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(71) Applicant (for all designated States except US): **FRENI  
BREMBO S.P.A.** [IT/IT]; Via Brembo, 25, I-24035 Curno  
(IT).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **GOTTI, Giovanni**  
[IT/IT]; Via Matteotti, 1, I-24036 Alm  (IT). **CAVESTRO,**  
**Luigi** [IT/IT]; Via Matteotti, 3, I-24030 Valbrembo (IT).

(74) Agents: **MACCALLI, Marco** et al.; Jacobacci & Partners  
S.p.A., Via Senato, 8, I-20121 Milano (IT).

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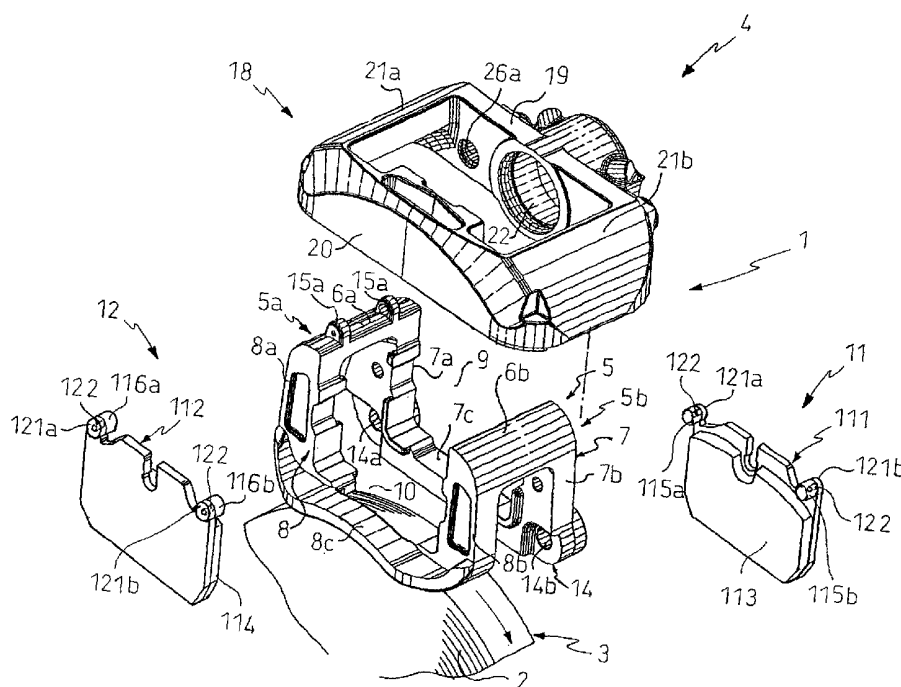
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(54) Title: BRAKE PAD FOR DISK BRAKE



(57) Abstract: A pad (11) for a disk brake comprising a plate (111) for supporting a friction lining (113) which can come into contact, at the braking stage, with a disk associated with the brake is characterized in that the pad comprises means (115a, 115b) associated rigidly with the plate for varying the mass of at least one portion (121a; 121b) of the plate so as to achieve an inertia of the pad that substantially prevents vibrations of the pad which could cause noise of the disk brake during braking.

Brake pad for disk brake

The present invention relates to pads for disk brakes and to disk brakes using the pads.

5 In general, in a disk brake, the braking action is produced by means such as, for example, cylinder and piston units which act on opposite surfaces of a rotating disk by means of pads.

As is known, a noise is often generated during this  
10 braking action and takes the form of a particularly annoying whistle which reduces travelling comfort.

The generation of noise of this type is attributed to vibratory phenomena which involve various components of the brake, also including the pads.

15 Much research has been carried out with the purpose of suggesting techniques for reducing or eliminating braking noise.

One of these techniques proposes that a weight be connected, by means of an elastic body, to a component of  
20 the disk brake which might start to vibrate. According to this technique, any vibration of this component of the brake is transmitted to the weight which, for low frequencies, oscillates in phase with the component to which it is connected. As the vibration frequency  
25 increases, the oscillations of the weight and of the

brake component become increasingly out of phase until a condition of phase opposite is reached, in which the vibration of the component is reduced or cancelled out. Moreover, according to this technique, the weight may be  
5 fitted alternatively on the piston, on the caliper body, or on the pad.

This technique requires the entire structure of the brake to be designed specifically.

This designing is necessary in order to produce an  
10 intermediate elastic element suitable to be placed between the brake component the oscillations of which are to be damped and a suitable weight, and also to provide a seat in which the weight can oscillate, deforming the elastic body.

15 The need to modify the structure of the brake so greatly in order to reduce the whistle phenomenon represents a considerable disadvantage. In fact, given the complexity of the phenomena which occur during a braking operation, and given their dependence on the  
20 particular application, that is to say on the type of vehicle in which the disk brakes are used, a particular solution which is optimal on the basis of theoretical simulations may not be satisfactory as a result of experimental tests or as a result of its use for  
25 applications other than those provided for.

Arrangements which do not have a great impact on the overall structure of the disk brake are therefore of particular interest.

The problem upon which the present invention is based is that of proposing a disk brake which has structural and functional characteristics such as to overcome the above-mentioned disadvantages mentioned with reference to the prior art.

This problem is solved by means of a pad for a disk brake comprising a plate for supporting a friction lining which can come into contact, at the braking stage, with a disk associated with the disk brake, characterized in that the pad comprises means associated rigidly with the plate for varying the mass of at least one portion of the plate so as to achieve an inertia of the pad that substantially prevents vibrations of the pad which could cause noise of the disk brake, during braking.

Further characteristics and the advantages of the invention will become clear from the following description of preferred embodiments thereof, provided by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a perspective view of a braking unit comprising two pads, with parts separated, in accordance with a first embodiment of the invention,

Figure 2 is a plan view of the disk brake of Figure 1, partially sectioned on the line II-II,

Figure 3 is a partially-sectioned side view of the disk brake of Figure 1,

5        Figure 4 is a schematic plan view of a disk and of a pad according to the prior art,

Figure 5 is a schematic front view of a second embodiment of a pad according to the invention,

10       Figure 6 is a schematic front view of a third embodiment of a pad according to the invention,

Figure 7 shows successive steps A-F for the production of the plate of the pad of Figure 6,

Figure 8 is a plan view of a fourth embodiment of a pad according to the invention, and

15       Figure 9 is a perspective view of a fixed-caliper disk brake, according to the invention.

With reference to Figures 1, 2 and 3, taken together, these show a disk brake 1 which can act on a braking band 2 of a disk 3 forming a braking unit 4,  
20       particularly for a motor vehicle, not shown.

In the particular embodiment shown in Figures 1, 2 and 3, the disk brake 1 is of the floating-caliper type, but the present invention may be applied to disk brakes of different types such as, for example, fixed-caliper  
25       disk brakes.

The disk brake 1 can be fixed to a stub axle of the motor-vehicle suspension and the disk 3 can be associated with a wheel of the motor vehicle. With reference to Figure 2, for a rotation of the disk 3 in the direction indicated by the arrow F1, the portions of the disk which lie on the left-hand side and on the right-hand side of the line III-III are defined as the input region and the output region for the disk 3, respectively.

The disk brake 1 comprises a caliper-holder body 5 in turn comprising two bridge elements or yokes 5a and 5b both of which are U-shaped and which lie in mutually spaced-apart planes. Each yoke 5a (5b) has a substantially shaft-shaped end 6a (6b) and two sides 7a, 8a (7b, 8b). The two yokes 5a (5b) are connected to one another rigidly in the region of the ends of the sides 7a and 7b and of the sides 8a and 8b, respectively, by respective cross-members 7c and 8c.

Respective seats 9 and 10 are formed in the sides 7 and 8 for housing respective pads 11 and 12.

The caliper-holder body 5 has holes 14a and 14b disposed at the ends of the cross-member 7c for the fixing of the caliper-holder body 5 to the stub axle of the motor-vehicle suspension.

A spring 15 is provided for restraining the pads 11 and 12. The spring 15 extends between the pads 11 and 12

and the caliper-holder body 5. In particular, the spring 15 is shaped as a leaf-spring with one end supported, by means of a pin 15b, by lugs 15a projecting from the end 6a and with an opposite end fitted under the end 6b. In  
5 an intermediate region, the spring 15 comprises two arms 16 and 17 acting on the pads 11 and 12, respectively.

The disk brake 1 comprises a substantially rectangular, rigid frame 18 through which the caliper-holder body 5 extends in an assembled configuration of  
10 the disk brake. The rigid frame 18 can surround the caliper-holder body 5 in the manner of a frame.

In particular, the rigid frame 18 is formed by opposed long sides, indicated 19 and 20, and by opposed short sides, indicated 21a and 21b.

15 The long side 19 extends beside the side 7 at the level of the seat 9 and has a seat 22 for a hydraulic piston 23 acting on the pad 11.

The long side 20 extends beside the side 8 at the level of the seat 10 of the pad 12 and has a projection  
20 24 having a flat surface 25 which faces the seat 10 and can act on the pad 12.

In the region of the long side 19, the frame 18 has two cylindrical seats 26a and 26b, which are arranged one on each side of the seat 22 of the piston 23, and which  
25 are in engagement for sliding in a guided manner with two

cylindrical guides 27a and 27b fixed to the caliper-holder body 5 in the region of the sides 7a and 7b.

The pads 11 and 12 comprise respective plates 111 and 112 for supporting corresponding friction linings 113  
5 and 114.

Means are associated with the end portions of each plate 111 (112) for varying the mass of these portions. In the specific example shown, these mass-varying means comprise two weights 115a, 115b fitted on the plate 111  
10 and two weights 116a and 116b fitted on the plate 112.

The pad 11 and the plate 111 will be described in detail below but, as will be clear to an expert in the art, this description can easily be extended to the pad 12 and to the plate 112 which are just the same as the  
15 pad 11 and the plate 111.

The plate 111 advantageously has a portion 121a and a portion 121b each having a rounded shape. The two portions 121a and 121b are disposed at opposite ends of the plate so that they face the input and output regions  
20 of the disk 3, respectively, when the plate is mounted in the disk brake 1. These two portions 121a and 121b of the plate 111 have an initial mass  $m_i$ .

According to the particular embodiment of the invention shown in Figures 1-3, the two portions 121a and  
25 121b are appropriately provided with screws 122 for the

fixing of the weights 115a and 115b which, in the embodiment shown, are cylindrical and have respective threaded holes suitable for housing screws 122. The weights 115a and 115b may be made of the same material of which the plate is made, or of a material having a different specific weight from that of the plate.

The weights 115a and 115b are arranged on the plate 11 in a suitable manner such that they are disposed beyond the outer edge of the disk when the plate is mounted in the disk brake 1. Contact between the weights 115a and 115b and the disk 3 is thus avoided, even after the friction lining 113 has worn.

In order to prevent the weights 115a and 115b coming into contact with respective symmetrical weights 116a and 116b of the plate 112, as a result of wear of the friction lining 113, the weights 115a, 115b, 116a, 116b preferably project inwardly relative to the disk brake 1 by a distance equal to less than half of the thickness of the disk 3.

It should also be noted that other means such as, for example, rivets, nails, calking, welding, glues and the like, may be used instead of the screws 122 for fixing the weights 115a and 115b to the plate 111.

The fixing means used for the pad 11 enable the weights 115a and 115b to be coupled structurally to the

plate 111 substantially rigidly, that is, in a manner such that the plate 111, together with the weights, substantially forms a single rigid body.

It is pointed out that the portions 121a and 121b  
5 provided with the weights 115a and 115b have an overall mass  $m_c$  which has changed and, in the specific case, has increased in comparison with the initial mass  $m_i$  which they had without the fitting of the weights.

It is pointed out, in particular, that the overall  
10 inertia of the pad provided with the weights 115a and 115b is modified in comparison with the inertia of the pad alone.

The cylindrical weights 115a and 115b are a particular example of mass-varying means which can be  
15 fitted on suitable portions of the plate 111.

Further means for varying the mass of a portion of the plate 111 may also be formed "integrally" with the plate during its production. For example, if the plate 111 is produced by casting, portions of the plate having  
20 a greater material content and hence a greater mass are formed. Alternatively, these portions of greater mass may be produced, for example, by folding suitable edge portions of the plate onto themselves. In this latter case, the plate 111 is formed by blanking of sheet metal  
25 resulting from a pressing stage, in which the presence of

the necessary additional material in the form of edge portions suitable for bending is provided for. This additional material can be bent by deformation so as to confer the desired shape on a portion of the plate.

5 Figure 6 shows a pad 200 of this type schematically and in a front view. The pad 200 comprises a plate 201 which supports the friction lining 113 and which, in the region of the portions 121a and 121b, has two edge portions 221a and 221b which can be bent onto themselves by

10 deformation. In the embodiment shown in Figure 6, the edge portions 221a and 221b, shown in broken outline, are in the form of strips.

Figure 7 shows six side views A-F of the plate 201, corresponding to six successive stages of the bending of

15 the portions 221a and 221b. In stage A, the portions 221a and 221b of the plate 201 are in the non-bent state, as they are produced by the blanking, and in the subsequent stages, the portions are bent onto themselves until they adopt the final configuration F.

20 The weights 115a and 115b may also be produced with the use of the same material of which the friction lining 113 is made. In this connection, it should be noted that, in accordance with conventional techniques, the friction lining is fixed to the plate by causing the

25 material which constitutes the friction lining to adhere

to a surface of the plate by means of a suitable semi-open mould which confers the desired shape. The adhesion of the lining to the plate is achieved, in addition to possible gluing, by pressing the mould and hence the material held therein against the plate at suitable temperatures.

In order to produce weights 115a and 115b made of the same material as the lining, the above-described method used for fixing the lining itself may be used, with the mould modified so as to provide suitable cavities in which to place the additional material corresponding to the weights.

The physical and geometrical characteristics and the arrangement on the plate 111 of the means for varying the mass of one or more portions of the plate are such as to achieve an inertia of the pad 11 that substantially prevents vibrations of the pad which arise during braking and which may cause noise of the disk brake.

In particular, the mass-varying means are such that the pad 11 adopts natural vibration frequencies which cannot substantially be excited during the operation of the disk brake 1.

To complete the description, the operation of the disk brake 1 will be described below.

Upon braking, as a result of the thrust of the

piston 23 against the pad 11, the frame 18 moves or floats along the guides until both the pad 11 on which the piston 23 acts and the opposed pad 12 on which the flat surface 25 acts are pressed into contact with the  
5 braking band 2 and act thereon with equal and opposite forces.

The advantages with regard to the noise of the disk brake according to the invention will become clearer from the following description of experimental analyses  
10 carried out on a conventional disc brake.

Figure 4 shows in plan a disk 40 rotating in the direction indicated by the arrow F2. The disk 40 is in contact with a lining 43 of a pad 41 comprising a plate 42 for supporting the friction lining 43.

15 As a result of the test, and as shown schematically in Figure 4, it was found that, during braking, the braking band of the disk 40 vibrates, adopting a substantially sinusoidal wave form represented by a curved line 45.

20 The vibration of the braking band of the disk 40 excites the pad 41 causing it to vibrate in turn. It was found that the pad 41 vibrates with a pivoting movement about an axis indicated by a cross in Figure 4, substantially transverse the pad and parallel to a radial  
25 axis of the disk 40. This vibratory movement was

observed as a result of measurements made by means of accelerometers which were placed on the pads 41 and which also detected different acceleration values in the regions of the pad facing the input and output regions of the disk 40.

In Figure 4, the difference between the accelerations measured is indicated by arrows F3 and F4 of different sizes. It is pointed out that, a greater acceleration was measured in the output region of the disks 40 than in the input region. Moreover, it should be noted that, when the whistling phenomenon arises, not only do vibrations of the braking band and of the pad occur, but the various components of the brake vibrate in resonance, influencing one another. In other words, a chain of vibrating elements is established, starting from the disk and passing through the pads and the caliper body until it also involves the suspension of the vehicle and the vehicle body itself. Every element making up the disk brake vibrates at its own natural frequency.

In the disk brake 1 according to the invention, the means for varying the mass of one or more portions of the pad 11 enable the moment of inertia of the pad 11, evaluated with respect to the axis about which the pad vibrates during braking, to be modified.

As is known, the natural vibration frequency of any

body, at which the body goes into resonance, is inversely proportional to the moment of inertia of the body.

The modification of the moment of inertia of the pad achieved by the above-mentioned mass-varying means causes  
5 the natural frequency of the pad to adopt a value which cannot substantially be excited by the other elements of the disk brake or by the disk itself during braking. In other words, in the disk brake formed in accordance with the invention, the chain of vibrating elements which is  
10 established during whistling is broken. Since the pad according to the invention is able neither to be excited nor to transmit the vibration, it represents a vibration-damping element.

Tests carried out on a disk brake similar to the  
15 disk brake 1 and formed in accordance with the invention have shown a reduction in whistling during braking.

In particular, the pad 11 formed in accordance with the invention is such as to have natural vibration frequencies which are not excited by the braking action  
20 or which fall outside the range of frequencies to which whistling phenomena normally correspond.

The characteristics of the mass-varying means associated with the plate can be determined experimentally in relation to a specific application,  
25 that is, for a specific disk brake and for a particular

vehicle.

The following is an example of a method for determining the characteristics.

A conventional disk brake suitable for fitting in a  
5 specific vehicle and comprising two pads having an  
initial structure determined in accordance with a  
conventional design method is considered. For example, a  
disk brake of the type shown in Figures 1-3, in which the  
plates 111 and 112 have no weights 115a, 115b or 116a,  
10 116b, is referred to. In this case, the plates 111 and  
112 are substantially plate-shaped.

In a first step, the behaviour of the disk brake in  
operation is analyzed, for example, by fitting it on the  
vehicle for which it has been designed and evaluating its  
15 performance during braking.

Its performance can be evaluated with conventional  
instrumentation by determining the noise spectrum which  
is manifested by a whistle produced during braking, or by  
listening to the noise directly. The performance of the  
20 brake may also be evaluated by measuring the magnitude of  
the vibrations of the pad, preferably in those portions  
of the plate which face the input and output regions of  
the disc, with accelerometers known to experts in the  
art.

25 An expert in the art can easily establish a

reference noise level corresponding to satisfactory performance for a given range of frequencies.

If performance is not satisfactory, that is, if there is a noise level greater than the reference level,  
5 a subsequent step comprising variation of the mass of one or more portions of the plates is performed.

As stated above, this variation of the mass is achieved, for example, by fitting weights rigidly to each plate.

10 Each plate advantageously comprises one or more fixing means similar to those defined above, which enable the weights to be fitted.

Alternatively, the pads according to the method described may be of the type shown schematically in  
15 Figure 5. In Figure 5 and in subsequent figures, the same reference numerals have been used as in the previous drawings to indicate similar or identical elements.

The pad 150 of Figure 5 comprises a plate 151 having portions 152 which are removable from the plate. Each  
20 portion 152 can be removed in order to be replaced by a portion having a different mass, for example, having the same volume but a different specific weight, or may be removed without being replaced.

The removal of one or more portions 152 of the plate  
25 151 leads to a reduction in the moment of inertia of the

pad 150. The reduction in the moment of inertia may shift the natural vibration frequencies of the pad 150 towards higher values but in any case outside the range of frequencies which are excited particularly during  
5 braking. Portions of the material of the plate may also be removed by perforation of portions of the plate, insofar as the structural functions of these portions allow.

The weights fitted on the plates 111 and 112, as  
10 well as the other means which can be used to vary the mass, are advantageously positioned in a manner such that they do not come into contact with the friction lining.

These weights are preferably positioned in regions which are disposed at opposite ends of the plate and  
15 which face the input and output regions of the disk 3. The increase in the moment of inertia of the plate and of the pad as a whole in order to reduce its natural vibration frequency is thus maximized.

The weights will advantageously have a mass  
20 proportional to the acceleration of the region of the plate to which they are fitted.

On the basis of the test measurements, the mass of the weight 115b fitted to the region of the plate corresponding to the output region of the disk 3 is  
25 typically greater than the mass of the weight 115a fitted

to the region of the plate corresponding to the input region of the disk 3.

The behaviour of the disk brake thus modified is analyzed again to assess whether the noise level is lower  
5 or higher than the reference level.

The modification of the mass is repeated until the disk brake has the desired performance with regard to noise, that is, until a value of the noise level approximately equal to preferably below the reference  
10 level is obtained.

The further modification may take place by replacing the weights previously fitted with other weights having lower or higher masses, or by adding other weights and/or by varying their positions. The fixing means applied to  
15 the plate, such as the screws 122, are advantageously such as to permit the subsequent removal of a weight previously fixed. Moreover, the other mass-modifying means described above or any other means suitable for the purpose are also applicable to this method.

20 When the disk brake analyzed achieves a satisfactory performance, the corresponding plates have adopted an optimal final structure as a result of the modifications applied.

These plates may themselves represent the plates  
25 which are suitable for that specific disk brake or may be

considered as prototypes for the design of definitive plates. For example, the definitive plates may make use of mass-varying means produced integrally at the production stage, as described above, but nevertheless  
5 having characteristics similar to those resulting from the tests performed. In this connection, Figure 8 shows a side view of a pad 160 comprising a plate 162.

The plate 162 comprises a substantially plate-shaped main body 163 and, at its ends, two portions 164 fixed to  
10 the main body 163, produced by casting, and having a function similar to that of the weights used in the above-described method according to the invention. As can be seen from Figure 8, the two portions 164 appear as projections which extend from the main body 163 towards  
15 the lining 113, giving the plate 162 a generally non-plate-like shape. In the embodiment of Figure 8, the masses of two portions 164 are different and depend on the positions which the two portions 164 adopt within the disk brake, relative to the input and output regions of  
20 the disk.

The above-described method according to the invention is particularly advantageous since the modifications to be performed on the structure of the plate in order to determine an optimal structure do not  
25 involve substantial modification of the other components

of the disk brake (for example the caliper body or the piston). This means that the pad produced by the method according to the invention can also be used to replace conventional pads present in already-existing disk brakes  
5 of the same type.

Figure 9 shows a fixed-caliper disk brake 100.

This unit comprises a caliper, generally indicated 102, which extends astride a sector of a braking disk 109. The caliper 102 comprises a first half-body 103, a  
10 second half-body 104, and two connecting elements 105 and 105' between the first and second half bodies 103 and 104.

The caliper 102 can be fixed to a stub axle of the suspension of the motor vehicle, and the disk 109 is  
15 suitable for association with a wheel of the motor vehicle. The first and second half-bodies 103 and 104 are in the form of reflectively symmetrical elongate shells to be positioned on opposite sides of the disk 109.

20 In particular, the first half-body 103 is arranged so as to face a first braking surface 191 of the disk. The second half-body 104 is positioned so as to face a second braking surface 192 of the disk.

Each of the first and second half-bodies 103 and 104  
25 has a surface 130 or 141 facing the disk and an opposed

surface 131 or 140.

Each of the surface 130 of the first half-body 103 which faces the disk and the surface 141 of the second half-body 104 which faces the disk has two seats 133 or  
5 143, respectively, (Figure 9 shows only the lateral seats 143) formed beside a corresponding central portion 132 or 142.

Each of the lateral seats 133 and 143 has through-holes 134 and 144 for housing corresponding screws 135  
10 and 145 for fixing to the connecting elements 105 and 105'.

In each of the central portions 132 and 142, on the other hand, two hydraulic braking cylinders are formed integrally in the first and second half-bodies 103 and  
15 104 and are arranged so as to face and open onto the respective surfaces 130 and 141 facing the disk, only the cylinders 140 of the second half-body 104 being shown in Figure 9.

Moreover, each of the first and second half-bodies  
20 103 and 104 comprises a pair of pistons guided for sliding in the hydraulic cylinders.

The first and second half-bodies 103 and 104 have ducts in conventional manner, for supplying brake fluid to the cylinders formed in the half-bodies and housing  
25 the pistons.

In each of the central portions 132 and 142 there are also two through-holes 136 or 146, respectively, for engagement by two guide pins 106.

The guide pins 106 have the function of guiding two  
5 pads 107, each mounted between the pistons of the first and second half-bodies 103 and 104 and the braking surfaces 191, 192 of the disk.

In particular, the pads 107 which, typically, are wholly identical and opposed, comprise respective plates  
10 171 for supporting corresponding friction linings 172. The friction linings 172 are fixed, in conventional manner, to respective support surfaces 173 of the plates, these surfaces facing towards the braking surfaces of the disk. Moreover, each plate 171 has two through-holes 174  
15 corresponding to the through-holes 136 and 146 formed in the first and second half-bodies 103 and 104, respectively.

The plates 171 comprise, in portions 122a and 122b, weights 115a and 115b similar to those described with  
20 reference to Figures 1-3. The weights 115a and 115b may be fixed to the plates 171 by the methods described above.

The fixed-caliper disk brake unit 100 further comprises wholly conventional elastic means 108 for  
25 holding the pads 107 on the guide pins 106 and, at the

same time, keeping them away from the disk when the disk brake unit is not in operation.

The connecting elements 105 and 105' are interposed between the first and second half-bodies 103 and 104 of the caliper 102. In the embodiment shown, the element 105' is disposed in the region in which the disk emerges from the caliper during its rotation (as indicated by the arrow "i" of Figure 9) and the element 105, remote from the element 105', is disposed, for example, in the region in which the disk enters the caliper during its rotation.

The operation of the fixed-caliper disk brake of Figure 9 is known and will therefore not be described in detail. The advantages with regard to the performance of the disk brake of Figure 9 are clear from the foregoing description given with reference to the disk brake of Figure 1.

Naturally, in order to satisfy contingent and specific requirements, an expert in the art may apply to the above-described pad and disk brake many modifications all of which, however, are included within the scope of protection of the invention as defined by the appended claims.

Claims

1. A pad (11) for a disk brake comprising a plate (111) for supporting a friction lining (113) which can come into contact, at the braking stage, with a disk (3) associated with the disk brake, characterized in that the  
5 pad comprises means (115a, 115b; 164) associated rigidly with the plate for varying the mass of at least one portion (121a; 121b; 122a; 122b) of the plate so as to achieve an inertia of the pad that substantially prevents  
10 vibrations of the pad which could cause noise of the disk brake, during braking.

2. A pad for a disk brake according to Claim 1 in which the pad has a moment of inertia, evaluated with respect to an axis about which the pad vibrates during  
15 braking, corresponding to a natural frequency of vibration of the pad which is substantially such as not to be excited at the braking stage.

3. A pad according to Claim 1 in which the mass-varying means comprise at least one weight (115a) which  
20 can be connected rigidly to a portion of the plate.

4. A pad according to Claim 3 in which the plate has means (122) for the fixing of the at least one weight.

5. A pad according to Claim 4, in which the means for the fixing of the at least one weight allow the  
25 weights to be removed and/or replaced.

6. A pad (160) according to Claim 3 in which the at least one weight (164) and the plate (162) form a single rigid body produced by casting.

7. A pad according to Claim 1, in which the mass-  
5 varying means comprise first and second mass-varying means associated with regions which are disposed at opposite ends of the plate and which can face an input region and an output region of the disk, respectively.

8. A pad according to Claims 3 and 7 and in which  
10 the first means comprise a first weight and the second means comprise a second weight, the first weight having a mass smaller than the mass of the second weight.

9. A pad according to Claim 1, in which the mass-  
varying means comprise at least one portion (221a; 221b)  
15 of the plate having a shape which can be modified by deformation.

10. A pad according to Claim 1, in which the mass-  
varying means comprise at least one portion (152) of the  
plate which can be removed from the plate.

20 11. A pad according to Claim 1 in which the mass-  
varying means comprise at least one element which can be connected rigidly to the plate and which has a specific weight different from the specific weight of the material of the plate.

25 12. A plate (111) for supporting a friction lining

for a disk-brake pad (11) according to any one of Claims 1 to 11.

13. A disk brake (1) comprising:

- a pad (11) which can be placed in contact with a disk (3) associated with the brake in order to exert a braking action,

- a caliper-holder body (5) which can be arranged astride the disk and which can house the pad, and

- means operatively connected to the pad for activating the braking force,

characterized in that the pad is in accordance with any one of Claims 1 to 11.

14. A method of producing a pad for a disk brake having a plate for supporting a friction lining having an inertia such as substantially to prevent the vibrations of the pad which could cause noise of the disk brake, during braking, the method comprising a step of:

- associating rigidly with the plate means for modifying the mass of at least one portion of the plate.

15. A method according to Claim 14 in which the step of associating mass-modifying means comprises a step of fitting at least one weight on a portion of the plate.

16. A method according to Claim 14 in which the step of associating mass modifying means comprises a step of providing the plate with at least one portion which can

be removed from the plate.

17. A method of producing a low-noise disk brake having a pad comprising a plate for supporting a friction lining, the method comprising the steps of:

5       - subjecting the disk brake to a first braking operation in a manner such that the lining is placed in contact with a disk associated with the brake,

      - evaluating a first level of noise associated with the first braking operation, and

10       - modifying the mass of at least one portion of the plate so as to achieve an inertia of the pad corresponding to a second level of noise during braking which is lower than the first level of noise.

18. A method according to Claim 17 in which the  
15       modification step comprises a step of fitting at least one weight on the plate in order to increase the mass of a portion of the plate.

19. A method according to Claim 17 in which the  
      modification step comprises a step of removing at  
      least one portion of the plate so as to reduce the mass  
      thereof.

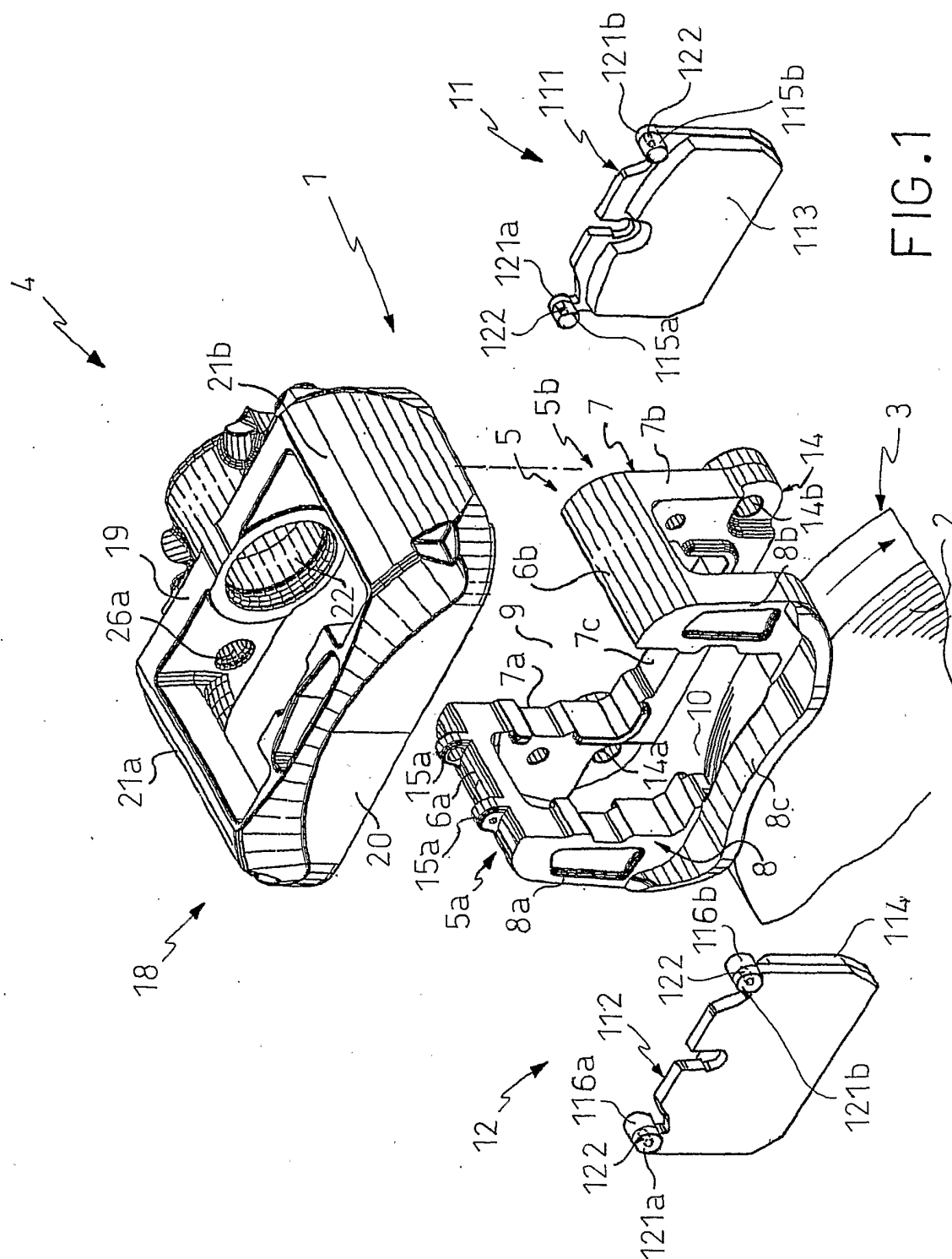
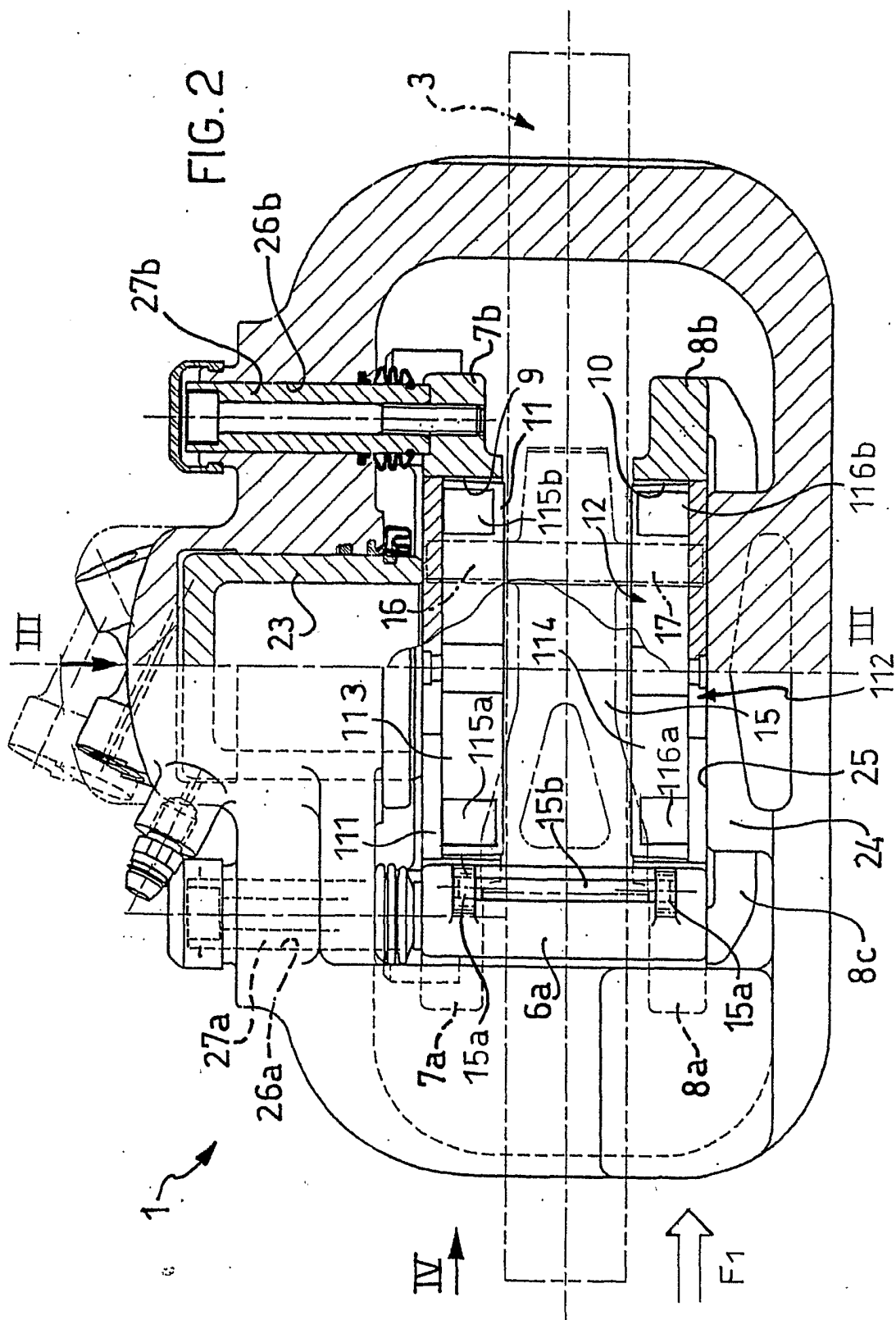
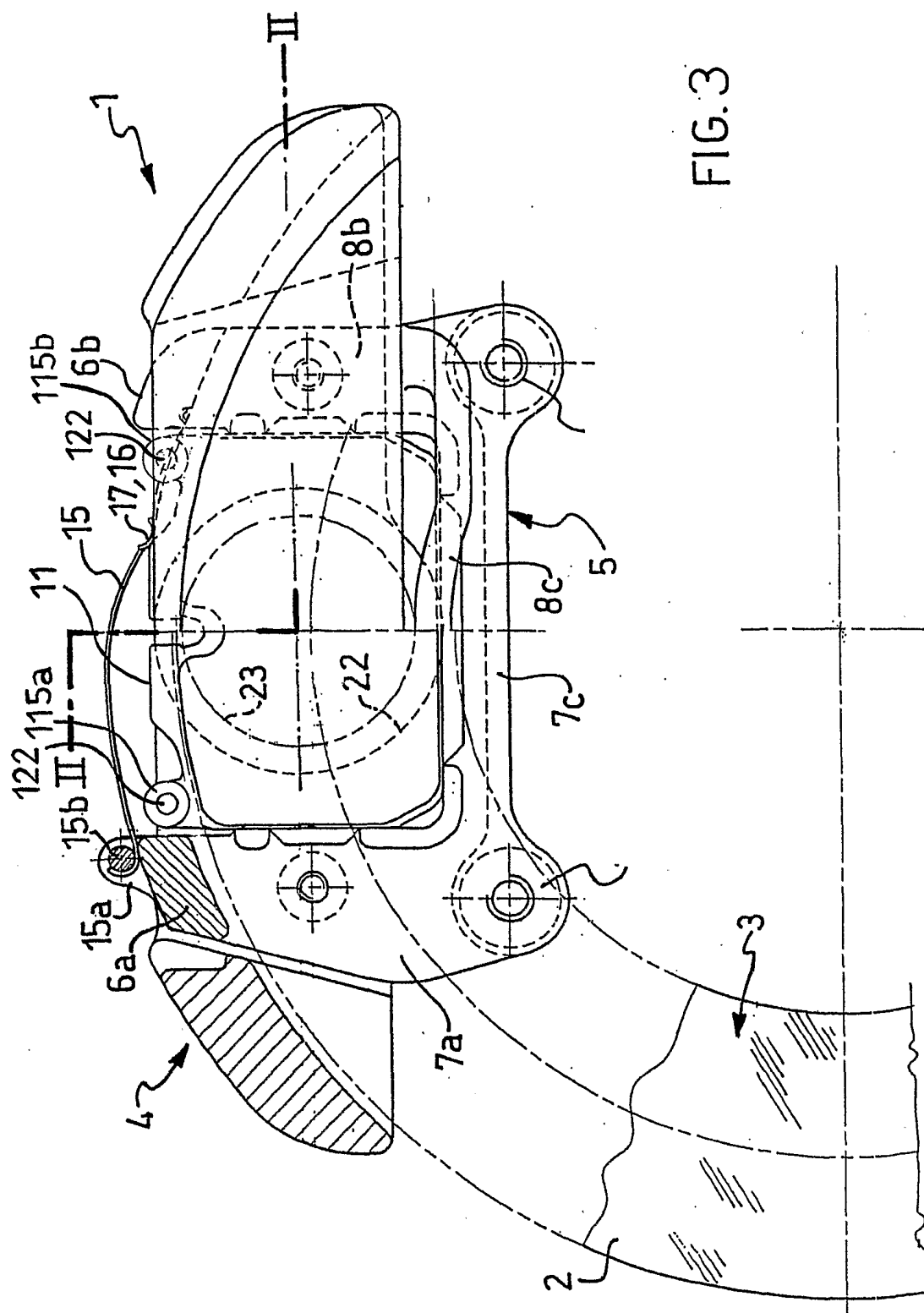


FIG. 1





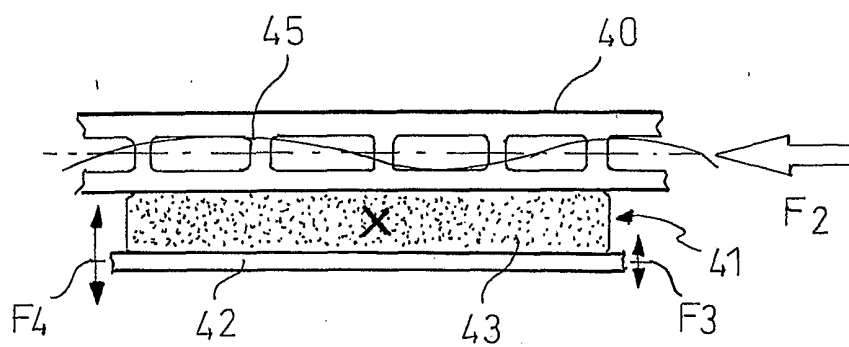


FIG. 4

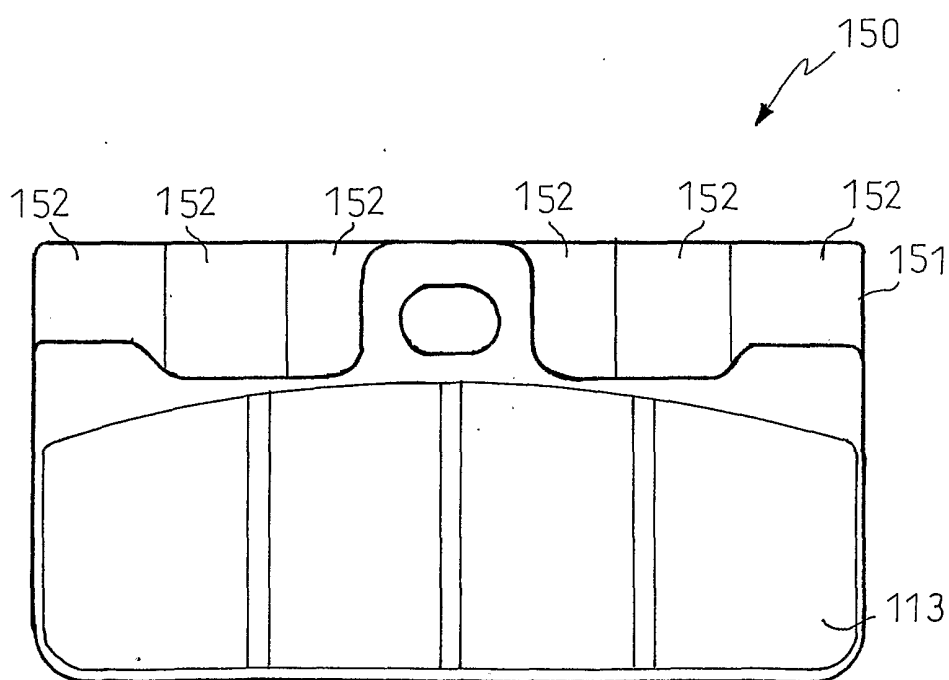


FIG. 5

FIG. 6

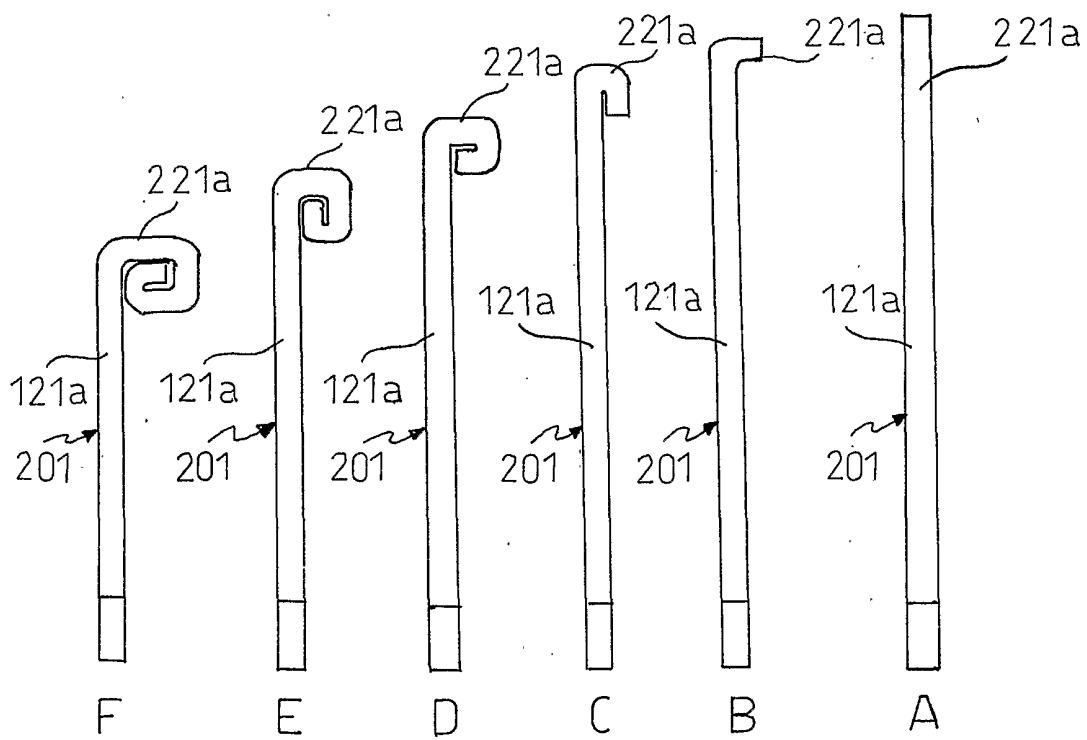
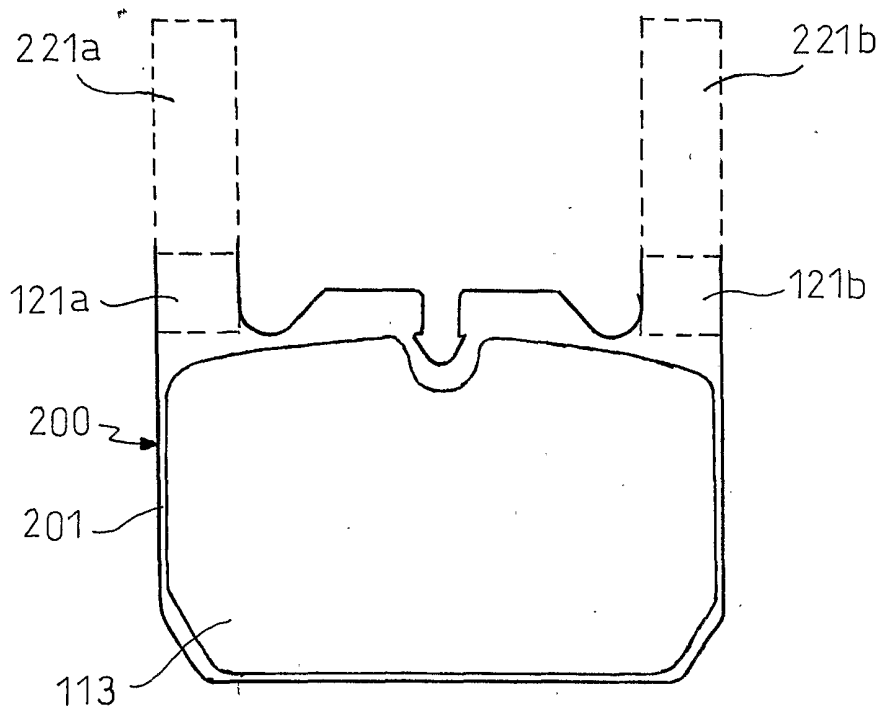


FIG. 7

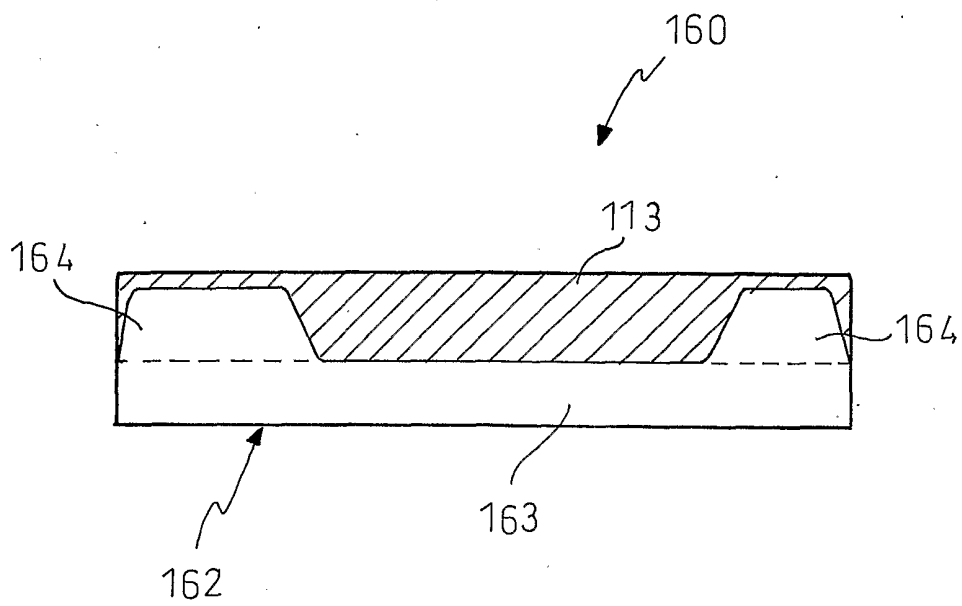
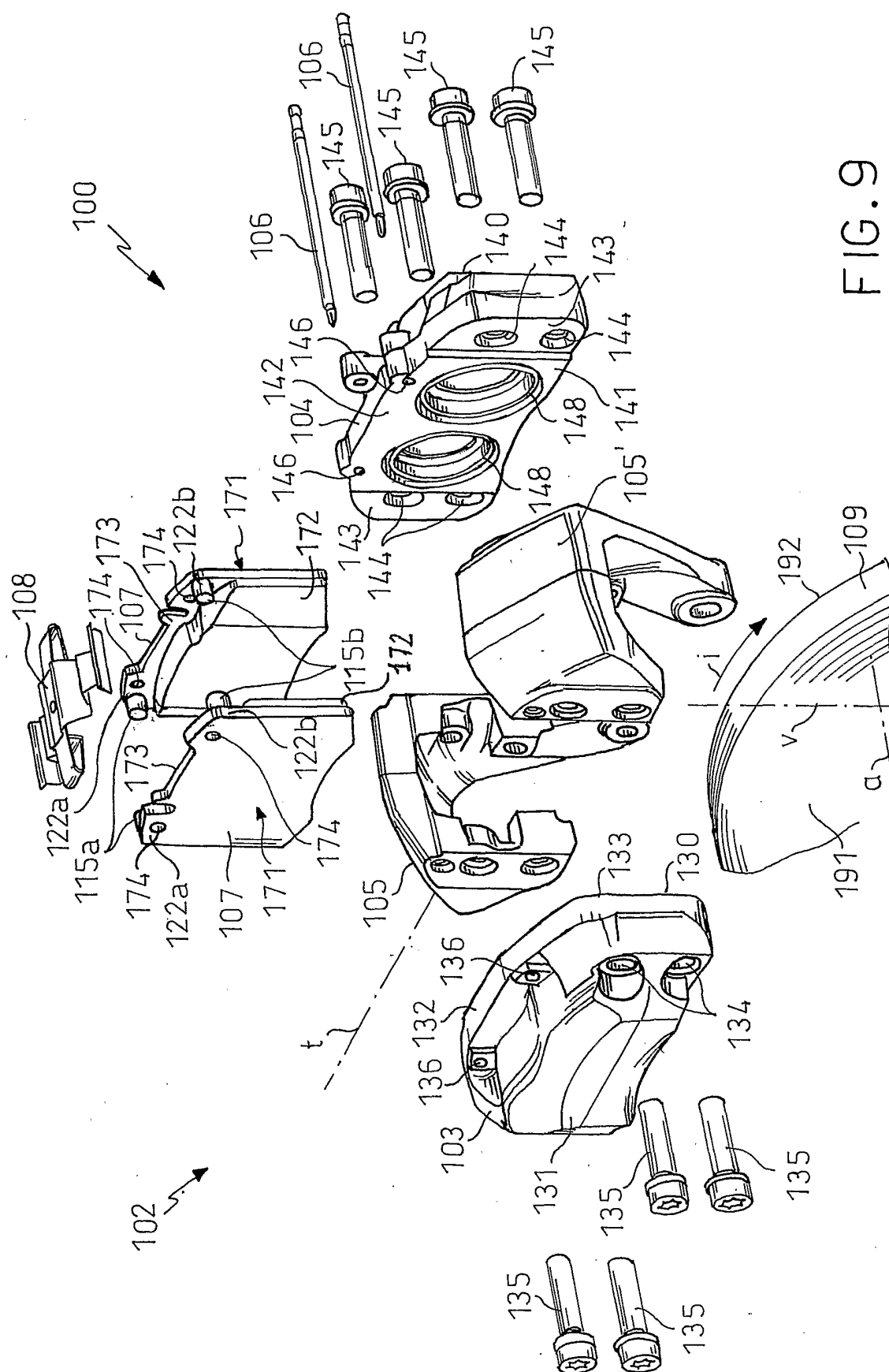


FIG. 8



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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 00/00334

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16D65/092 F16D55/00

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, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                                                                                             | Relevant to claim No. |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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| A          | ---                                                                                                                                                                            | 17                    |
| X          | EP 0 737 823 A (HINO MOTORS LTD)<br>16 October 1996 (1996-10-16)<br>column 4, line 50 -column 6, line 24<br>column 12, line 17 -column 13, line 52<br>figures 14,17            | 1-5,7,<br>10-19       |
| X          | PATENT ABSTRACTS OF JAPAN<br>vol. 009, no. 322 (M-440),<br>18 December 1985 (1985-12-18)<br>& JP 60 157526 A (YAMAHA HATSUDOKI KK),<br>17 August 1985 (1985-08-17)<br>abstract | 1-5,<br>11-16         |
| A          | ---                                                                                                                                                                            | 17                    |
|            | ---<br>-/--                                                                                                                                                                    |                       |



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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- \*&\* document member of the same patent family

Date of the actual completion of the international search

20 April 2001

Date of mailing of the international search report

27/04/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, 1x. 31 651 epo nl,  
Fax: (+31-70) 340-3016

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Topolski, J

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PCI/11 00/00334

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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Information on patent family members

International Application No

PCT/IT 00/00334

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
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