(12) UK Patent Application (19) GB (11) 2 332 027 (13) A

(43) Date of A Publication 09.06.1999

(21) Application No 9814830.7

(22) Date of Filing 08.07.1998

(30) Priority Data
(31) 19729024 (32) 08.07.1997 (33) DE

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(51) INT CL[6]
F16D 65/56

(52) UK CL (Edition Q)
F2E ELFE E104 E114

(56) Documents Cited
WO 98/21497 A2 WO 97/22814 A1 WO 96/12900 A1
US 5449052 A US 5379867 A

(58) Field of Search
UK CL (Edition Q) **F2E ELFE ELFG**
INT CL[6] **F16D 65/38 65/40 65/52 65/56**
Online:WPI,EPODOC,PAJ

(54) Abstract Title

Wear-adjusting device for a disc brake for a motor vehicle

(57) A disc brake for a motor vehicle comprises a rotary lever 5 which, upon braking, acts on a slidable element 7 carrying two adjusting spindles 8, 9 which press a brake lining 10 in the direction of the brake disc 3. In addition, as the lever 5 is actuated it rotates a fork 25, of a wear-adjusting device 13, which, via a one-way rotating coupling 22 constituted by the fork, ramp disc 23 of asymmetrical profile and rollers 24, rotates expansion tube 20 and star wheel 21 to rotate the spindles 8, 9 to compensate for brake lining wear. When rotation of the spindles is stopped by reaction forces continued rotation of the fork relative to the ramp disc will be permitted by axial displacement of the ramp disc against the force of an adjustable spring system including central pin 16 and the expansion tube 20.

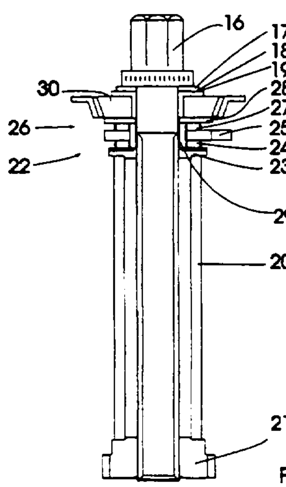

FIG. 1

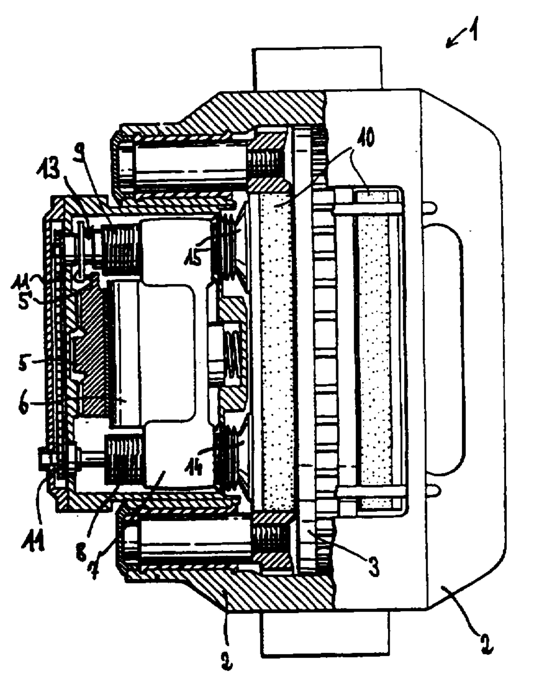

Fig. 6

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This print incorporates corrections made under Section 117(1) of the Patents Act 1977.

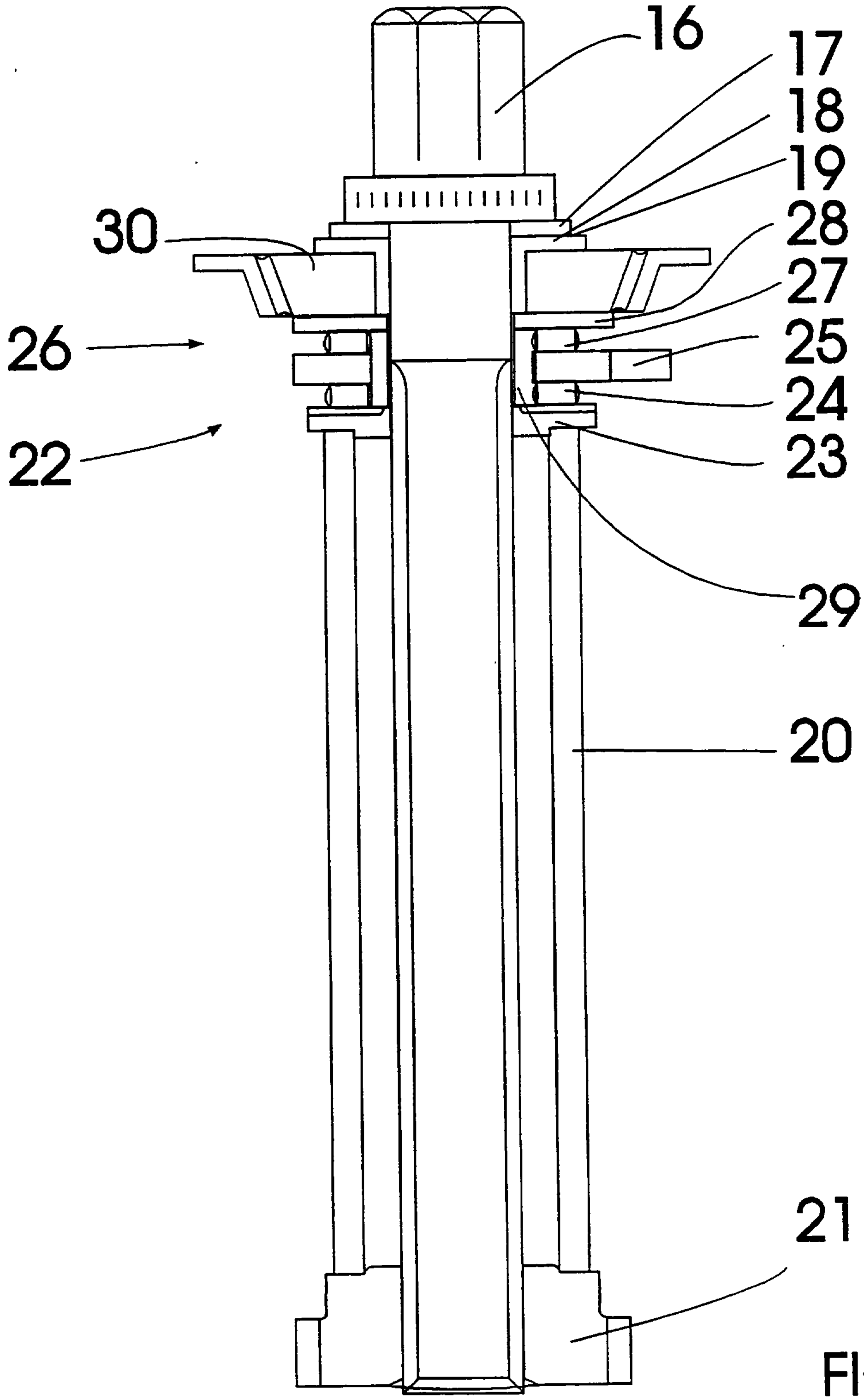

FIG. 1

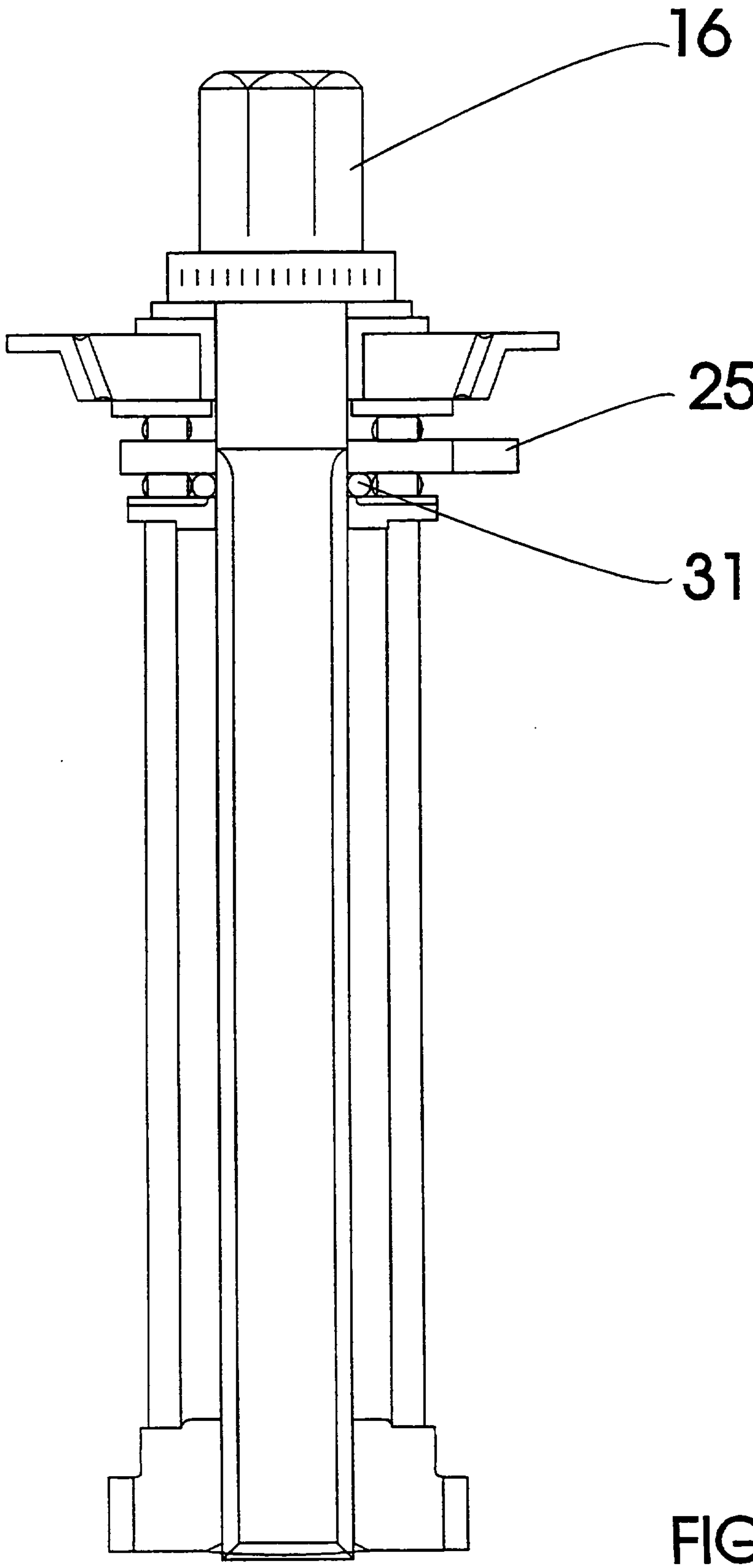

FIG. 2

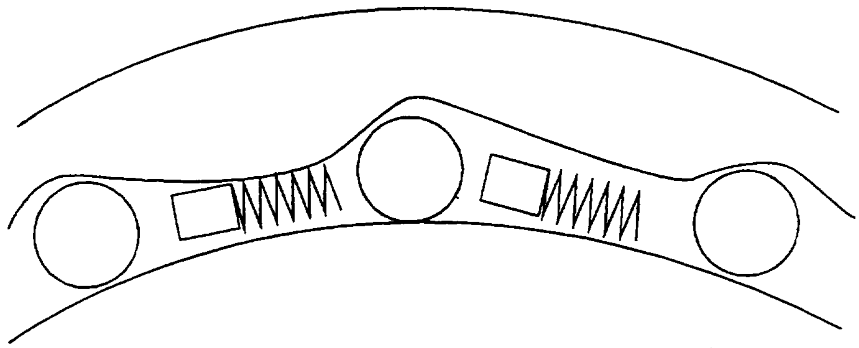

Fig. 3

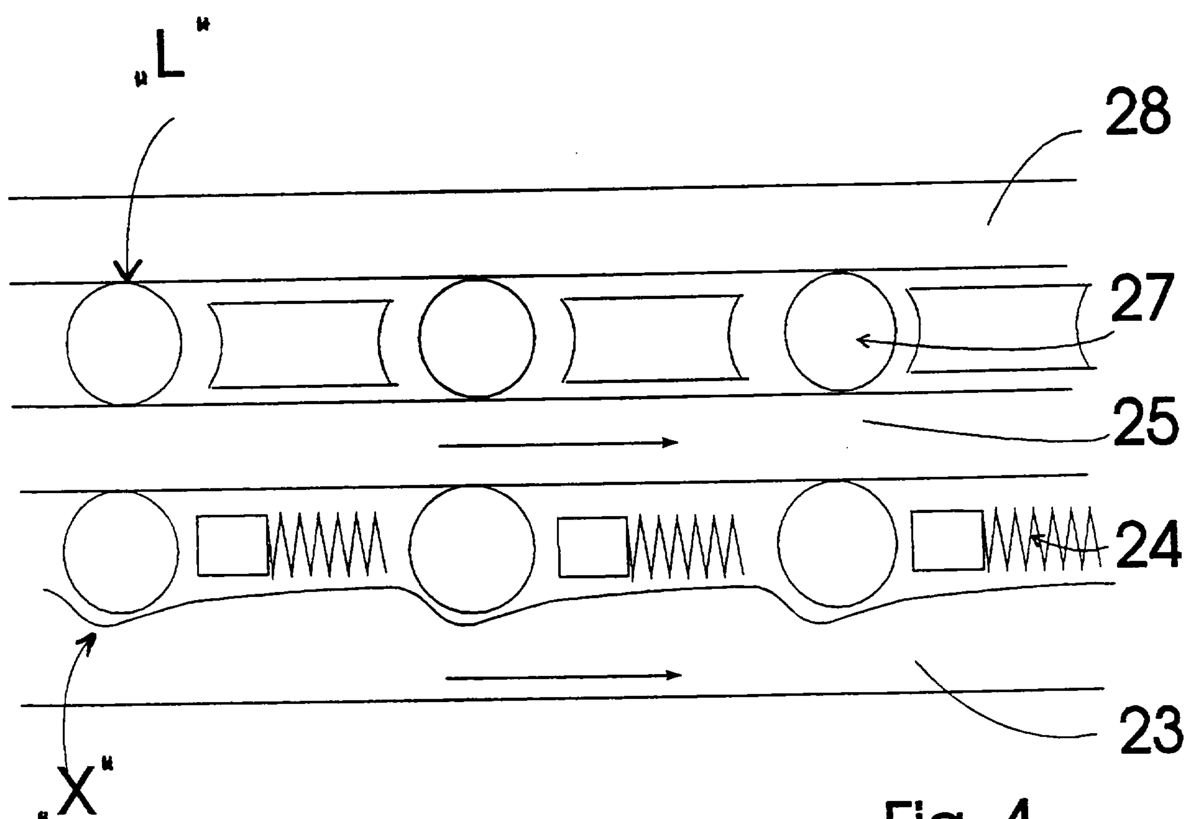

Fig. 4

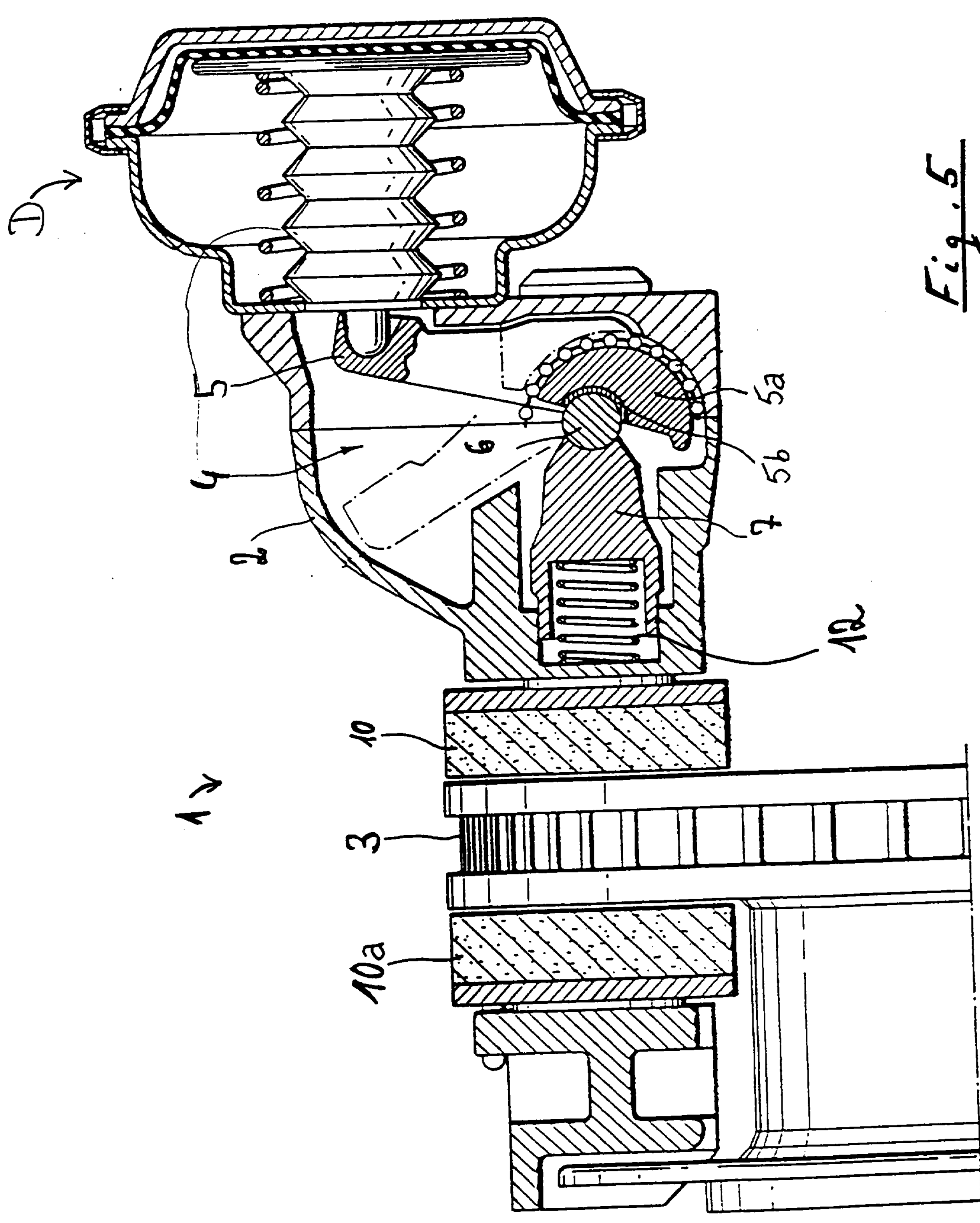

Fig. 5

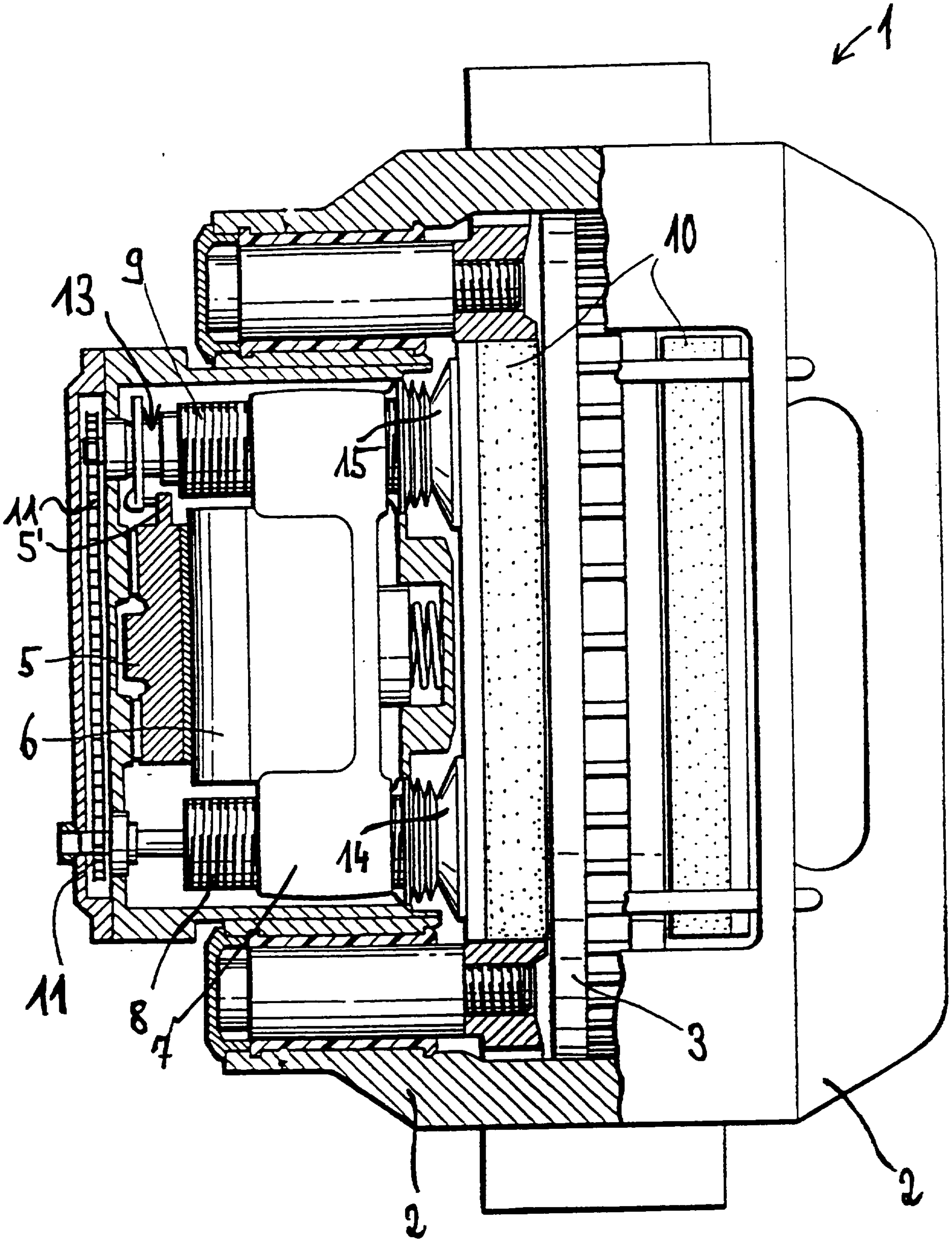

Fig. 6

Wear-adjusting device for disc brakes

The invention relates to a wear-adjusting device for disc brakes according to the preamble of claim 1. A wear adjusting device of this type is known, for example, from WO 91/19115, for automatically adjusting the play of the brakes as the pads wear down.

The disc brake according to WO 91/19115, having a brake application device provided on one side, contains a cam lever which is rotatable about an axis parallel to the plane of the brake disc and, and co-operates by way of a cross-piece with one, or preferably two, adjusting spindles, against which a brake lining is supported. The two adjusting spindles are coupled by means of a belt or a chain so that they rotate together. One of the adjusting spindles has a recess into which a rotary drive protrudes; this drive can be driven by the cam lever and during the application stroke effects a screwing of the adjusting spindle - and thus, by way of the toothed belt, of the second adjusting spindle as well - in the direction towards the brake disc. The rotary drive contains a one-way rotary coupling and also a torque-limiting coupling or overload coupling, by which an undesired screw movement of the adjusting spindles during the fixed braking stroke and the releasing stroke is avoided.

Central elements of the above-mentioned brake adjustment mechanism are the one-way coupling and the overload coupling, which are, for example, designed as systems which act in a frictionally engaged manner (for example the one-way coupling is constructed as a wrap-spring free-wheel or ratchet and the overload coupling as a friction sliding coupling or an axial toothed coupling). The operation of these systems is subject to strong scatter in the possible coefficients of friction. In Fig. 5 of WO 91/19115, for example, the overload coupling is constructed in rolling bearing technology as a ball-shaped coupling, the switching torque of which is dependent exclusively on the geometry of the ramp-like pockets which hold the balls, and the magnitude of the prestressing force. This system has the advantages of being more or less free of frictional influences and of permitting very high switching torques in a small space. The one-way coupling of this adjuster is realised as a clamp-roller sleeve-type free-wheel, which has a very high accuracy of response and permits high transmission torques in a small space.

The adjusting device shown in WO 91/19115 is, among other things, also suitable for a disc brake as shown in Figures 5 and 6 of the present application. The brake shown in these Figures is, for example, known from EP 0 566 008, to the full extent of which reference is hereby made. Furthermore, EP 0 492 143 is cited as prior art.

One problem of the adjusting device of WO 91/19115, which has proven itself per se, results from the use of a plurality of high-precision components (for example the output or drive bushings) and the high manufacturing costs connected therewith. There is therefore the desire for a simplification of the above-described construction in order to achieve a clear reduction in cost. The invention is therefore aimed at solving this problem.

The invention achieves this aim by providing a single coupling mechanism fulfilling both the one-way and the overload functions. A wear-adjusting device for a disc brake for motor vehicles, in particular a pneumatically actuated disc brake for commercial vehicles, is developed in which a rotary lever which is actuated upon braking acts on at least one shiftable or slidable element, which actuates at least one, preferably two, adjusting spindle(s), which press(es) a brake lining in the direction of a brake disc, the adjusting device being constructed in such a way that it adjusts the adjusting spindle(s) by rotating them further, for which purpose there are provided a one-way rotating coupling which locks in the adjusting direction and an overload coupling, which are integrated to form a combined one-way rotating and overload coupling system. Bringing these two functions together in one structural system unit on the one hand saves on costs by reducing the number of high-precision components required, and on the other hand simplifies the assembly of the adjuster.

This can preferably be realised by constructing the one-way rotating and overload coupling system as an axially prestressed rolling bearing coupling having two rolling-body bearings arranged on either side of a selector fork. Preferably a device for torque limiting is furthermore constructed in such a way that in one of the two rolling-body bearings an overrun of the bearing elements of the rolling bearing occurs if a limiting torque is exceeded. This device can be realised in an uncomplicated way by having an asymmetrical ramp disc form one of the rotor discs of one axial bearing. This means that, essentially, the only non-standard part is the special ramp disc, the remaining parts being standard.

Advantageous developments of the invention are given in the other subclaims.

For a better understanding of the invention embodiments of it will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a diagrammatic view of a first embodiment of the invention;

Figure 2 shows a diagrammatic view of a further embodiment of the invention;

Figure 3 shows a diagrammatic representation of a section of a sleeve-type free-wheel in order to illustrate the operation of the adjuster;

Figure 4 shows a diagrammatic representation of a section of an adjuster in accordance with the invention; and

Figures 5 and 6 show different views of a disc brake as existing in the prior art, in which the use of the adjusting device in accordance with the invention is advantageous.

First of all, the construction and operation of the pneumatic disc brake according to Figures 5 and 6 is outlined briefly. The disc brake 1 has a brake caliper 2, which clasps an internally ventilated brake disc 3. Provided on one side of the brake disc 3 is a brake application device 4, which has a rotary actuating lever 5 mounted in a sliding bearing and moved by the piston rod of a compressed-air cylinder D. The lever 5 has a foot portion 5a rotating in a cylindrical bearing and an eccentric recess with a bearing lining 5b for an eccentric rod 6. As illustrated by the position of the lever 5 shown with a dashed line the lever 5 for its part actuates, or rotates, the eccentric rod 6, which in turn co-operates by way of a pressure piece, in the form of a cross-piece 7, with two adjusting spindles 8, 9, against which one of the brake linings 10 is supported. The two adjusting spindles 8, 9 are coupled by means of a chain 11. A spring 12 is placed under stress between the cross-piece 7 and the brake caliper 2 and thus ensures that the cross-piece 7 is prestressed in the direction of the rotary lever 5.

On both outer sides, the cross-pieces 7 have respective bores provided with an internal thread, into which the adjusting spindles 8 and 9, which are provided with external threads, are screwed. There protrudes into the recess of the upper (in Figure 6) adjusting spindle 9 a rotary drive 13 (which is here constructed according to the prior art, but this does not make any difference with respect to the basic principle of the actuation of the rotary drive), which is actuated by the rotary lever 5, in particular a pin 5' preformed thereon, and during the application stroke effects a screwing of the adjusting spindle 9 - and thus, by way of the chain 11, of the other spindle 8 as well - in the direction towards the brake disc 3.

When compressed air is applied to the cylinder D, the rotary lever 5 is swivelled, turning the eccentric 6 and shifting the cross-piece 7 towards the brake disc 3, so that the spindles 8, 9 move in the direction of the near-side lining 10. The pressure pieces 14, 15 at the ends of the adjusting spindles 8, 9 thus shift this brake lining 10 towards the brake disc 3. Meanwhile, the brake caliper 2, which is mounted on a brake carrier (not shown) in a manner such that it can be shifted in the axial direction and which entrains the other brake lining 10a, is also shifted so that the brake is applied.

The invention envisages a particular construction of the rotary drive, i.e. of the wear adjuster 13; this will now be described with reference to Figure 1.

The wear adjuster or adjusting device 13, shown in Figure 1, consists of a central pin 16 on which there are placed a flange 17 and an angle bushing 18, which together form a sliding bearing 19 for the pin to rotate. The central pin 16 is inserted into a spacer tube 20 and with the spacer tube 20, which is mounted on a drive star 21 or constructed in one piece therewith, forms an axially acting spring element for exerting a compressive stress. The central pin 16 is preferably constructed as an expandable screw, which is screwed to the drive star 21 in such a way that axial prestressing forces can be exerted on the elements between the screw head and the drive star. In order to achieve a larger resilient stroke the spacer tube 20 can be combined with further spring elements, for example cup springs (not shown).

With this embodiment a combined one-way rotating and overload coupling system is arranged between the bearing 19 and the tube 9, comprising two axial bearings 22 and 26. The system is axially prestressed as described above, compressing the two bearings located at the upper axial end of the adjuster. Of these axial bearings the lower bearing 22 acts as a rolling-body free-wheel (ratchet) system and simultaneously as a torque limiter, as will now be explained.

The rolling-body free-wheel system 22 has a (lower in Figure 1) ramp disc 23 for realising an axial roller-type free-wheel and also has a rolling-body crown 24 with retainer and spring elements, placed on the ramp disc 23, and a selector fork 25 resting on the rolling-body crown 24. The selector fork 25, or the outer surfaces, is simultaneously the "upper" axial bearing rotor disc of the axial rolling-body free-wheel system 22 and also the "lower" rotor disc for the upper axial rolling bearing 26. The further rolling bearing 26 is used to transmit the prestressing force. In addition to the selector fork, it comprises a rolling-body crown or race (reference number 27), which rests on the selector fork, and a further (upper in Figure 1) rotor disc 28.

The required axial release play of the rolling-body free-wheel 22 is ensured by a spacer sleeve 29 which is drawn over the pin 16 between the ramp disc 23 and the further rotor disc 28. The length of the spacer sleeve 29 is preferably of such dimensions that with the selector fork 25 not actuated the distance between the deepest point on the ramp (point "X") in the ramp disc 23 (see Figure 4 in this respect) and the running surface of the rotor disc 28 (see "L") is larger by the amount of a specified release play than the overall thickness of the rolling bodies of the axial bearings 22 and 26 plus the distance between the two running surfaces on the selector fork 25 (= the thickness of the selector fork) plus the maximum ramp depth in the ramp disc 23 with respect to the bearing surface of the spacer sleeve 29 on the ramp disc 23.

The operation of the adjuster 13 shown in Figure 1 is as follows: the adjuster 13 is clamped rigidly in the housing of the brake caliper 2 by a bearing element 30 (rubber/metal composite bushing). Tooth-like adjuster driving pins protruding from the rotary brake lever (cf. Fig. 6) engage in recesses of the selector fork 25. When the brake lever is actuated, the selector fork 25 is driven by the driving pins in the direction of an advancing rotating movement of the drive star 21. As it does so the rolling bodies 24 of the free-wheel are moved against the ramp surfaces on the ramp disc 23, so that their rolling movement is stopped there by the resultant clamping forces.

In this state, the ramp disc 23 is rotated by the clamping forces generated and this rotating movement is transmitted by way of the drive star 21 to the threaded spindles of the wear-adjusting system of the brake. With the correct air play, the rotating movement of the threaded spindles 8, 9 is stopped by reaction forces. Because the selector fork is moved further as a result of the actuation of the brake, the selector fork is now rotated relative to the fixed ramp disc. With this rotating movement, the rolling bodies 24 roll up the ramp surfaces of the ramp disc 23 and move it downwardly against the prestressing force of the spring system (comprising the central pin 16, the expansion tube 20 and possibly an additional spring element in the axial direction).

The magnitude of the torque required to overcome the rigid coupling between the selector fork 25 and the ramp disc 23 is determined by the gradient of the ramps and the magnitude of the axial prestressing force. Because the magnitude of the prestressing force can easily be varied by a greater or lesser rotation of the central (expander) pin 16 into the drive star 21, the limiting torque of the free-wheel system, above which torque the rigid coupling is overridden, can be adjusted precisely over a broad range.

The variation of the limiting torque as a function of the angle of twist can be influenced particularly easily by varying the course of the ramp gradient. The ramp shape is preferably designed in a degressive manner, resulting in a torque which drops with the increase of the angle of rotation.

Figure 2 shows a variant of the invention in which the required free-wheel release play is produced by a further rolling-body crown 31 arranged between the ramp disc 23 and the selector fork 25, so that the spacer sleeve 29 of Figure 1 can be omitted. Otherwise, the operation corresponds to that of Figures 1 and 4.

In order to clarify the operation of the invention, reference is additionally made to Figure 3. Figure 3 shows a clamped-roller free-wheel, which contrary to the prior art has dimensions such that the elastic deformation of the force-absorbing components forming the free-wheel ramps is designed in such a way that when a specified limiting torque is reached, an overtravel is possible without a further significant rise in the transmitted torque. In the case of a particularly high overtravel requirement (maximum brake action), it is even possible, contrary to the prior art, to roll over one free-wheel ramp into the next ramp trough without damaging the free-wheel. A limiting of the rise in force in the overtravel is achieved by a degressive course of the ramp contour, i.e. having a decreasing slope in this direction. On the other hand in the other (blocking) direction the ramp is steep and short, resulting in an asymmetric profile. This construction also makes it possible to bring about a reduction in the torque after the limiting torque has been exceeded. The invention can make use of this idea and transfers it to the solution of Figures 1 and 4.

List of reference numerals

disc brake	1
brake caliper	2
brake disc	3
brake application device	4
rotary lever	5, 5a, 5b
eccentric	6
cross-piece	7
adjusting spindles	8, 9
brake linings	10, 10a
chain	11
spring	12
rotary drive	13
pressure pieces	14, 15
pin	16
flange disc	17
angle bushing	18
sliding bearing	19
spacer tube	20
driver star	21
rolling-body free-wheel system	22
ramp disc	23
rolling-body crown	24
selector fork	25
axial rolling bearing	26
rolling-body crown	27
rotor disc	28
spacer sleeve	29
bearing element	30
rolling-body crown	31

Claims

1. A wear-adjusting device for a disc brake for motor vehicles of the type comprising a rotary lever (5) which is actuated upon braking so as to act on at least one slidable element (7), which in turn actuates at least one adjusting spindle (8, 9) which presses a brake lining in the direction of a brake disc;

the wear-adjusting device (13) being adapted to adjust the adjusting spindle (8, 9) by rotating it further as the brake wears, to this end including a one-way rotary coupling locking in the adjusting direction and an overload coupling,

characterised in that the one-way rotating coupling and the overload coupling are consolidated to form a combined one-way rotating and overload coupling system.

2. A wear-adjusting device according to claim 1, in which the one-way rotating and overload coupling system includes a selector fork actuated during braking and is constructed as a rolling bearing coupling having two rolling-body bearings (22, 26), which are arranged on either side of the selector fork (25).

3. A wear-adjusting device according to claim 2, in which the overload coupling includes a device (23) for torque limiting, which is constructed in such a way that in one of the rolling-body bearings (22) an overrun of the bearing elements occurs if a limiting torque is exceeded.

4. A wear-adjusting device according to claim 3, in which the device for torque limiting includes a ramp disc (23), which forms one of the rotor discs of the said bearing (22).

5. A wear-adjusting device according to claim 4, in which the ramp disc (23) has axially extending indentations in one of its outer disc surfaces so as to form ramps arranged on both sides.

6. A wear-adjusting device according to claim 5 in which the gradient of the free-wheel ramps is different on either side of the indentations.

7. A wear-adjusting device according to claim 5 or 6, in which the ramps on one side of the indentations are constructed as clamping ramps but in such a way that when a limiting torque is exceeded the rolling bearing elements can jump over into the adjacent indentation.

8. A wear-adjusting device according to claim 7, in which the gradient of the free-wheel ramps from the deepest point of the indentations in the clamping direction first of all extends constantly and then decreases progressively.

9. A wear-adjusting device according to any preceding claim and including a central pin (16), which by way of a bearing element (30) such as an ultra bushing connects the adjusting device to the brake caliper (2).

10. A wear-adjusting device according to claim 9 and further including a spacer tube (20) guided over the central pin (16) and supported on a drive star (21) and/or constructed in one piece with the drive star (21), so that the central pin (16) forms with the spacer tube (20) a spring element which acts axially on the bearings (22, 26).

11. A wear-adjusting device according to claim 10, in which the central pin (16) is axially adjustable relative to the drive star (21).

12. A wear-adjusting device according to claim 11, in which the central pin (16) is constructed as an expandable screw and is screwed directly or indirectly to the driver star (21) in order to achieve axial prestressing forces.

13. A wear-adjusting device according to any of claims 10 to 12, in which the spacer tube (20) is

combined with further spring elements, such as cup springs.

14. A wear-adjusting device for a brake, including two coaxial roller bearings, in particular according to one of the preceding claims, including:

- a ramp disc (23),

- a first rolling-body race (22) with a retainer and spring elements, forming a free-wheel bearing;

- a selector fork (25), one axial side of which is designed as an axial bearing rotor-disc surface of the axial rolling-body free-wheel and the other axial side of which is designed as an axial bearing rotor-disc surface of the rolling-body crown (26) of the second bearing, which transmits the axial prestressing force while allowing relative rotation of the fork, and

- a second rotor disc (27) of the second rolling-body crown.

15. A wear-adjusting device according to any preceding claim, in which a spacer sleeve (29) is guided over the central pin (16) between the upper rotor disc (28) and the ramp disc (23), the length of which spacer sleeve is such that in the case of a non-actuated selector fork, the distance between the deepest point on the ramp in the ramp disc (23) and the running surface of the rotor disc (28) is larger by the amount of a specified release play than the overall thickness of the rolling bodies of the axial bearings (22 and 26) plus the thickness of the selector fork (25) plus the maximum ramp depth in the ramp disc (23) with respect to the bearing surface of the spacer sleeve (29) on the ramp disc (23).

16. A wear-adjusting device substantially as described with reference to any of the attached Figs. 1 to 4.

17. A pneumatically actuated disc brake for commercial vehicles, including a wear-adjusting device

according to any preceding claim.

18. A brake according to claim 17 and having two adjusting spindles, the wear-adjusting device being mounted in one of these spindles.

Application No: GB 9814830.7
Claims searched: 1-13 and 15

Examiner: Peter Squire
Date of search: 28 January 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F2E ELFE ELFG

Int Cl (Ed.6): F16D 65/38, 40, 52, 56

Other: Online:WPI,EPODOC,PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X, P	WO 98/21497 A2	(Meritor) see whole document	1
X	WO 97/22814 A1	(Lucas) see page 13 line 5 to page 14 line 2	1
X	WO 96/12900 A1	(Haldex) see page 8 line 28 to page 9 line 10	1
X	US 5449052	(Perrot Bremse) see col.5 lines 31-57	1
X	US 5379867	(Perrot Bremse) see col.6 lines 18-56	1

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Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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E Patent document published on or after, but with priority date earlier than, the filing date of this application.