

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
31 May 2007 (31.05.2007)

PCT

(10) International Publication Number  
**WO 2007/060391 A1**

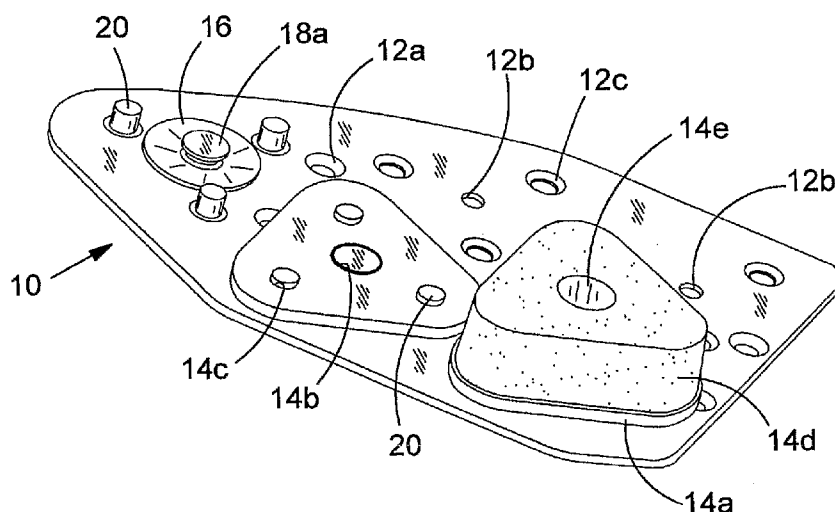
- (51) International Patent Classification:  
*F16D 65/092* (2006.01)
- (21) International Application Number:  
PCT/GB2006/004238
- (22) International Filing Date:  
15 November 2006 (15.11.2006)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
0523858.9 24 November 2005 (24.11.2005) GB
- (71) Applicant (for all designated States except US): **FEDERAL-MOGUL FRICTION PRODUCTS LIMITED** [GB/GB]; Chapel-en-le-Frith, High Peak, Derbyshire SK23 0JP (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **HOLME, John, David** [GB/GB]; Phoenix House, 27 High Street, Crick, Northamptonshire NN6 7TS (GB). **FERDANI, Phillip** [GB/GB]; 18 Mereside Gardens, Whaley Bridge, Derbyshire SK23 7SB (GB). **PATEL, Nanoo** [GB/GB]; 10 Almond Road, Kingswinford DY6 7DL (GB).

- (74) Agents: **DENMARK, James, Christopher** et al.; Harrison Goddard Foote, Orlando House, 11c Compstall Road, Marple Bridge, Stockport SK6 5HH (GB).
- (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, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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, LV, 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).

Declaration under Rule 4.17:  
— of inventorship (Rule 4.17(iv))

[Continued on next page]

(54) Title: PAD ASSEMBLY FOR USE IN A DISC BRAKE



(57) Abstract: A pad assembly for use in a disc brake comprises a carrier plate, a backing plate (14a) to one side of which is secured at least one friction pad (14d) and which is mounted on its alternate side on the carrier plate, spring means (16) acting between the carrier plate and the backing plate, said spring means and said mounting allowing for limited rocking and/or linear movement of the backing plate relative to the carrier plate, said limited relative movement taking place against the action of the spring means, wherein the assembly also comprises a plurality of transmitting members (20) secured to one or other of the carrier plate or the backing plate and projecting to engage the other so as to enable the transmission of force between the two plates, the arrangement of said force transmitting members being such that at least two of said force transmitting members are generally equiangularly arranged about the geometric centre of the carrier plate. Additionally, the force transmitting members may be arranged more proximate the periphery of the backing plate than its geometric centre.

WO 2007/060391 A1



**Published:**

— with international search report

*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.*

**PAD ASSEMBLY FOR USE IN A DISC BRAKE**

This invention is concerned with a pad assembly for use in a disc brake.

5 Disc brakes are well known and operate by bringing pads into engagement with opposite sides of a disc to bring about deceleration of the disc. Thus, a typical disc brake has at least one pad mounted on each side of the disc and means for moving the pads towards the disc. The term "pad assembly" is used herein to mean an arrangement with one or more pads mounted on a common carrier plate.

10

In order to improve the engagement between the pads and the disc and to reduce uneven wear of the pads and/or the disc, some disc brakes, for example for use on railway vehicles, provide that the pads are mounted on the carrier plate in such a way that they can make limited movement relative to the carrier plate to enable them to "conform" better to the disc. Specifically, the pad may be mounted so that it can tilt, pivot or rock to bring its disc-engaging surface parallel to the surface of the disc. Where there are a plurality of pads, they may be mounted so that they can move towards or away from a carrier plate so that the pads all engage the disc. Examples can be found in US5934418 and German utility model number 2982113.

20

Another example is described in EP 1318321A which discloses a pad assembly in which pads are mounted on the carrier plate by means of a headed fastener. Each pad comprises a block of friction material mounted on a backing plate. The headed fastener is fixed to the carrier plate and passes through a hole in the backing plate of the pad and the head is on the opposite side of the backing plate from the carrier plate so that the head prevents the pad from becoming detached from the carrier plate. The backing plate is a relatively loose fit on the headed fastener so that the pad can make limited movements relative to the carrier plate. The limited movements can be a rocking, tilting or pivoting movements or may be linear movements towards the carrier plate or may be a combination of such movements. The limited relative movements enable the pad to conform more accurately to the surface of the disc. These relative movements take place against the action of spring means which is provided by resilient tongues projecting from the carrier plate and engaging in shallow recesses formed in the backing plate. The tongues are pre-tensioned against the backing plate by the headed fastener.

35

In the pad assembly which is disclosed in EP 1318321, the braking force, which is applied by the disc to each pad during braking, is transmitted by the backing plate of the pad to the resilient tongues of the carrier plate. This arrangement is unsatisfactory because in certain circumstances very considerable stress is applied to the tongues  
5 which can cause cracking at their junction with the remainder of the carrier plate.

A further, more complex arrangement shown in EP0263752 discloses an arrangement whereby a backing plate on which a number of brake pads are mounted is subsequently mounted adjacent a carrier plate by means of a substantially central spring-biased  
10 mounting. Additionally, there is provided a pair of bores, one in the backing plate, and one in the carrier plate which can be aligned to allow for an indexing pin to be received in both to prevent rotation of the backing plate relative to the carrier plate. However, it is clear from this document that the central spring-biased mounting carries substantially all  
15 the load when the brake pads engage against the friction surface to give rise to a braking effect, as is the case in all other prior art carrier plate/backing plate arrangements, and that the provision of an indexing pin is merely to prevent relative rotation.

It is an object of the present invention to provide a pad assembly in which the above  
20 mentioned cracking problem is reduced or eliminated.

Accordingly, the invention provides a pad assembly as set forth in the appended claims.

In the pad assembly according to the invention, the braking force applied to the pad is  
25 transmitted to the carrier plate by virtue of the force transmitting members, ideally in the form of symmetrically arranged pins fixed to the carrier plate, and thus such force, or the majority of it, does not pass through the spring. Each pin is preferably cylindrical but may have another shape.

30 The provision of the force transmitting members reduces the stress on the spring means thus reducing the possibility of cracking. Additionally, the spring means can therefore be designed to operate more efficiently as a spring since it is not required to carry out the function of force transmission. This enables more efficient spring means to be provided and also gives the possibility of using spring means with different spring characteristics  
35 in different parts of the assembly. In particular, the spring means can be made more resistant to the high temperatures sometimes encountered during braking.

The backing plate may be mounted on the carrier plate by means of a fastener fixed to the carrier plate, the fastener projecting through a hole in the backing plate and having a head on the other side thereof, such as a rivet. In this case, the spring means may  
5 comprise one or more conical spring washers encircling said fastener. Alternatively, the spring means may comprise one or more conical spring washers encircling each force transmitting member so that the washers are retained by the force transmitting members. These conical spring washers may be of the type known as "Belleville" washers. Each fastener or force transmitting member may retain one or a stack of two or  
10 more such washers.

Where the pad assembly comprises a plurality of backing plates each having a friction pad mounted thereon, and in turn being mounted on a common carrier plate, the spring means may have spring characteristics appropriate to its position on the carrier plate, ie  
15 the spring means for some of the backing pads may be stiffer than those of others. For example, a pad provided on a backing plate at a leading or trailing edge of the carrier plate may have less stiff spring means than the remainder of the pads on later or more rearward facing backing plates.

20 There now follows a detailed description, to be read with reference to the accompanying drawings, of two pad assemblies which are illustrative of the invention.

In the drawings:

25 Figure: 1 is a perspective view of the first illustrative pad assembly but can also serve to illustrate the second illustrative pad assembly since the two assemblies are identical in appearance when viewed from this direction;

30 Figure 2: is a perspective view of the first illustrative pad assembly with parts omitted to enable the construction to be seen;

Figure 3: is a similar view to Figure 2 but of the second illustrative assembly;

35 Figure 4: is a cross-sectional view, on a larger scale than Figures 1 to 3, taken through a portion of the first illustrative assembly; and

Figure 5: is a view similar to Figure 4 but taken through the second illustrative assembly.

5 The first illustrative pad assembly 10 which is shown in Figures 1, 2 and 4 is for use in a disc brake. The assembly 10 comprises a carrier plate 12, five pads 14 mounted on the carrier plate 12, and spring means 16 acting between the carrier plate 12 and each of the pads 14.

10 The carrier plate 12 may be made of steel or cast iron or other suitable material. The carrier plate 12 has holes of three different types passing through it. Firstly, there are six holes 12a arranged in two rows of three which are provided so that screws (not shown) can pass through the holes 12a to secure the carrier plate to a mounting of a brake (not shown). Secondly, there are five holes 12b distributed over the plate 12. These holes 12b are provided to enable the pads 14 to be mounted on the carrier plate 12 as  
15 described below. Thirdly, there are fifteen holes 12c which are distributed in five groups of three with each group of three being distributed symmetrically about one of the holes 12b.

As the five pads 14 are identical in construction, only one need be described in detail.  
20 The pad 14 comprises a backing plate 14a which is best seen in Figure 2.

The plate 14a is generally triangular when viewed in plan and has a central hole 14b therethrough and also three smaller holes 14c equally spaced about a hole 14b but remote therefrom, being nearer the periphery of the backing plate 14a than its  
25 geometrical centre and the centre of the hole 14b. The holes 14c are cylindrical through holes as can be seen from Figure 4 but the hole 14b has a step in as is also visible in Figure 4. This step is formed by an upper portion of larger diameter and a lower portion of smaller diameter. The holes 14b and 14c are in the same relationship to one another as the holes 12b and 12c in the carrier plate 12 so that, when a hole 14c overlies a hole  
30 12b, the hole 14c and 12c can be brought into overlying relationship.

The pad 14 also comprises a block of friction material 14d which is adhered to the upper surface of the backing plate 14a. The friction material is preferably of the sintered metal type which is particularly useful for use in railway vehicles but may be of another type,  
35 for example a resin bonded friction material bonded for example by phenolic resin. In Figure 2, the friction material block 14d has been omitted from one of the two backing

plates 14a shown. The friction material block 14d is also generally triangular and is slightly smaller than the backing plate 14a (although this is not necessarily the case). A hole 14e passes through the block of friction material 14d and communicates with the hole 14b in the backing plate 14a.

5

The pad 14 is mounted on the carrier plate 12 by means of a headed fastener 18 in the form of a rivet. This fastener 18 is set in one of the holes 12b in the carrier plate 12 so that it is fixed thereto and projects through the hole 14b in the backing plate 14a and has a head 18a on the other side of the backing plate 14a which fits into the enlarged portion of the hole 14b within the hole 14e in the friction material block 14d. The fastener 18 is a relatively loose fit in the hole 14b so that the pad 14 can make limited rocking, tilting or pivoting movement and/or linear movement relative to the carrier plate 12 to enable the upper surface of the block 14d to conform to a disc. Since the block of friction material 14d is generally triangular when viewed in a plane parallel to the carrier plate 12, which is also parallel to the plane of the disc when the assembly 10 is mounted in a disc brake, the block 14d conforms to the disc surface according to the well-known "milking stool" principle and also can move towards the carrier plate to equalise the pressure applied to each of the five pads 14.

20 The spring means of the assembly 10 comprises five conical spring washers 16 each of which encircles one of the fasteners 18 between the carrier plate 12 and the backing plate 14a of the associated pad 14. Each washer 16 is pre-tensioned by the fastener 18 which is fixed to the carrier plate 12. The washer 16 serves to centre the pad 14 on the fastener 18. The limited relative movement between the pad 14 and the carrier plate 12 takes place against the action of the washer 16. In a modification of the first illustrative pad assembly 10, the spring washer 16 may be replaced by a stack of such washers. It is also possible to use alternative forms of spring, including the resilient tongues mentioned above of EP 1318321. In the case of the assembly 10, all five washers 16 have identical spring characteristics but this may not be the case.

30

The assembly 10 also comprises fifteen force transmitting members 20 which are each arranged to transmit braking force applied to the pads 14 to the carrier plate 12. Each of the members 20 is fixed into one of the holes 12c through the carrier plate 12 so that the fifteen members 20 are grouped in five groups of three. Each group of three members 20 is distributed about one of the fasteners 18 in identical fashion to the distribution of the holes 14c about the hole 14b in the backing plate 14a of the associated pad 14.

35

Since all the force transmitting members 20 are identical, only one will be described in detail. The member 20 is in the form of a headless rivet fixed into a hole 12c through the carrier plate 12. The member 20 projects as a cylindrical pin normally to the carrier plate 12 and projects into a recess in the pad 14 which is formed by one of the holes 14c. As  
5 can be seen in Figure 4, the member 20 projects right through the hole 14b and into a recess 14f in the friction material 14d. The member 20 is a close fit in the hole 14b but sufficient clearance is allowed for the relative movement between the pad 14 and the carrier plate 12 to be accommodated. However, when braking force is applied to the pads 14, the members 20 are engaged by the sides of the holes 14c and the force is  
10 transmitted by the members 20 to the plate 12.

It is to be noted that the arrangement of the holes 14c and the corresponding force transmitting members is chosen so as to be generally symmetrical relative to the centre of hole 14b in the backing plate 14a. By this is meant that the angular separation of at  
15 least two, and most preferably all, force transmitting members provided for a particular backing plate is generally equal, thus ensuring that that the force distribution is superior as compared to other possible arrangements. Ultimately, this makes the assembly as a whole less likely to fail.

20 Also, ideally, such are arranged nearer the periphery of the backing plate than the centre of hole 14b so that together, each of the force transmitting members is better capable of carrying the significant loads to which they will be exposed during the braking of the vehicle in which the arrangement is provided. Additionally, the force will be evenly distributed between each of the force transmitting members.

25

In an alternative to the assembly 10, the force transmitting members 20 may not project into recesses in the pad 14 but instead may engage edges thereof, in which (ideally) grooves, conforming at least partially to the cross-sectional shape of the force transmitting members, are provided. In other words, the members 20 associated with a  
30 particular pad 14 may project past the edges of the backing plate 14a. For example, each member 20 may engage the plate 14a at a central region of one of its sides. In some cases, a single member 20 may engage the edges of two adjacent plates 14a.

In the operation of the pad assembly 10, pressure between a disc and the upper surface  
35 of each block of friction material 14d causes the pad 14 to move relative to the fastener 18 against the action of the spring washer 16. As mentioned above, since the block of

friction material 14d is generally triangular, the well-known "milking stool" principle applies so that force is evenly distributed over the block of friction material. The pad 14 may also move linearly towards the carrier plate to equalise the forces between the five pads 14 mounted on the same carrier plate 12. The braking forces applied by the disc to the pads 14 are transmitted through the members 20 so that the braking forces apply little or no stress to the conical spring washers 16.

The second illustrative pad assembly 100 is shown in Figures 3 and 5 and, as stated above, the assembly 100 looks identical to the assembly 10 in the view forming Figure 1.

The assemblies 10 and 100 are identical to one another except in the form of the spring means acting between the carrier plates and the pads thereof. Accordingly, only the spring means of the assembly 100 will be described in detail. Like parts in the drawings of the two assemblies are given the same reference numbers.

In the assembly 100, each conical spring washer 16 of the assembly 10 is replaced by six conical spring washers 22 of a smaller size. These spring washers 22 are not positioned to encircle the fastener 18 but instead each encircles one of the members 20, there being two spring washers 22, one on top of the other, on each of the members 20 associated with each pad 14.

In modifications of the assemblies 10 and 100, there may be, on the same carrier plate 12, pads 14 with associated conical spring washers 16 while other pads have spring washers 22 associated with them. Furthermore, there may be one or two or more than three force transmitting members 20 acting with each pad 14.

**CLAIMS**

1. A pad assembly for use in a disc brake, the assembly comprising a carrier plate, a backing plate to one side of which is secured at least one friction pad and which is mounted on its alternate side on the carrier plate, spring means acting between the carrier plate and the backing plate, said spring means and said mounting allowing for limited rocking and/or linear movement of the backing plate relative to the carrier plate, said limited relative movement taking place against the action of the spring means, wherein the assembly also comprises a plurality of force transmitting members secured to one or other of the carrier plate or the backing plate and projecting to engage the other so as to enable the transmission of force between them, the arrangement of said force transmitting members being such that at least two of said force transmitting members are generally equiangularly arranged about the geometric centre of the backing plate.
2. An assembly according to claim 1 wherein the force transmitting members are arranged more proximate the periphery of the backing plate than its geometric centre.
3. A pad assembly according to claim 2, wherein the force transmitting member is fixed to the carrier plate and projects into a recess formed in the backing plate.
4. A pad assembly according to claim 2, wherein the force transmitting member is fixed to the backing plate and projects into a recess formed in the carrier plate.
5. A pad assembly according to any preceding claim, wherein said backing plate is mounted on the carrier plate by means of a fastener fixed to the carrier plate, said fastener projecting through a hole in said backing plate and having a head on the other side thereof.
6. A pad assembly according to claim 5, wherein said spring means comprises one or more conical spring washers encircling said fastener.
7. A pad assembly according to any one of claims 1 to 6 wherein spring means comprises one or more conical spring washers encircling each force transmitting member.

- 5 8. A pad assembly according to either one of claims 6 or 7, wherein the pad assembly comprises a plurality of pads mounted on a plurality of backing plates, each mounted to a common carrier plate, and the spring means associated with each pad has spring characteristics appropriate to its position on the carrier plate.
9. A pad assembly according to any one of claims 1 to 8, wherein each force transmitting member is in the form of a pin fixed to the carrier plate.
- 10 10. A pad assembly according to any one of claims 1 to 9, wherein the friction pad is generally triangular when viewed in a plane parallel to that of the carrier plate.
- 15 11. A pad assembly according to claim 1 wherein the force transmitting members are fixed in the carrier plate and project to engage the peripheral edges of the backing plate.
- 20 12. A pad assembly according to claim 11 wherein grooves are provided in the peripheral edges of the backing plate to at least partially receive said force transmitting members, said grooves conforming at least partially to the portion of the cross-sectional shape of the force transmitting members.
13. A pad assembly substantially as hereinbefore described with reference to, and as shown in, Figures 1, 2 and 4, or Figures 3 and 5 of the accompanying drawings.

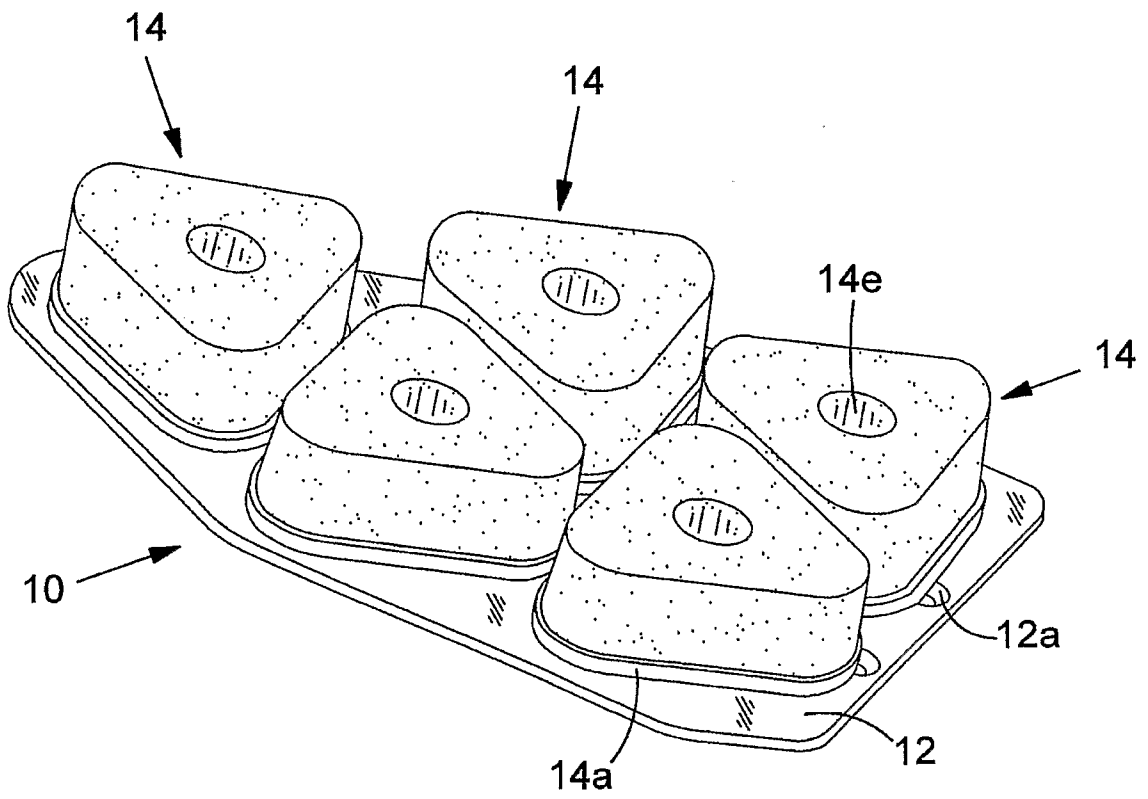
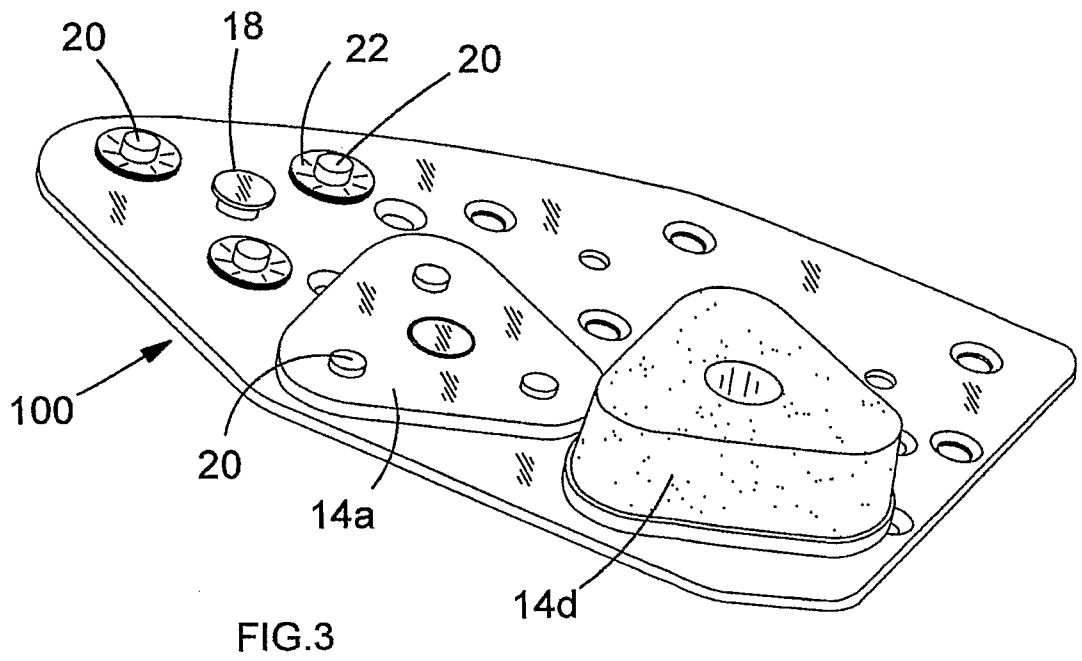
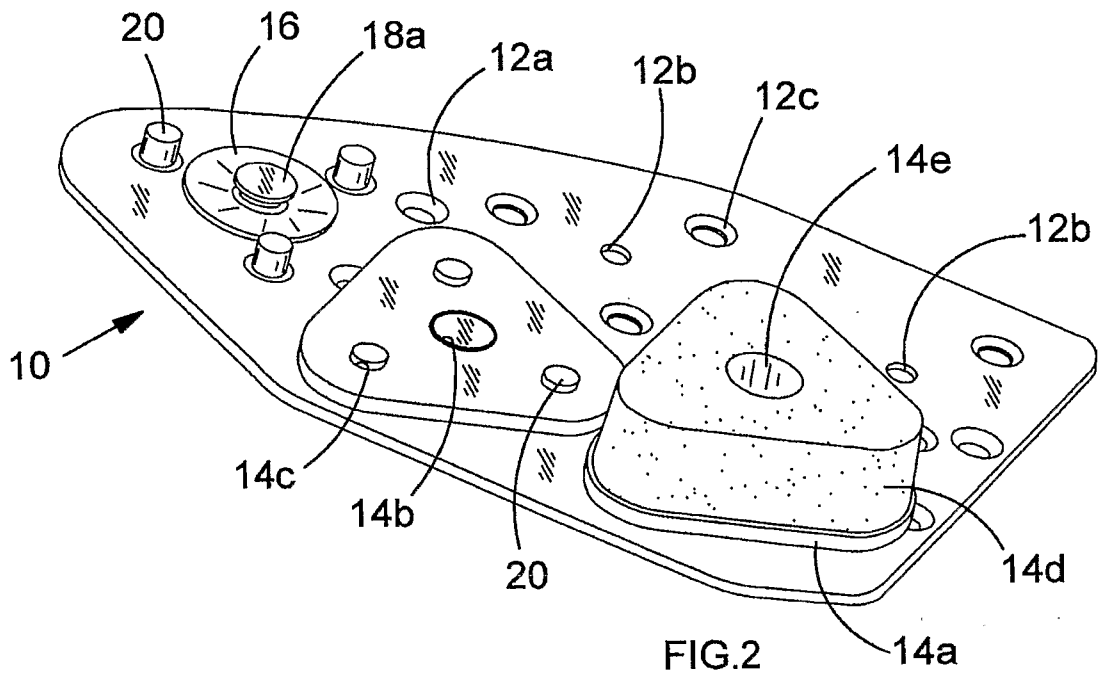


FIG.1



3/3

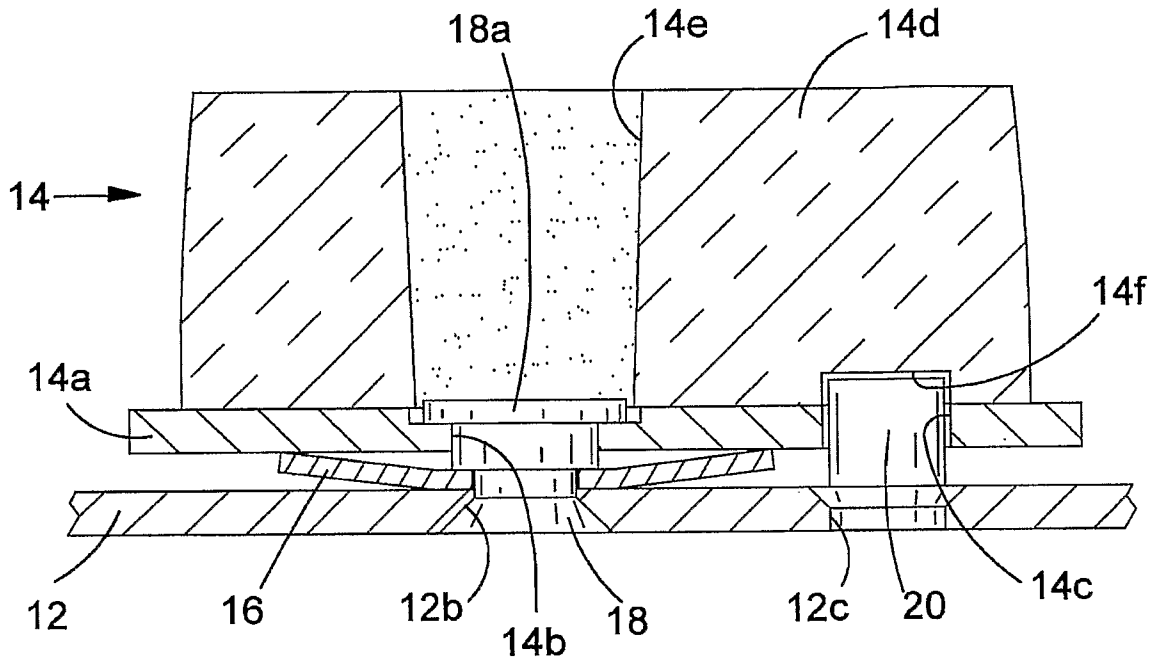


FIG. 4

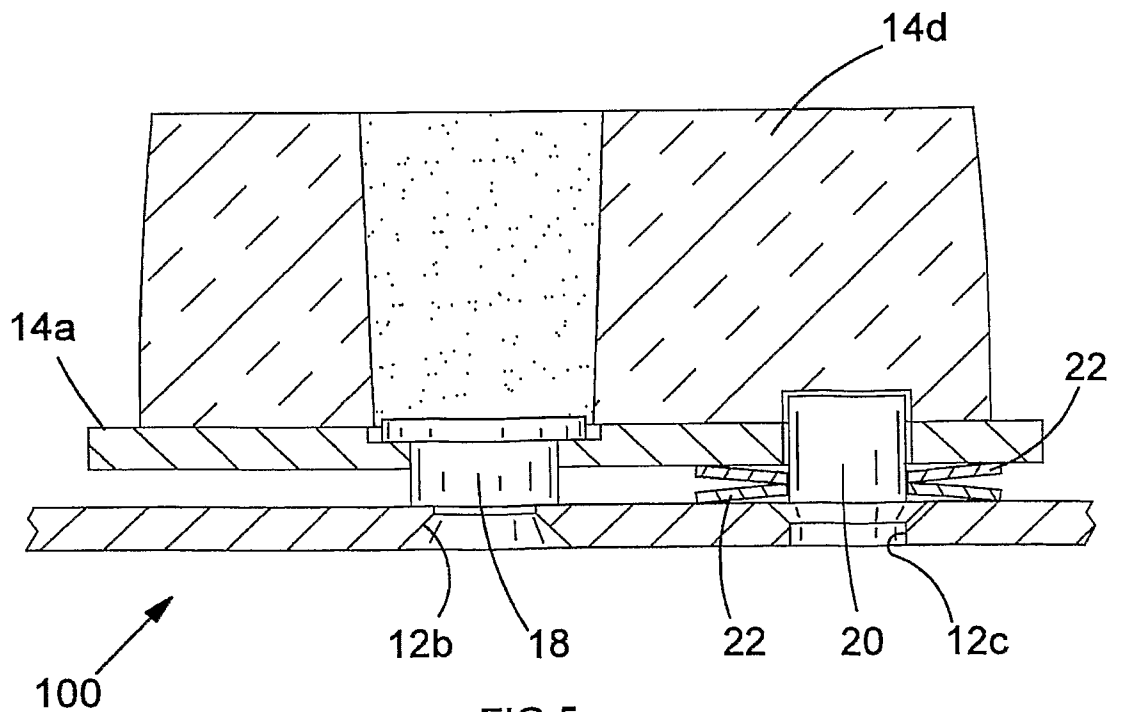


FIG. 5

## INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2006/004238

A. CLASSIFICATION OF SUBJECT MATTER  
INV. F16D65/092

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)  
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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 85 14 607 U1 (JURID WERKE GMBH, 2056 GLINDE, DE) 4 July 1985 (1985-07-04)	1-4, 9, 10
Y	page 12, line 20 - page 15, line 3; figures	5-8, 11, 12
X	US 2003/234149 A1 (PETERSEIM MICHAEL [DE] ET AL) 25 December 2003 (2003-12-25) paragraph [0062]; figures 5,6	1-7, 9
Y	DE 298 21 113 U1 (JURID WERKE GMBH [DE]) 18 February 1999 (1999-02-18) cited in the application page 6, last paragraph - page 7; figures 3,4	5-8
Y	EP 0 263 752 A2 (WABCO WESTINGHOUSE EQUIP [FR]) 13 April 1988 (1988-04-13) cited in the application column 8, line 45 - line 53; figure 5	11, 12

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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

Date of the actual completion of the international search

23 January 2007

Date of mailing of the international search report

31/01/2007

Name and mailing address of the ISA/

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

Authorized officer

Van Koten, Gerard

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2006/004238

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 8514607	U1	04-07-1985	NONE	
US 2003234149	A1	25-12-2003	DE 10227328 A1 FR 2841309 A1	08-01-2004 26-12-2003
DE 29821113	U1	18-02-1999	NONE	
EP 0263752	A2	13-04-1988	DE 3765512 D1 FR 2604763 A1	15-11-1990 08-04-1988