continuous concavity viewed from the axis of symmetry s.

[0047]. In other words, the curvature of the orbits
15 preferably never changes sign and the tangents to the same orbit do not intersect that orbit at any point.

[0048]. Preferably, the orbit is a circle or an ellipse.

[0049]. Alternatively, said orbit has a polygonal
20 shape.

[0050]. Preferably, therefore, plates 3, 3' have grooves 10, 10' with an annular shape on their inner surfaces 8, 8'.

[0051]. In accordance with a preferred embodiment the

grooves 10, 10' are formed on both inner surfaces 8, 8'.

[0052]. According to a further favourable aspect of the invention, the grooves 10, 10' along said circumference have the same length.

5 [0053]. In accordance with one embodiment of the invention, at least one of said grooves 10, 10' extends substantially along an eccentric circumference with respect to the axis of symmetry s of brake disc 1 (figures 2 and 3).

10 [0054]. According to an aspect of the invention, a first surface 8 defining the air duct 7 has a first groove 10 eccentric to the axis of symmetry s, and a facing second surface 8' defining said air duct has a second groove 10' eccentric to the axis of symmetry s and
15 geometrically opposite said first groove 10, as can be seen in figures 2 and 3.

[0055]. In other words, said first groove 10 and said second groove 10' have a substantially mirror image shape, but the first groove 10 is arranged in an angular
20 position around the axis of symmetry s offset 180° with respect to the angular position of the second groove 10'.

[0056]. The grooves 10, 10' are favourably mirror images of one another, in this way ensuring a substantially identical distribution of the stiff regions

and yielding regions, respectively, in both plates 3, 3'.
[0057]. Said grooves are favourably obtained by casting, through respective protuberances on the surface of a casting core.

5 [0058]. The plates 3, 3' of self-ventilated braking band 2 comprising said geometrically opposite eccentric grooves 10, 10' are connected by said connecting elements 4 in the shape of fins extending substantially radially to the axis of symmetry s.

10 [0059]. In other words, said connecting elements 4 are prevalently oriented in a radial direction to the axis of rotation s of brake disc 1 and are spaced apart uniformly.

[0060]. According to a preferred embodiment of the
15 invention, in the region of intersection or overlap (in the front view of the braking band 2 of figure 2) of the two eccentric and geometrically opposite grooves 10, 10', the connecting fins 4, and more precisely three of said fins, are interrupted (figures 1, 2 and 3) while in the
20 remaining regions, the grooves 10, 10' extend beneath the fins 4.

[0061]. For this reason the overlap of the two eccentric grooves 10, 10' defines at least one region of overlap, substantially a portion of a ring.

[0062]. Favourable, the overlap of the two eccentric grooves 10, 10' defines two regions of overlap.

[0063]. According to an aspect of the invention the two regions of overlap, that is the two portions of the ring,
5 are diametrically opposite (figures 2 and 3).

[0064]. For this reason the regions of overlap define a plurality of connecting elements 4 outside said regions of overlap, meaning that the connecting elements 4 outside said regions of overlap are those substantially
10 comprised in the ring portions complementary to the ring portions of overlap (in the front view of figure 2).

[0065]. In other words, in the non-intersecting regions of grooves 10, 10', said grooves 10, 10' pass beneath said fins 4, meaning that said fins 4 are not interrupted
15 in correspondence with said regions of intersection or overlap, but are astride the grooves, which extend in the plate.

[0066]. The edges 18 in the regions of intersection between the grooves 10 and connecting elements 4 are
20 preferably rounded.

[0067]. The connecting elements 4 between plates 3, 3' of the braking band 2 can be produced in any number and cross-section shape, aimed at ensuring both the rigid coupling between said plates 3, 3' and a cooling air flow

12 within air duct 7.

[0068]. According to an aspect of the invention said connection between the two plates 3 and 3' is formed by said shaped fins 4, which define a plurality of
5 ventilation channels 17 formed in said ventilation duct 7 and substantially radial to the axis of rotation s of brake disc 1 and spaced substantially uniformly apart.

[0069]. Furthermore, in figures 1 and 2 connecting elements 4 can be seen that form at least one clew or
10 swelling at their radial ends.

[0070]. In other words, at least one connecting element 4 or fin has a substantially oval and elongated cross-section and an enlargement or swelling at one end, for example circular, oval or polygonal, such as at least a
15 portion of cylinder, parallelepiped and similar, that is at least one connecting element 4 has two clews 11 on its ends.

[0071]. The clews 11 are thus suitable for reducing the inner width of the ventilation channels 17, that is, to
20 realise a local narrowing of said ventilation channels 17.

[0072]. Preferably, therefore, at least one of the fins 4, interrupted and arranged in the region of intersection or overlap of the grooves 10, 10', has two clews 11 or

enlargements at its two ends.

[0073]. In accordance with a favoured embodiment, the braking band 2 has at least six interrupted cooling fins 4 each bearing at least one of said clews 11 at its ends.

5 [0074]. Thus according to an aspect of the invention, each of the regions of intersection or overlap of grooves 10, 10' has three fins 4, each of which is an interrupted fin comprising an outer semi-fin 4' and an inner semi-fin 4'', meaning that said interrupted fin is not arranged as
10 a "bridge" over the grooves 10, 10'.

[0075]. Furthermore, each semi-fin 4' has a clew 11 at the peripheral end or, in accordance with one embodiment, two clews at the radial ends of the semi-fin.

[0076]. Moreover, each inner semi-fin 4'' comprises a
15 clew 11 at the end towards the region of groove overlap or, according to a further embodiment, two clews 11 arranged at the respective radial ends of said inner semi-fin 4''.

[0077]. Favourably, said six cooling fins 4 each
20 comprising an outer semi-fin 4' and an inner semi-fin 4'' are arranged in groups of three fins in regions diametrically opposite surfaces 8, 8', identified by the regions of groove intersection 10, 10'.

[0078]. So each of the fins 4, with the respective fins

arranged on its sides, realises each of said ventilation channels 17, meaning that said connecting elements 4 in combination are suitable for defining a ventilation channel 17.

5 [0079]. Favourably, therefore, the fins 4 in radial combination are suitable for defining the ventilation channels 17 spaced uniformly apart and arranged substantially radially.

[0080]. It is clear that the ventilation channels 17,
10 formed through fins 4 that present at least one clew 11 at one end, are ducts with at least one narrowed section, meaning that in each ventilation channel 17 (figures 2 and 4) the air flow 12 encounters at least one outer bottleneck 13 in its flow, in which the air speed
15 increases, improving the efficacy of the heat exchange with the braking band 2 and thus improving the cooling of disc 1.

[0081]. Preferably, therefore, the air flow 12 encounters at least one outer bottleneck 13 in each of
20 the ventilation channels 17.

[0082]. Furthermore, in the zone of intersection of grooves 10, 10', that is to say in the region in which the interrupted fins 4 each comprising an outer semi-fin 4' and an inner semi-fin 4'' are arranged, the cooling

air flow 12, in the ventilation channels 17 defined in said region of intersection, encounters in succession an inner bottleneck 15, an intermediate bottleneck 14 and said outer bottleneck 13, produced by the clews 11 formed
5 in the interrupted fins 4, meaning that each of the ventilation channels 17 comprises passages of reduced cross-section, which thus increase the speed of the cooling air 12.

[0083]. Thus according to an aspect of the invention,
10 the cooling air flow 12 in the regions of intersection or overlap of the grooves 10, 10' has greater speed and turbulence, the turbulent flow being at the same time effectively channelled and controlled by the narrowed sections formed in the ventilation channels 17.

15 [0084]. The conditions of the cooling air flow 12 achieved in this way in the ventilation channels 17 bearing the opportunely narrowed sections effectively increase the heat exchange between the air and disc 1, in particular in the peripheral zone of the braking band 2
20 and in the regions of intersection of the grooves 10, 10'.

[0085]. A braking band 2 for a disc 1 for a disc brake produced according to the invention has numerous advantages.

[0086]. The particular shape of the cross-section of grooves 10, 10', that is the fact that it becomes wider towards the air duct 7 for a predominant part of its depth, has an advantageous sound-damping effect.

5 [0087]. The arrangement of the grooves 10, 10' on the surfaces defining the air duct 7 inside the braking band 2 allows easy machining of the outer surfaces and avoids the need for machining to achieve said grooves 10, 10', with clear time and cost savings.

10 [0088]. The production of said grooves 10, 10' in the desired shape and arrangement on the inner surfaces defining the air duct 7 and opposite the outer braking surfaces prevents both the need to use special pads and the build-up of abrasive materials, as occurs in the
15 grooves of the known art.

[0089]. Grooves 10, 10' with different arrangements and depths provide an advantageous indication of the current state of wear of the brake disc 1 and/or the reaching of the maximum permissible wear of the brake disc 1.

20 [0090]. A further advantage of the present invention regards the cooling of brake disc 1 with the self-ventilated braking band 2.

[0091]. In fact, it has been seen that as well as increasing the cooling surfaces, the grooves 10, 10' on

the surfaces defining said air duct 7 inside the braking band 2 also create turbulence in the air flow, which in its turn favours the heat exchange between the plates 3, 3' and the air itself, thus improving disc cooling.

5 [0092]. According to a further advantageous aspect of the present invention, the provision of the fins 4 with clews 11 at their ends reducing the inner width of the ventilation channels 17 enables an increase in the speed and turbulence of the cooling air flow 12, increasing
10 heat exchange and thus increasing the cooling of disc 1.

[0093]. Also advantageously, the provision of the clews 11 on the fins 4 near the regions of intersection or superimposition of the grooves 10, 10' allows excellent channelling and control of both the cooling flow 12 and
15 the generated air vortex, with the elimination of annoying vibrations and periodic-type noise 18, thanks to the local narrowing of the ventilation channels 17 obtained by the arrangement of the clews 11 or enlargements at the ends of the fins 4.

20 [0094]. Unexpectedly in fact, thermal cracking due to non-uniform cooling is not generated along the surfaces of the fins 4 or plates 3, 3'.

[0095]. Surprisingly, in fact, the arrangement of the clews 11 on the ends of fins 4 also introduces an overall

structural strengthening of the plates 3, 3', which provides an excellent counter-balance for the yielding introduced by grooves 10, 10'.

[0096]. Furthermore, the clews 11 coupled at the regions of intersection of the grooves 10, 10', that is to say the region with the greatest intrinsic structural yielding, gives a notable local strengthening of the plates 3, 3'.

[0097]. For this reason the presence of the clews 11 introduces an advantage related to the increased efficacy of the thermal exchange that acts synergically with said mechanical and structural strengthening, allowing the unusual effect of eliminating thermal cracking.

[0098]. In the case of grooves involving the entire plate thickness, their specific cross-section shape, becoming narrower towards the friction surface of the braking band, advantageously inhibits the build-up of abrasive material from the pads and favours the break-up of material protruding from the pads in the region of the annular grooves.

[0099]. Uneven wear of the pads is consequently impeded.

[00100]. The production of projections aimed at cutting said material projecting from the pads even prevents the

initial formation of any projection in the region of the annular grooves before breaking it up, thanks to the cross-sectional shape of said groove.

[00101]. As well as all the above advantages, where the
5 eccentric grooves open towards the outer surfaces 9, 9'
of plates 3, 3', they perform a radial outward and return
travel across the braking surfaces 9, 9' of the braking
band 2 on each revolution of the braking band around the
axis of symmetry of the brake disc, restoring the
10 friction surfaces of the pads 16 and favouring their even
wear.

[00102]. The braking band 2 and the bell 5 may also be
produced in two separate parts which can be coupled
together.

15 [00103]. Naturally, in order to satisfy contingent and
specific requirements, a person skilled in the art may
apply further modifications and variations to the braking
band 2 according to the present invention, all of which
are however included within the scope of protection of
20 the invention as defined by the following claims.

CLAIMS

1. Braking band (2) of a disc-brake disc (1) comprising at least two plates (3, 3') connected together by
5 connecting elements (4), in which the air space between said plates forms an inner air duct (7) to cool said braking band (2), and in which at least one of the plates (3, 3') has on one of its surfaces (8, 8') defining said air ducts (7) at least one groove (10, 10') extending
10 along at least a portion of an orbit around an axis of symmetry (s) of disc (1) and having a cross-section which becomes wider, for a predominant part of its depth, towards said air duct (7), characterised by the fact that said connecting elements (4) are suitable for defining in
15 combination at least one ventilation channel (17) and have at one end a clew element (11) suitable for producing a local narrowing of said ventilation channel (17).

2. Braking band (2) according to claim 1, wherein said
20 groove (10, 10') extends substantially along an eccentric circumference with respect to the axis of symmetry (s) of the disc (1).

3. Braking band (2) according to claims 1 or 2 wherein said groove (10, 10') is open towards the outer surface

(9, 9') of said plate (3, 3').

4. Braking band (2) according to claims 1 or 2 wherein said groove (10, 10') has a depth less than the thickness of said plate (3, 3').

5 5. Braking band (2) according to any of the previous claims, wherein at least one of the grooves (10, 10') is annular.

6. Braking band (2) according to any of the previous claims, wherein at least one groove (10, 10') has a
10 greater depth than the depth of at least one other groove (10, 10').

7. Braking band (2) according to any of the previous claims, wherein at least one groove (10, 10') has a greater width than the width of at least one other groove
15 (10, 10').

8. Braking band (2) according to any of the previous claims, wherein the grooves (10, 10') of said first and second surface (8, 8') are annular.

9. Braking band (2) according to any of the previous
20 claims, wherein a first surface (8) defining the air duct (7) has a first groove (10) eccentric with respect to the axis of symmetry (s) and a facing second surface (8') defining said air duct (7) has a second groove (10') eccentric to the axis of symmetry (s) and geometrically

opposite said first groove (10).

10. Braking band (2) according to claim 9, wherein said eccentric grooves (10, 10'), by overlapping one another, define a region of overlap.

5 11. Braking band (2) according to claim 10, wherein said region of overlap defines a plurality of connecting elements (4) outside said region of overlap.

12. Braking band (2) according to any of the previous claims, wherein said grooves (10, 10') pass beneath said
10 connecting elements (4) outside said region of overlap.

13. Braking band (2) according to any of the claims 10 to 12, characterised by the fact that said connecting elements (4) are interrupted near said region of overlap.

14. Braking band (2) according to any of the previous
15 claims, characterised by the fact that said connecting elements (4) are each produced in the shape of fins.

15. Braking band (2) according to claim 13 or 14, wherein said interrupted connecting elements (4) each comprise an outer semi-fin (4') and an inner semi-fin
20 (4'').

16. Braking band (2) according to any of claims 13 to 15, wherein said cooling air flow (12), in the ventilation channels (17) arranged in said region of overlap and defined by said interrupted connecting

elements (4), encounters in succession an inner bottleneck (15), an intermediate bottleneck (14) and an outer bottleneck (13), defined by said clews (11) and suitable for increasing the speed of said cooling air flow (12).

17. Braking band (2) according to claim 16 wherein each of said ventilation channels (17) comprises at least one outer bottleneck (13) suitable for increasing the speed of said cooling air flow (12).

10 18. Braking band (2) according to any of the previous claims, wherein at least one of said grooves (10, 10') has a trapezoid shape in cross-section.

19. Braking band (2) according to claim 11, wherein the oblique sides of said trapezium form an angle between 15° and 90° with the longer base.

20. Braking band (2) according to claim 11 or 12, wherein said grooves (10, 10') have the shape of an isosceles trapezium in cross-section.

21. Braking band (2) according to any of claims 11 to 20 13, wherein the oblique sides of said trapezium form an angle of 85° with the longer base.

22. Braking band (2) according to any of the previous claims, wherein the edges of said groove (10, 10') are rounded.

23. Braking band (2) according to any of the previous claims, wherein at least one of said grooves (10, 10') on the surface (8, 8') opposite the braking surface (9, 9') of each brake plate (3, 3') has a depth (13) equal to the
5 minimum permissible thickness of the respective worn brake plate (3, 3').

24. Braking band (2) of a disc-brake disc (1) comprising at least two plates (3, 3') connected between them by connecting elements (4), in which the air space between
10 said plates forms an inner air duct (7) to cool said braking band (2), and said two plates (3, 3') have on two the corresponding surfaces (8, 8') defining said air ducts (7) at least two eccentric grooves (10, 10') extending along at least a portion of an orbit around an
15 axis of symmetry (s) of the disc (1) and which by overlapping define a region of overlap and also having cross-section which becomes wider, for a predominant part of their depth, towards said air duct (7), wherein moreover said connecting elements (4) are suitable for
20 defining in combination at least one ventilation channel (17) having at one end at least one clew element (11) suitable for producing a local narrowing of said ventilation channel (17) and wherein the connection elements provided in said region of overlap of said

grooves (10, 10') are interrupted and have a plurality of said clew elements (11) formed near said region of overlap and suitable for producing said local narrowing.

25. Disc-brake disc comprising a braking band (2)
5 according to any of the previous claims.

26. Disk brake comprising a disk-brake disk (1)
according to claim 25.

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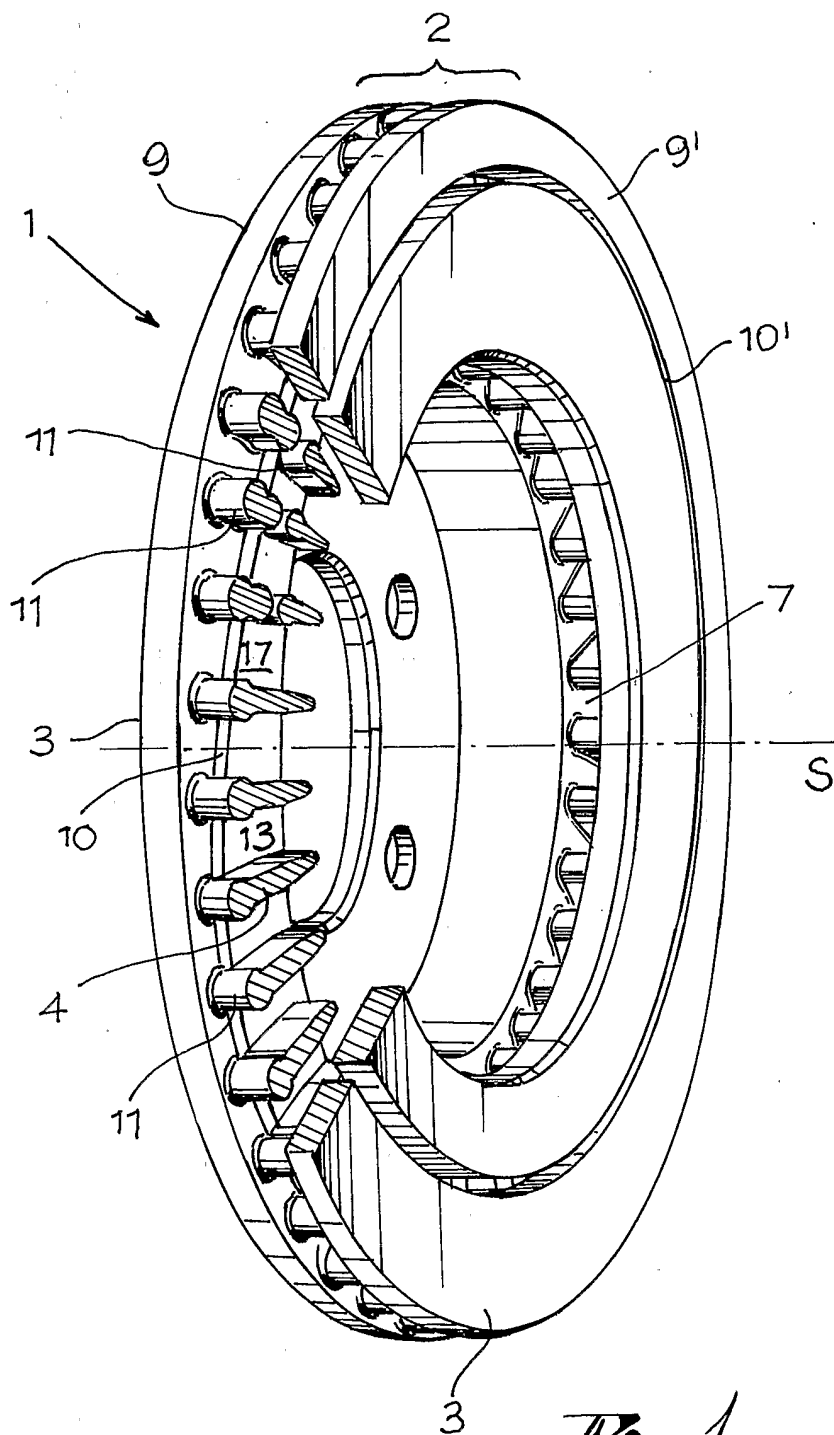


Fig. 1

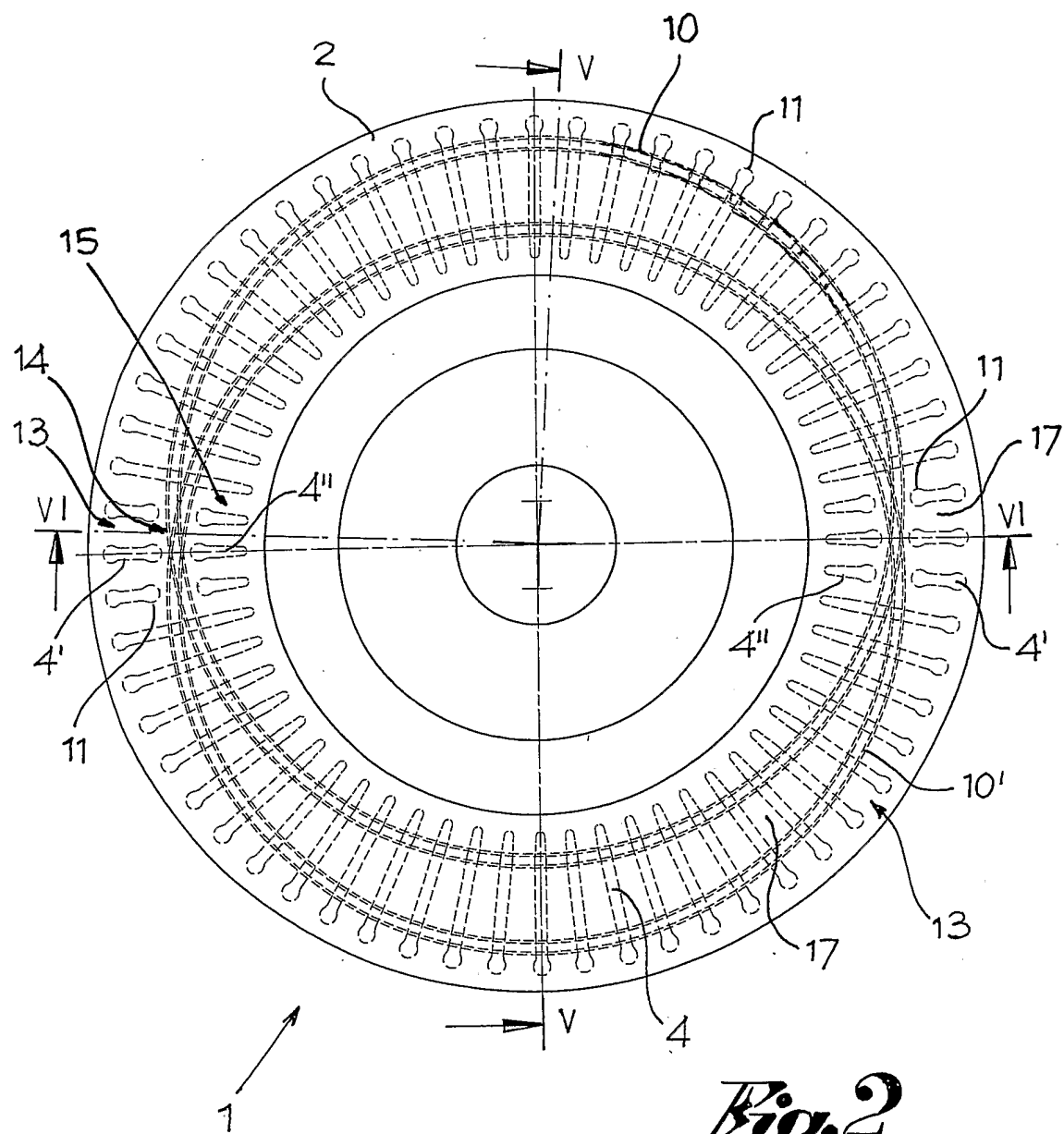
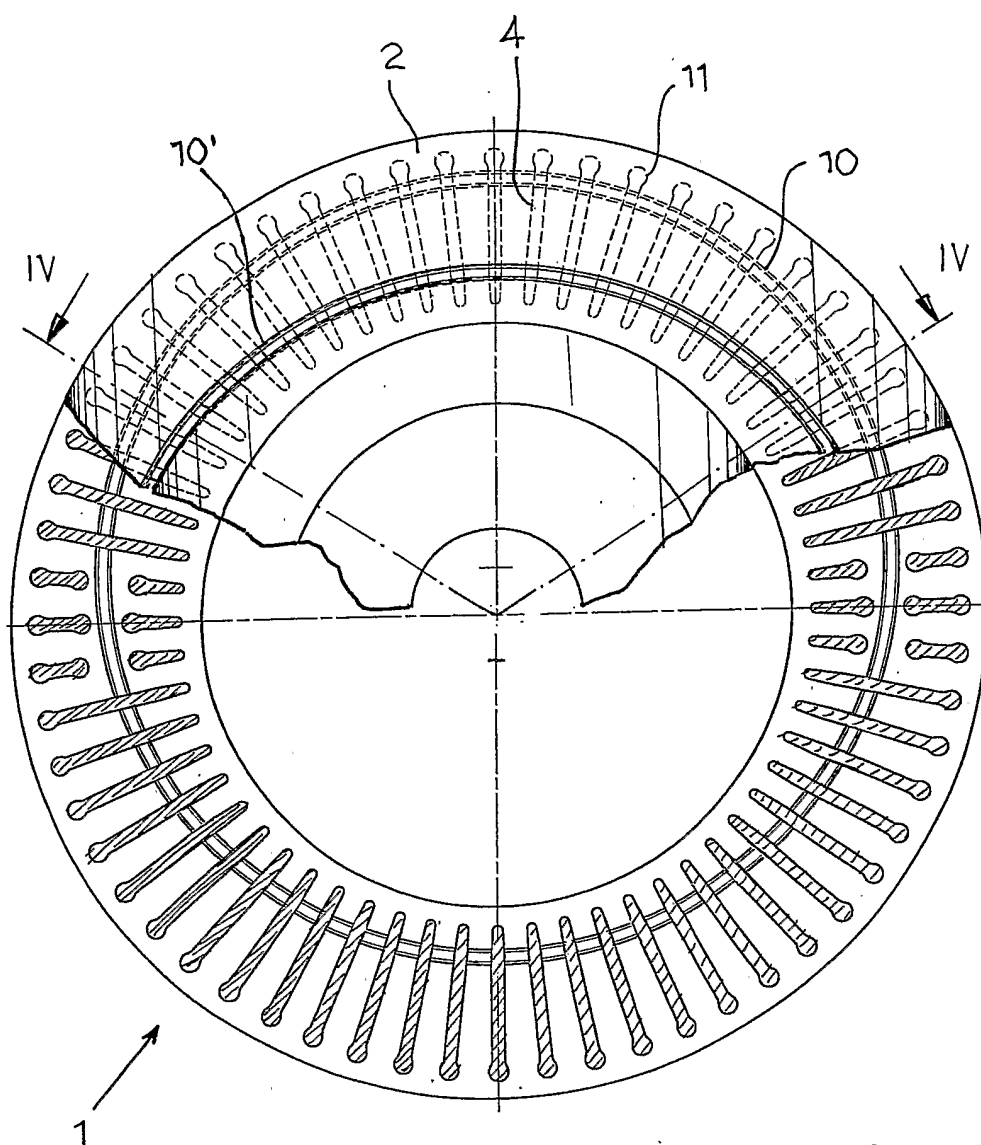
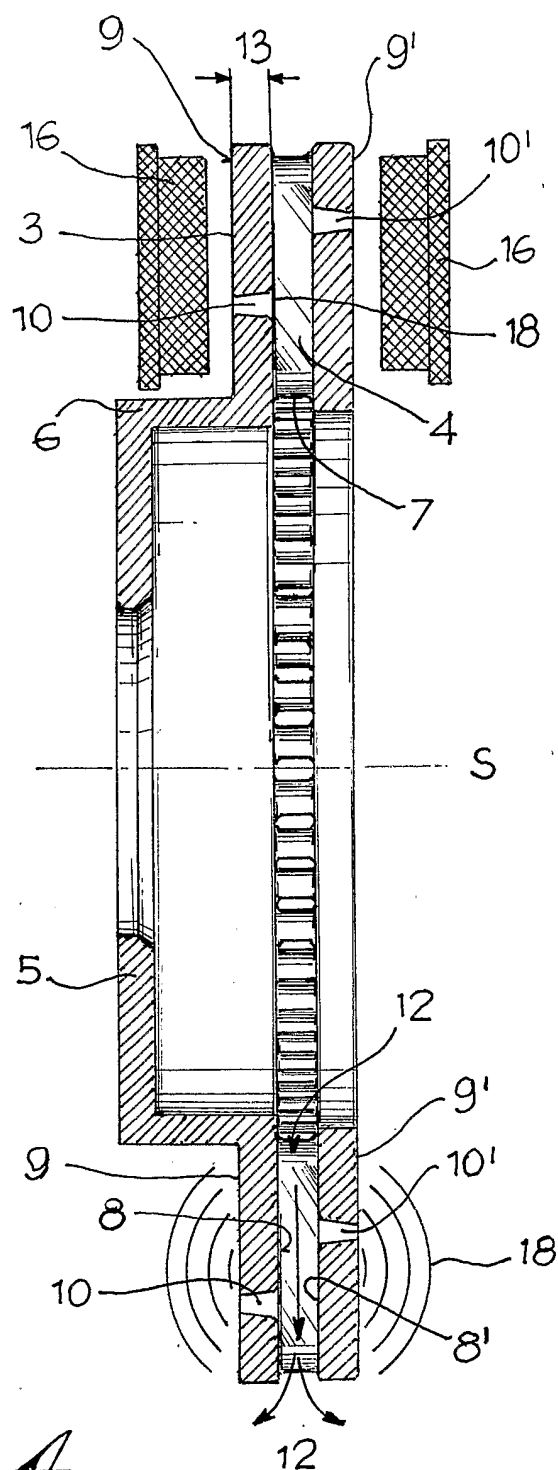


Fig.2

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*Fig. 3*

4/5

*Fig. 4*

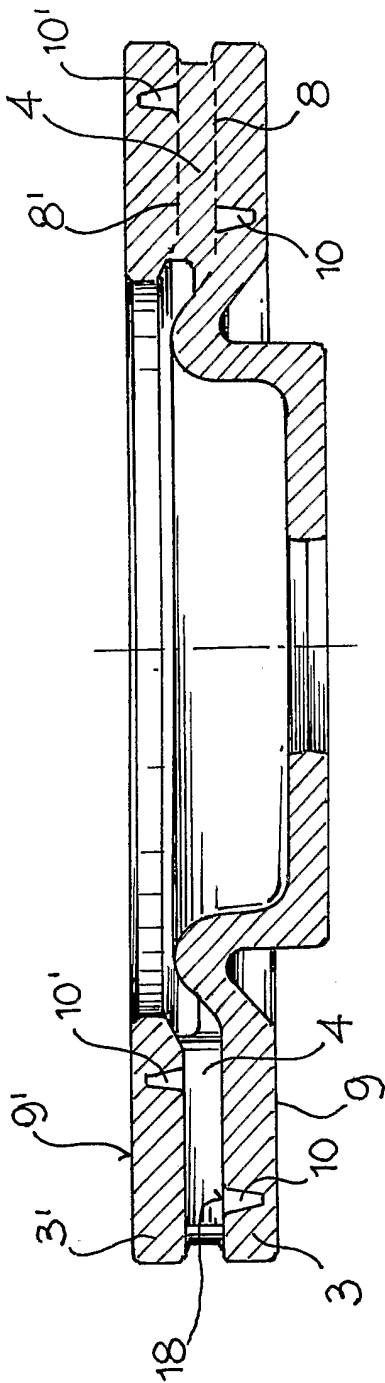


Fig. 5

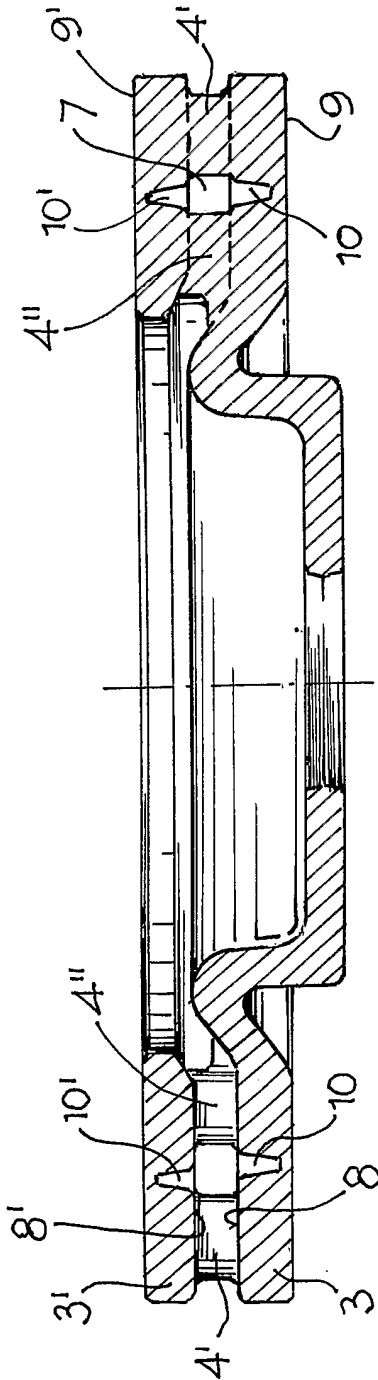


Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT2004/000726

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16D65/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/097292 A (FRENI BREMBO S.P.A; MERONI, GIUSEPPE; RAVASIO, SIMONE; OBERTI, LEONE) 5 December 2002 (2002-12-05) cited in the application the whole document	1-26
X	EP 1 048 874 A (FRENI BREMBO S.P.A) 2 November 2000 (2000-11-02) paragraph '0016! - paragraph '0027!; figures 3,7	1
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

16 June 2005

Date of mailing of the international search report

23/06/2005

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IT2004/000726

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