(12) UK Patent Application (19) GB (11) 2 268 552 (13) A

(43) Date of A Publication 12.01.1994

(21) Application No 9214272.8

(22) Date of Filing 04.07.1992

(71) Applicant(s)
T & N Technology Limited

(Incorporated in the United Kingdom)

Cawston House, Cawston Lane, RUGBY, Warwickshire, CV22 7SB, United Kingdom

(72) Inventor(s)
David Alec Parker
Vincent Clive Wright

(74) Agent and/or Address for Service
P L Drury et al
T & N Plc, Group Patent Department, Bowdon House, Ashburton Road West, Trafford Park, MANCHESTER, M17 1RA, United Kingdom

(51) INT CL^5
F16D 69/04

(52) UK CL (Edition M)
F2C C1C3AX

(56) Documents Cited
GB 2058249 A GB 0830581 A GB 0780088 A

(58) Field of Search
UK CL (Edition K) F2C, F2E
INT CL^5 F16D

(54) **Annular friction elements**

(57) A generally annular friction element (10), such as a clutch facing, has fixing holes (20,22) circumferentially distributed therein. These holes have a cross-section shape in the plane of the element (10) which is elongated in the circumferential direction. The holes (20,22) may be elliptical, arcuate, or may have at least one straight side.

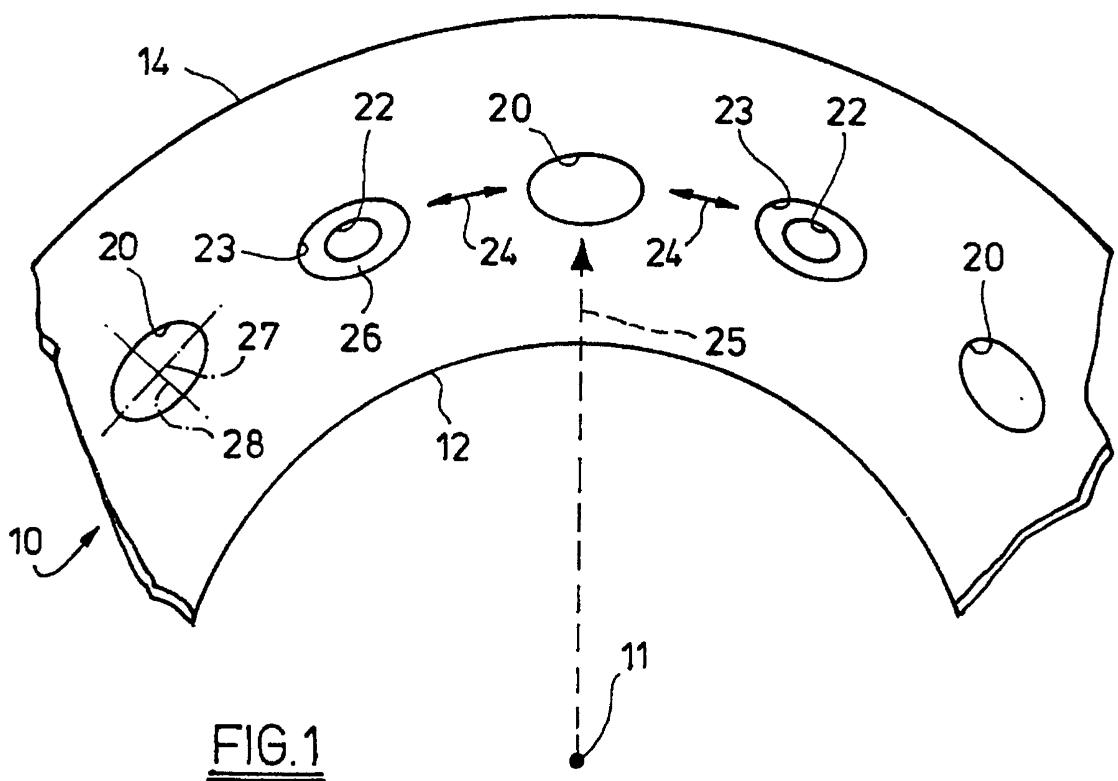

FIG.1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

GB 2 268 552 A

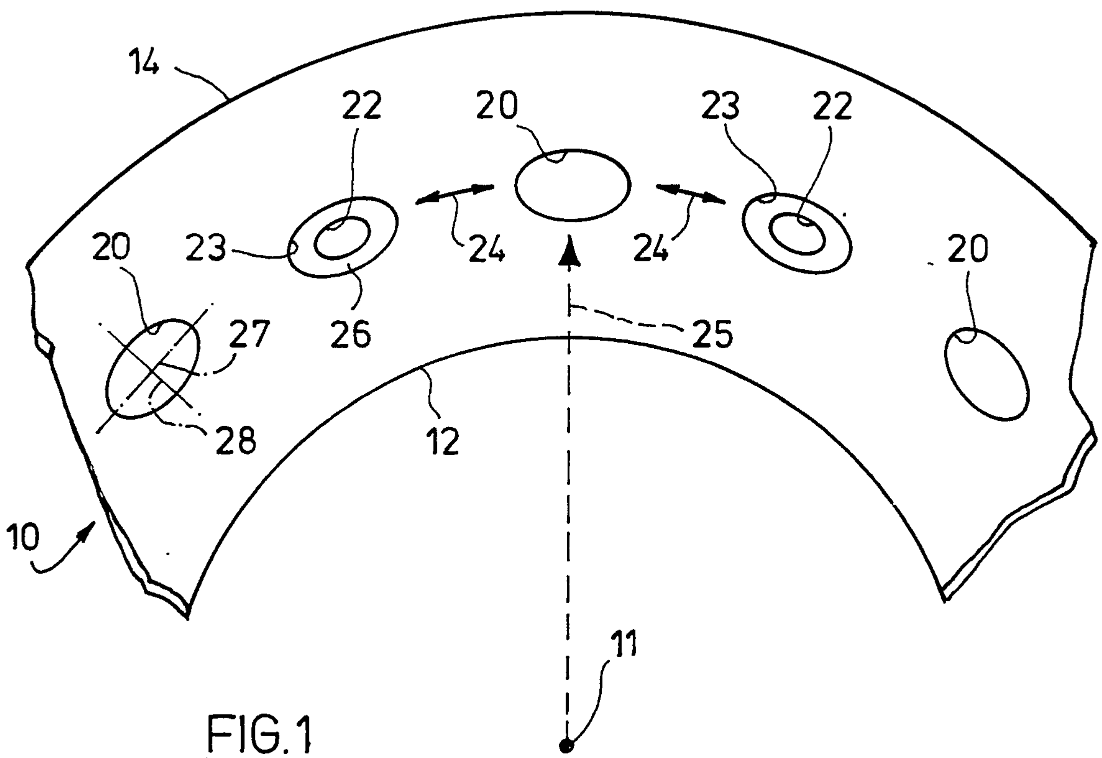
14
22
20
23
22
20
23
24
24
20
26
25
27
28
12
10
11

FIG.1

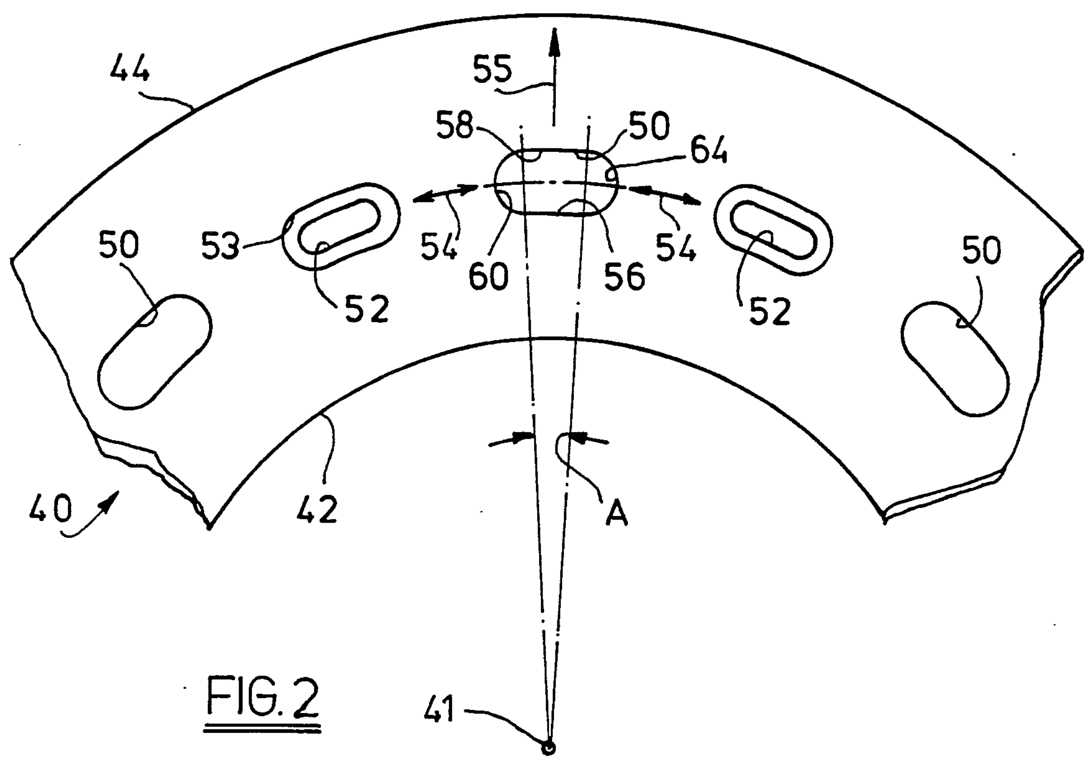
44
55
58
50
64
50
53
54
54
50
60
56
52
52
42
A
40
41

FIG.2

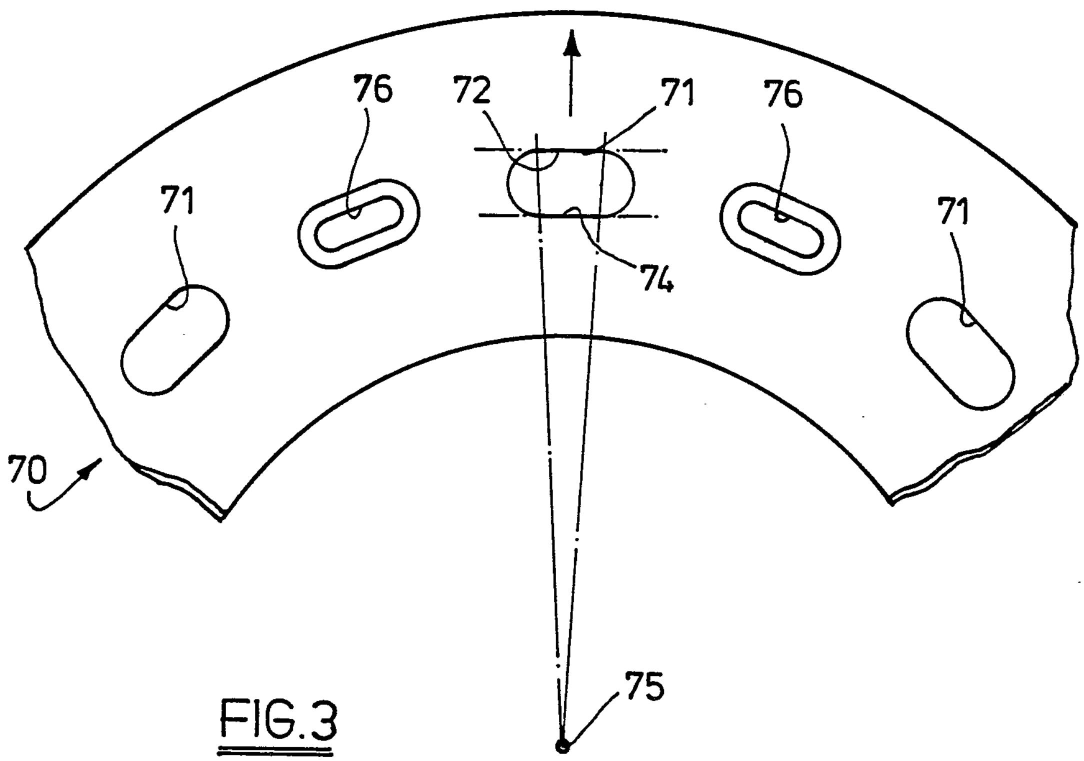

FIG.3

ANNULAR FRICTION ELEMENTS

This invention is concerned with annular friction elements of the type which are formed, for example, by heating and pressing generally annular preforms containing curable friction material. Such friction elements are used, for example, as clutch facings.

Generally annular friction elements for use as clutch facings comprise friction material which defines a plurality of circumferentially-distributed holes through the facing. These holes are of two different types. Firstly, there are holes which are clearance holes for the formation of heads on rivets securing another clutch facing to an opposite face of a support on which the first-mentioned clutch facing is mounted. These clearance holes enable the rivet to be set. Secondly, there are countersunk holes by which the clutch facing is itself held on to the support. A rivet is received in such a hole so that its head abuts the abutment surface provided by the countersink and the shank of the rivet extends through the support and into a clearance hole in the other clutch facing. A head is then formed in said clearance hole so that the clutch facing is firmly attached to the support.

Such clutch facings, particularly when used in automotive applications, are subject to high rotational speeds and, hence, to high circumferential forces. If such clutch facings cannot withstand such forces, they burst. Accordingly, clutch facings are subjected to burst tests in which they are heated to simulate operating conditions and then spun at increasing speed until they burst. The rotational speed at which bursting occurs gives a measure of clutch quality. It is clearly desirable to increase this burst speed to increase the range of possible uses of such a clutch facing or to increase the safety factor thereof.

The aforementioned holes are a source of weakness in the clutch facing and reduce its burst speed.

It is an object of the present invention to provide a generally annular friction element having a higher burst speed by reducing the reduction in burst speed caused by the aforementioned holes.

The invention provides a generally annular friction element comprising friction material which defines a plurality of circumferentially-distributed holes through the element, the holes being adapted to receive portions of headed fasteners projecting from a support on which the friction element is mounted, each hole having a cross-sectional shape in the plane of the element which is of greater extent in a circumferential direction of the element than in a direction extending generally radially of the element at the hole.

A friction element according to the invention, has its holes elongated in the circumferential direction, i.e. the holes have an aspect ratio in this direction which is greater than unity. It is found that friction elements having their holes elongated in this manner exhibit higher bursting speeds than conventional friction elements having holes of circular cross-section, the diameter of the circular holes being equal to the smallest dimension of the elongated holes. The increase in burst speed depends on the particular shape of hole adopted and also on its relative size in relation to the element. However, it has been found that increases in burst speed of 25% are achievable in some cases.

The cross-sectional shape of said holes may be generally elliptical with the ellipse's major axis extending substantially in said circumferential direction. This is found to give a considerable increase in burst speed. Said major axis may extend between 2.8 and 1.5 times the length of a minor axis which extends generally radially of the element at the hole. Said minor axis may be between 5 and 13 millimetres long.

The cross-sectional shape of said holes may alternatively be generally arcuate, being defined by two circumferentially-extending side surfaces which are arcuate about points at or close to the centre of the element. This shape of hole is easier to form by conventional machining operations, such as milling, than a hole which is elliptical. Said side surfaces may subtend arcs of between 2° and 15°, angles of approximately 8° having been found to be advantageous. Said side surfaces may be spaced by between 5 and 13 millimetres. Said side surfaces may join generally semi-circular end surfaces of the hole.

Alternatively, the cross-sectional shape of said holes may be formed by opposed end surfaces joined by circumferentially-extending side surfaces, at least one of said side surfaces being substantially straight. Said side surfaces then extend substantially parallel to a tangent to the friction element in the circumferential direction. Such a straight side surface may subtend an arc of between 2° and 15° at the centre of the friction element, e.g. approximately 6°. Such a hole may be substantially "D-shaped" having its side surface nearest to the centre of the element straight and the other side surface arcuate. Alternatively, both side surfaces may be straight and may be spaced by between 5 and 13 millimetres.

The aforementioned holes may be made by pressing a shaped former through said element. The former having the shape of the cross-sectional shape required. Alternatively, the holes may be made by machining operations, e.g. milling.

The holes which are countersunk may have countersunk portions of the same cross-sectional shape but enlarged.

There now follow detailed descriptions, to be read with reference to the accompanying drawings, of three friction elements which are illustrative of the invention.

In the drawings:

Figure 1 is a diagrammatic view of a section of the first illustrative friction element;

Figure 2 is a view similar to Figure 1 but of the second illustrative friction element; and

Figure 3 is a view similar to Figures 1 and 2 but of the third illustrative friction element.

The first, the second, and the third illustrative friction elements are all clutch facings and are generally annular comprising friction material. Specifically, the friction elements are formed by winding a single length of yarn coated with a curable friction material on to a rotating plate to form a preform. The yarn comprises several filaments or strands of materials such as aramid, rayon or glass. The strands are impregnated with a substance which enables them to be coated with a curable friction material which is, thus, incorporated into the preform. The preform is then pressed and heated to form the completed friction element.

Figure 1 shows a segment of the first illustrative clutch facing 10. This segment defines 5 of the 16 holes through the facing 10 which are equally distributed circumferentially about a centre 11 of the facing 10. The facing 10 is annular between a circular inside edge 12 and a circular outside edge 14.

The aforementioned holes through the facing 10 are of two types which alternate so that there are 8 holes of each type. A first type of hole 20 extends through the facing 10 with a constant cross-section throughout the length of the hole 20. A second type of hole 22, however, has a countersunk portion 23 of larger cross-sectional area than the remainder of the hole 22. The holes 20 are adapted by their size and position to provide clearance for the formation of heads or shanks of portions of rivets (not shown), which project from a support (not shown) on which the facing 10 is mounted. These rivets hold a similar clutch facing on an opposite side of the support. The cross-sectional shape in the plane of the facing 10 of each hole 20 is shown in Figure 1. This shape is of greater extent in a circumferential direction 24 of the facing 10 than in a direction 25 extending generally radially of the facing 10 at the hole 20. The holes 22 are adapted by their size and position to receive heads and shanks of rivets (not shown) by which the facing 10 itself is held on the support. The shanks of these rivets pass through the holes 22 and their heads are received in the countersunk portion 23 and abut a radially-extending surface 26 between the countersunk portion 23 and the remainder of the hole 22.

The cross-sectional shape in the plane of the facing 10 of the holes 22 is also shown in Figure 1. This shape is of greater extent in the circumferential direction 24 than in the radial direction 25, the shape of the countersunk portion 23 being the same but enlarged.

The cross-sectional shape of each hole 20 is generally elliptical with the major axis 27 of the ellipse extending substantially in said circumferential direction 25. The major axis 27 can also be considered as extending tangentially as it is aligned at right angles to a radius of the facing 10 passing centrally through the hole 20.

The major axis 27 is approximately twice as long as the length of the minor axis 28 which extends radially. The minor axis 28 is 11 millimetres long so that a rivet head of approximately 10 millimetres diameter can be formed in the hole 20.

The cross-sectional shape of the holes 22 is also generally elliptical, the countersunk portion 23 being of the same shape and size as the holes 20 and the remainder of the hole 22 having the shape of a smaller ellipse with a minor axis 5mm long and a major axis approximately twice this length and extending in the circumferential direction 24.

The holes 20 and 22 in the facing 10 are formed by pressing formers (not shown) through the facing as it is pressed from a preform.

The shanks of the rivets received in the holes 20 and 22 may be of circular cross-section or this cross-section may be elliptical so that it is complementary to the shape of the hole. Alternatively, this cross-sectional shape may be another shape which is elongated in the circumferential direction. Such an elliptical or other elongated cross-section reduces any tendancy for the clutch facing to slip relative to the rivets. The heads of the rivets may have similar elliptical or elongated cross-sections.

The first illustrative facing 10 was compared with a comparative clutch facing of the same size, shape and composition but having the holes therein of circular cross-section with the diameter of the holes the same length as the minor axis of the elliptical shapes of the holes 20 and 22, including the countersunk portion 23. The facing 10 was found to have a burst speed which was 25% greater than the comparative facing.

Figure 2 shows the second illustrative clutch facing 40 which is annular about a centre 41. The facing 40 has a circular inner edge 42 and a circular outer edge 44. The facing 40 has circumferentially-distributed holes 50 and 52 defined by the friction material of the facing 40 and adapted to receive portions of headed fasteners (not shown) projecting from a support on which the friction element is mounted.

There are 8 holes 50 each of which has a cross-sectional shape in the plane of the element 40 which is of greater extent in a circumferential direction 54 than in a direction 55 extending generally radially of the element at the hole 50. The cross-sectional shape of the hole 50, which is constant throughout the length of the hole 50, is generally arcuate being defined by 2 circumferentially-extending side surfaces 56 and 58 which are arcuate about the centre 41 and subtend an angle A of 8°. The side surfaces 56 and 58 are 11 millimetres apart in the radial direction and join generally semi-circular end surfaces 60 and 64 of the hole 50. These semi-circular end surfaces 60 and 64 are centred on a line extending through the centre of the hole 50 in the circumferential direction 54. The holes 50 are for the same purpose as the holes 20 of the facing 10.

There are 8 holes 52 which alternate with the holes 50. The holes 52 have countersunk portions 53 of the same cross-section size and shape as the holes 50 and the remainder of the hole 53 is of a similar cross-sectional shape but smaller. The holes 52 have the same purpose as the holes 22 of the facing 10.

The holes 50 and 52 in the facing 40 are formed by milling operations. The facing 40 was turned about the centre 41 through the angle subtended by the hole while a milling cutter cut out the hole.

The second illustrative clutch facing 40 was compared with a comparison facing of the same size, shape and composition but having holes which were circular and of a diameter the same as the spacing of the circumferentially extending edges of the holes 50 and 52, including the countersunk portion 53. This comparison facing was, thus, identical to the comparison facing compared with the first illustrative facing 10. The second illustrative facing 40 was found to have a burst speed which was approximately 25% higher than the comparison facing. These comparisons were repeated with the angle subtended by the side surfaces 56 and 58 reduced to 2°, 4° and 6°. The results were that the burst speeds were still better than the comparison sample but not so good as when the angle was 8°, the results being a 12% increase, a 17% increase and a 21% increase respectively.

The third illustrative element 70 shown in Figure 3 is the same as the element 40 but having holes 71 and 76 in which the arcuate side surfaces 56 and 58 of the holes 50 and 52 arereplaced by straight side surfaces 72 and 74 subtending an angle of 6° at the centre 75 of the element 70. The element 70 was found to have a burst speed increase of 23%. When only the radially-innermost surface 56 of the element 40 was made straight with the surface 58 retaining an arcuate form, a burst speed increase of 14% was found. Moving the centre of curvature of the side surfaces 56 and 58 away from the centre 41 towards the hole 50 was found to still give increased burst speeds but not as great an increase as when the surfaces were centred at the centre 42.

The rivets received in the holes 50 and 52, or 71 and 76, may have complementary cross-sections to those of the holes.

CLAIMS

1 A generally annular friction element comprising friction material which defines a plurality of circumferentially-distributed holes through the element, the holes being adapted to receive portions of headed fasteners projecting from a support on which the friction element is mounted, each hole having a cross-sectional shape in the plane of the element which is of greater extent in a circumferential direction of the element than in a direction extending generally radially of the element at the hole.

2 A friction element according to Claim 1, wherein said cross-sectional shape is generally elliptical with the ellipse's major axis extending substantially in said circumferential direction.

3 A friction element according to Claim 2, wherein said major axis extends between 2.8 and 1.5 times the length of a minor axis of said cross-sectional shape.

4 A friction element according to Claim 3, wherein said minor axis is between 5 and 13 millimetres long.

5 A friction element according to Claim 1, wherein said cross-sectional shape is generally arcuate being defined by two circumferentially-extending side surfaces which are arcuate about points at or close to the centre of the element.

6 A friction element according to Claim 5, wherein said side surfaces subtend arcs of between 2° and 15°.

7 A friction element according to either one of Claims 5 and 6, wherein said side surfaces are spaced by between 5 and 13 millimetres.

8 A friction element according to any one of Claims 5 to 7, wherein said side surfaces join generally semi-circular end surfaces of the hole.

9 A friction element according to Claim 1, wherein said cross-sectional shape has opposed end surfaces joined by circumferentially-extending side surfaces, at least one of said side surfaces being substantially straight.

10 A friction element according to any one of Claims 1 to 9, wherein said holes are made by pressing a shaped former through said element.

11 A friction element according to any one of Claims 1 to 9, wherein said holes are made by machining operations.

12 A friction element according to any one of Claims 1 to 11, wherein at least some of said holes are countersunk to provide an abutment surface for a fastener head.

13 A friction element substantially as hereinbefore described with reference to Figure 1 or Figure 2 or Figure 3 of the accompanying drawings.

Patents Act 1977 **Examiner's report to the Comptroller under Section 17 (The Search Report)**	Application number 9214272.8

Relevant Technical fields (i) UK Cl (Edition K) F2C: F2E (ii) Int Cl (Edition 5) F16D	Search Examiner A BURROWS
Databases (see over) (i) UK Patent Office (ii)	Date of Search 13 AUGUST 1992

Documents considered relevant following a search in respect of claims 1-13

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2058249 A (SAHABODIEN) Figures 1, 2, 4: Lines 93-96 page 1	1, 9
X	GB 0830581 (RAYBESTOS) Figure 1	1, 5, 6, 7, 8
Y	GB 0780088 (FERODO) Figures 3 and 4	1, 9, 11

to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).