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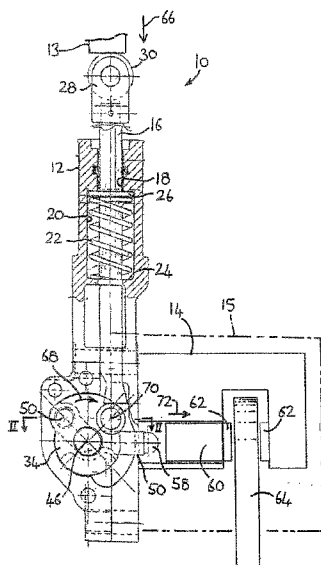
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(54) Title: BRAKE ACTUATOR

Fig. 1



(57) Abstract: There is disclosed a brake actuating adaptor (10). This is for use in a braking system which includes a brake actuating driver (13) adapted for movement in a first, vertical direction (66) and a disc brake assembly (15) having an actuating piston (60) movable in transverse horizontal direction (72) for applying the disc brakes (62). The adaptor has a push rod (12) for engagement with the actuating driver, a plunger (50) for engagement with the actuating piston for applying the disc brakes, and an interconnecting rotatable crank (34) for translating movement of the push rod in the vertical direction to corresponding movement of the plunger in the horizontal direction.

BRAKE ACTUATOR

TECHNICAL FIELD

The present invention relates to a brake actuating adaptor. In particular, in a preferred embodiment, the adaptor is for adapting a braking system for use where the braking system has a brake booster configured to exert its braking effect in a downward direction and where the brake assembly of the braking system is configured to be actuated in a lateral direction in order to apply the brakes.

BACKGROUND TO THE INVENTION

10 In the trucking transport industry, it is beneficial to have as much space available within the trailer or other cargo areas of a truck to maximise the size of load that can be transported per journey. This is desirable as it can result in greater efficiency and hence a significant saving in cost.

15 With the advent of independent suspension in trucks, greater space has been available in such cargo areas, as their bottom decks can be at a level between the opposite side wheel wells, rather than having to be disposed above the suspension systems. Indeed, this can result in significantly increased available space in such cargo areas so that they can even be provided with two loading decks, one above the other.

20 However, given the typical width of such trucks, maximising the available width in the cargo area between the opposite side wheel wells necessitates having the wheel wells as narrow as possible. For example, wheel wells of such trucks may be 1,400mm apart to make suitable allowance for the loading of pallets, which typically leaves only about 550mm width available
25 for each wheel well. As a result, the components of the braking system of such a truck that are disposed in the wheel wells must be suitable for being accommodated in such a narrow space.

In the past, drum brakes have been used, and these are suitable for the available widths of wheel wells due to their inherently narrow construction.

However, it is beneficial to be able to make use of disc brakes in such vehicles due to their greater effectiveness when compared with drum brakes. A disadvantage of this is that the configuration of a typical disc brake assembly usually requires a significant width of available space. This
5 is because such an assembly typically has a brake actuating piston which is operable in a horizontal direction, and this, in turn, has required that the brake booster be disposed to the side of the brake assembly.

To accommodate such a configuration, greater lateral space is required in each wheel well, and this results in a corresponding decrease of space in
10 the cargo area.

A known braking system includes a brake assembly which is operable via a lever rather than via a piston. The assembly also includes a push rod which is connected to the brake booster and which operates vertically to actuate the lever for applying the brake. As a result of the vertical operation of the
15 push rod, the brake booster is disposed above, rather than to the side of, the brake assembly. Consequently, considerably less width is required in the wheel well to accommodate such a construction.

However, such braking systems are not readily available. It is therefore desirable to provide an alternative means of achieving similar advantages.

20 **SUMMARY OF THE INVENTION**

According to the invention there is provided a brake actuating adaptor for use in a braking system which includes a brake actuating driver configured for actuating movement in a first direction and a disc brake assembly having an actuating piston movable in a second direction, transverse to the
25 first direction, for applying disc brakes of the assembly, the adaptor including:

a push rod configured for engagement with the actuating driver and to be driven in said first direction by the driver;

a plunger configured for engagement with the actuating piston and
30 for movement in said second direction for displacing the piston to apply the disc brakes; and

an interconnecting means interconnecting the push rod and the plunger, the interconnecting means being configured such that movement of the push rod in said first direction causes the interconnecting means to drive the plunger to move in said second direction, this movement being
5 simultaneous with, and corresponding to, said movement of the push rod.

In a preferred embodiment, the interconnecting means includes a crank rotatably engaged with each of the push rod and the plunger.

Then, preferably, the crank is rotatable about a crank axis, and is connected to the push rod at a push rod connection so as to be rotatable relative to
10 the push rod about a push rod connection axis, and is connected to the plunger at a plunger connection so as to be rotatable relative to the plunger about a plunger axis.

In a preferred embodiment, the first direction and second direction are substantially at right angles to each other.

15 Then, preferably, said crank axis, push rod connection axis, and plunger axis are substantially parallel to one another, and an imaginary first line extending from the push rod connection axis to the crank axis extends at a right angle with respect to an imaginary second line extending from the plunger axis to the crank axis.

20 Preferably, said first direction is a downward direction and said second direction is a lateral direction.

Preferably, the plunger axis is on one side of a third imaginary line which is parallel to the first direction and which extends through the crank axis, the push rod connection axis is on an opposite side of the third imaginary line,
25 and a fourth imaginary line, extending from the plunger axis in the second direction extends from said one side of the first imaginary line to said opposite side of the first imaginary line.

Preferably, said first and third imaginary lines define an angle of substantially 45 degrees between them and said second and third imaginary
30 lines define an angle of substantially 45 degrees between them.

In a preferred embodiment, the push rod is configured for said engagement with the actuating driver such that the push rod is free to move laterally relative to the actuating driver in relation to said first direction.

5 Then, preferably, the push rod includes a roller adapted for said engagement with the actuating driver to facilitate said lateral movement of the push rod relative to the actuating driver.

10 In a preferred embodiment, the plunger connection is configured such that the plunger is laterally rotatable relative to the crank between a first position in which the plunger extends in a first direction perpendicular to the plunger axis and a second position on one side of the first position, in which the plunger extends in a second direction which is at an acute angle to the first direction and to the plunger axis, and between the first position and a third position on an opposite side of the first position, in which the plunger extends in a third direction which is at an acute angle to the first direction and to the plunger axis.

15 Preferably, the brake actuating adaptor includes a part-spherical bearing mounted to the crank, wherein the plunger defines an aperture with an internal wall which is shaped complementarily to the bearing and which is slidable therealong to enable said lateral rotation.

20

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

25 Figure 1 is a side view, partly cut away, of a brake actuating adaptor according to an embodiment of the invention, together with a disc brake calliper which is shown schematically, in cross-section;

Figure 2 is a section view, along line II-II in Figure 1, showing *inter alia*, part of a crank of the brake actuating adaptor;

Figure 3 is a side view, partly cut away, of the crank in Figure 2;

Figure 4 is a side view of a plunger forming part of the brake actuating adaptor of Figure 1;

Figure 5 is a front view of a push rod forming part of the brake actuating adaptor of Figure 1;

5 Figure 6 is a side view of the push rod of Figure 5; and

Figure 7 is a view, corresponding to that of Figure 2, of another embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the Figures 1 to 6, there is shown a brake actuating adaptor 10 according to the invention. The adaptor 10 includes a housing 12 which is for mounting beneath an actuating driver 13. The actuating driver 13, in turn, is connected to a brake booster of a vehicle's braking system (the booster and system not being shown). The housing 12 is also bolted to a brake calliper 14 of a disc brake assembly 15 (the manner of bolting not being shown).

The adaptor 10 includes a push rod 16 disposed within a passage 18 in the housing 12. The passage 18 includes a spring chamber 20 for accommodating a coil spring 22 mounted around the push rod 16. The lower end of the spring 22 engages a lower shoulder 24 of the chamber 20, while the upper end of the spring engages a collar 26 forming part of the push rod 16. The spring 22 maintains the push rod 16 biased upwards to a resting position as shown in Figure 1.

The push rod 16 further includes a pair of spaced upper walls 28 between which there is provided a roller 30 which is rotatably mounted to the upper walls. The roller 30 engages the lower end of the actuating driver 13.

The lower end of the push rod 16 is forked, having two spaced-apart tines 32, each tine having a substantially flat lower end 33.

There is provided a crank 34 which has a pair of stub axles 36 projecting from its opposite faces. The crank 34 has two spaced-apart portions 38

joined to each other by a lower crank wall 40, with a space 42 between the portions. Each portion 38 has an outwardly projecting boss 44.

The stub axles 36 are accommodated in complementary recesses (not shown) in the housing 12. The axles 36 enable the crank 34 to be rotated
5 relative to the housing 12 about a crank axis 46.

Each of the crank portions 38 defines a circular aperture 48 disposed opposite to the respective boss 44 of that portion. A plunger 50 is connected to the crank 34 by means of a shaft 52 which extends through the circular apertures 48 of the crank, and through a circular aperture 54 of
10 the plunger. The shaft 52 enables the plunger 50 to rotate relative to the crank 34 about a plunger axis 56.

The plunger 50, at the opposite end to its circular aperture 54, has a rounded actuating knob 58.

The lower end 33 of each tine 32 of the push rod 16 engages a respective
15 one of the bosses 44 of the crank portions 38.

As mentioned above, the housing 12 is bolted to the calliper 14 of the disc brake assembly 15. The configuration is such that the plunger 50 protrudes into the brake assembly 15 so that the knob 58 engages an actuating piston 60 of the assembly. This piston 60 is configured, on being depressed, to
20 apply disc brakes 62 of the brake calliper 14 to a brake disc 64.

The brake actuating adaptor 10 is used to convert vertical movement of the driving actuator 13, which movement is effected by the brake booster (not shown) into horizontal movement of the plunger 50 to apply the disc brakes 62.

25 Thus, as the actuating driver 13 moves downwards as indicated by the arrow 66 in Figure 1, this causes a corresponding movement of the push rod 16, which, in turn, urges each of the bosses 44, which are engaged by the lower ends 33 of the tines 32, in a downward direction.

This downward urging causes the crank 34 to rotate about the crank axis 46

in the direction of the arrow 68 as shown in Figures 1 and 3.

It will be appreciated that, as the lower end 33 of each tine 32 engages a respective one of the bosses 44 by abutting the boss, when the crank 34 is rotated in the direction of the arrow 68, the lower end of each tine is caused
5 effectively to roll along the outer circumference of the boss. The effect is substantially the same as if the lower end of each tine 32 were rotating about the central axis 70 of the respective boss 44. This axis 70 will thus be referred to below as a push rod connection axis.

As the crank 34 rotates in the direction of the arrow 68, this causes both
10 the push rod connection axis 70 and the plunger axis 56 to rotate about the crank axis 46. This results in the plunger 50 being urged to move in the direction of the arrow 72 as shown in Figures 1 and 4.

That portion of the plunger 50 opposite its circular aperture 54 is maintained in its horizontal orientation as it is moved in the direction
15 indicated by the arrow 72, by the engagement of that portion with the disc brake assembly 15.

In Figure 7, there is shown a brake actuating adaptor 10.1 which is a different embodiment to the adaptor 10. Parts of the embodiment of Figure 7 corresponding to parts described in relation to the other figures have
20 corresponding reference numerals, but with the suffix ".1".

In the actuator 10.1, there is provided a spherical plain bearing 80, having a central aperture 82 through which the shaft 52.1 passes.

The plunger 50.1 in this embodiment, instead of having a circular aperture 54 as in the actuator 10, has a part-spherical aperture 54.1 which is
25 complementary to the outer shape of the bearing 80.

In addition, the plunger 50.1 itself, other than at its actuating knob 58.1, is more slender than the plunger 50, thereby providing clearance spaces 84 between it and the portions 38.1 of the crank 34.1.

The complementary part-spherical shapes of the bearing 80 and aperture

54.1, together with the clearance spaces 84, allows the plunger 50.1 to rotate laterally relative to the crank 34.1, as indicated by the arrow 86. In a preferred embodiment, the plunger 50.1 can rotate up to five degrees in either lateral direction.

- 5 This feature allows the plunger 50.1 to accommodate rotation of the piston 60, particularly when this forms part of, or is connected to, a brake calliper lever (not shown) forming part of the brake assembly 15.

A pair of saucer springs 88 is provided to urge the plunger 50.1 to its central (non-laterally rotated) position as shown in Figure 7.

- 10 Use of a brake actuating adaptor according to the invention is described below in relation to the adaptor 10. However, it is to be understood that the description applies equally to other embodiments such as the adaptor 10.1.

As the brake actuating adaptor 10 is used to convert the vertical movement of the actuating driver 13 into horizontal movement of the plunger 50 and
15 hence of the piston 60 of the brake assembly 15, it will be appreciated that it is used in a scenario where the brake assembly itself is not specifically adapted for such use. In particular, the brake assembly 15 is adapted to be directly engaged with an actuating driver (not shown) that is applied to the piston 60 horizontally, and not vertically.

- 20 Accordingly, it is most important that the effect of the brake actuating adaptor 10 on the brake assembly 15 is substantially the same as if the actuating driver 13 (driven by the brake booster) were acting directly on the piston 60 of the brake assembly.

This is to ensure that the braking action as applied by an operator of the
25 vehicle in which the brake system is installed is transmitted as accurately as possible to the brake assembly 15. In particular, it is important to ensure that the horizontal movement of the plunger 50 corresponds substantially exactly to the vertical movement of the actuating driver 13 in all respects (such as distance moved over time and force transmitted) except for the
30 direction of movement. This effect is achieved by the configuration of the

crank 34.

For the purpose of explaining the configuration of the crank 34, reference will be made to certain lines as best shown in Figure 3, which, although illustrated, may be regarded as being imaginary lines as they do not
5 actually form part of the adaptor 10.

In particular, such an imaginary line 74 extending between the push rod connection axis 70 and the crank axis 46 extends at a right angle to another imaginary line 76 which extends between the plunger axis 56 and the crank axis 46. In addition, the relative positions of the push rod connection axis
10 70 and plunger axis 56 is such that they are symmetrically disposed about a further, downwardly extending, imaginary line 78 which passes through the crank axis 46, parallel to the direction of motion of the push rod 16 as indicated by the arrow 66.

As a result, the angle defined between the imaginary line 74 and the further
15 imaginary line 78, is 45 degrees, as is that between the imaginary line 76 and the further imaginary line 78.

It will also be noted that the push rod connection axis 70 is disposed on the right hand side of the further imaginary line 78 while the plunger axis 56 is disposed on the left hand side of that line as shown in Figure 3. In addition,
20 the direction of movement of the plunger 50, as indicated by the arrow 72, is the direction from the plunger axis 56 towards the push rod connection axis 70 along a another imaginary line 79.

As a result of this configuration, the downward movement of the push rod 16 is substantially translated by the crank 34 into an exactly corresponding
25 horizontal movement of the plunger 50.

As the disc brakes 62 wear through use, the actuating piston 60 will move correspondingly closer to the disc 64 with a compensating movement of the calliper 14 as a whole towards the centre of the vehicle (that is, in a left-hand direction as shown in Figure 1).

30 For example, over a distance travelled of, say, 800,000 kilometres, the

amount of wear may be such that the piston 60 is displaced up to around 23mm. As the calliper 14 moves as mentioned above, the entire housing 12, which is bolted to the calliper 14, also moves laterally together with the calliper, relative to the actuating driver 13.

- 5 This lateral movement of the housing 12 is enabled by the roller 30 which allows the push rod 16 to remain in firm engagement with the actuating driver 13, while being laterally movable relative to it.

It will be appreciated that, as a result of the brake actuating adaptor 10, a disc brake assembly such as the assembly 15, in which the actuating piston is operated horizontally, can be used, even though the actuating effect transmitted by the brake booster is directed vertically downward. This assists in enabling a reduction in the required width of the wheel well in which the brake assembly is disposed, as the brake booster can be positioned above, and remote from, the assembly, but spaced only a short distance from the assembly in a lateral direction.

Although the invention is described above with reference to specific embodiments, it will be appreciated by those skilled in the art that it is not limited to those embodiments, but may be embodied in many other forms.

CLAIMS

1. A brake actuating adaptor for use in a braking system which includes a brake actuating driver configured for actuating movement in a first direction and a disc brake assembly having an actuating piston movable in a second direction, transverse to the first direction, for applying disc brakes of the assembly, the adaptor including:
- 5 a push rod configured for engagement with the actuating driver and to be driven in said first direction by the driver;
- a plunger configured for engagement with the actuating piston and for movement in said second direction for displacing the piston to apply the disc brakes; and
- 10 an interconnecting means interconnecting the push rod and the plunger, the interconnecting means being configured such that movement of the push rod in said first direction causes the interconnecting means to drive the plunger to move in said second direction, this movement being simultaneous with, and corresponding to, said movement of the push rod.
- 15
2. A brake actuating adaptor as claimed in claim 1 wherein the interconnecting means includes a crank rotatably engaged with each of the push rod and the plunger.
- 20
3. A brake actuating adaptor as claimed in claim 2 wherein the crank is rotatable about a crank axis, and is connected to the push rod at a push rod connection so as to be rotatable relative to the push rod about a push rod connection axis, and is connected to the plunger at a plunger connection so as to be rotatable relative to the plunger about a plunger axis.
- 25
4. A brake actuating adaptor as claimed in claim 3 wherein the first direction and second direction are substantially at right angles to each other.
5. A brake actuating adaptor as claimed in claim 4 wherein said crank axis, push rod connection axis, and plunger axis are substantially parallel to one another, and wherein an imaginary first line extending from the push rod connection axis to the crank axis extends at a right angle with respect
- 30

to an imaginary second line extending from the plunger axis to the crank axis.

6. A brake actuating adaptor as claimed in claim 5 wherein said first direction is a downward direction and said second direction is a lateral direction.

7. A brake actuating adaptor as claimed in claim 6 wherein the plunger axis is on one side of a third imaginary line which is parallel to the first direction and which extends through the crank axis, the push rod connection axis is on an opposite side of the third imaginary line, and wherein a fourth imaginary line, extending from the plunger axis in the second direction extends from said one side of the first imaginary line to said opposite side of the first imaginary line.

8. A brake actuating adaptor as claimed in claim 7 wherein said first and third imaginary lines define an angle of substantially 45 degrees between them and said second and third imaginary lines define an angle of substantially 45 degrees between them.

9. A brake actuating adaptor as claimed in any one of claims 3 to 8, wherein the push rod is configured for said engagement with the actuating driver such that the push rod is free to move laterally relative to the actuating driver in relation to said first direction.

10. A brake actuating adaptor as claimed in claim 9 wherein the push rod includes a roller adapted for said engagement with the actuating driver to facilitate said lateral movement of the push rod relative to the actuating driver.

11. A brake actuating adaptor as claimed in any one of claims 3 to 10, wherein the plunger connection is configured such that the plunger is laterally rotatable relative to the crank between a first position in which the plunger extends in a first direction perpendicular to the plunger axis and a second position on one side of the first position, in which the plunger extends in a second direction which is at an acute angle to the first direction

and to the plunger axis, and between the first position and a third position on an opposite side of the first position, in which the plunger extends in a third direction which is at an acute angle to the first direction and to the plunger axis.

- 5 12. A brake actuating adaptor as claimed in claim 11 including a part-spherical bearing mounted to the crank, wherein the plunger defines an aperture with an internal wall which is shaped complementarily to the bearing and which is slidable therealong to enable said lateral rotation.

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Fig. 1

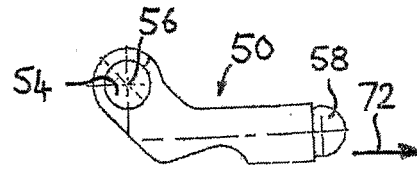
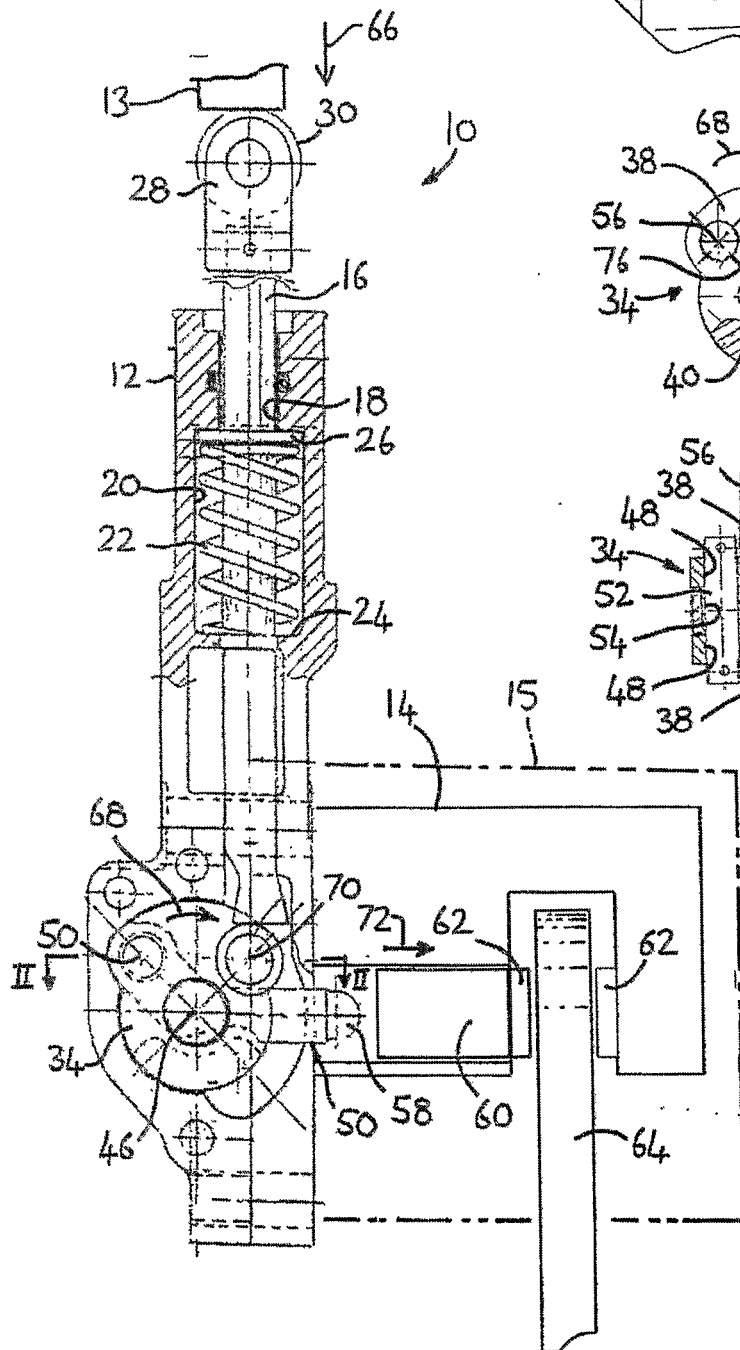


Fig. 4

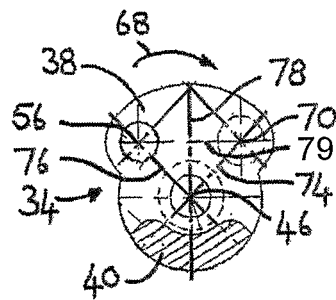


Fig. 3

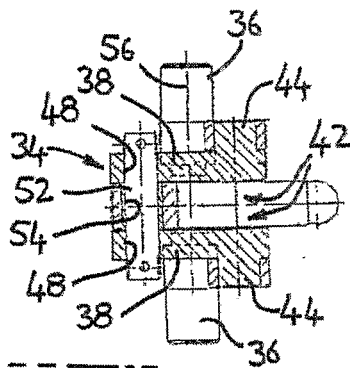


Fig. 2

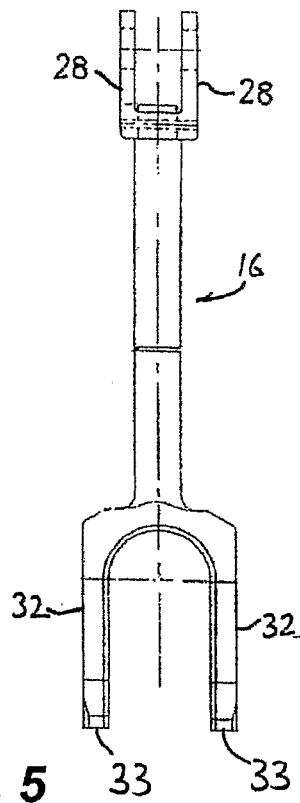


Fig. 5

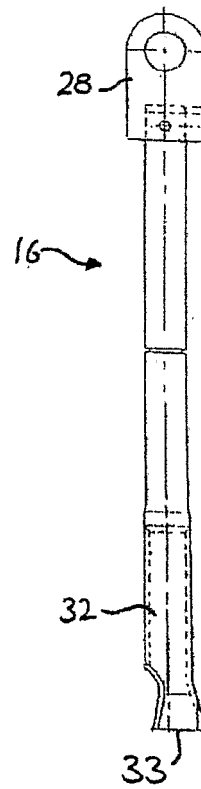


Fig. 6

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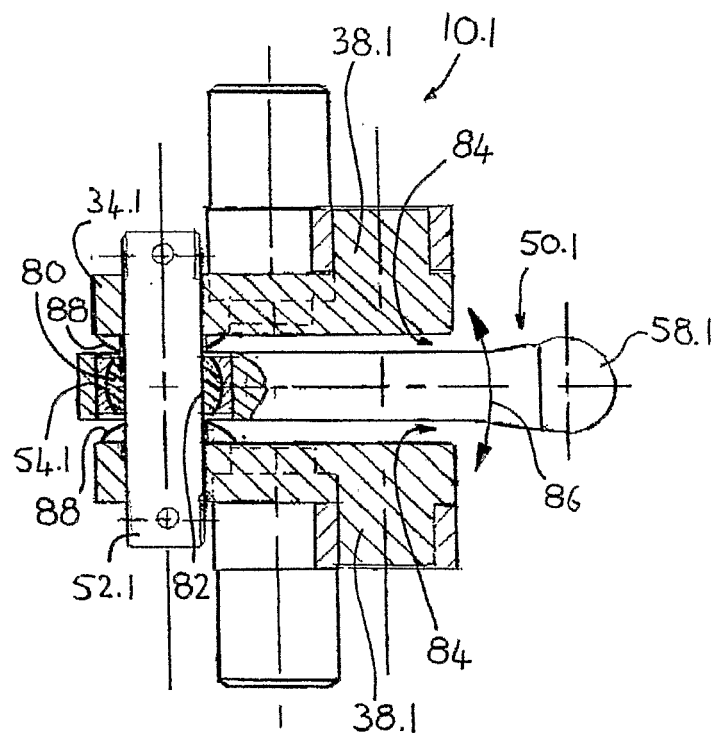


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2009/000054

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. *F16D 55/226* (2006.01), *F16D 65/095* (2006.01), *F16D 65/18* (2006.01), *F16D 55/224* (2006.01),
F16D 65/14 (2006.01), *F16D 65/30* (2006.01)

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)

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 practicable, search terms used)

EPODOC, WPI: IPC B60T 1/IC, 7/IC, 11/IC, 13/IC, F16D 55/IC, 65/IC and keywords DISK, DISC, ROD, PISTON, PLUNGER, CRANK, CAM, TRANSVERSE, RIGHT-ANGLE, PERPENDICULAR and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4429768 A (MARGETTS et al.) 07 February 1984 See column 2 line 44 to column 5 line 34 Figures 1-6.	1-4
X	GB 829866 A (MINISTER OF SUPPLY) 09 March 1960 See page 1 line 56 to page 2 line 108, Figures 1-4.	1-4
X	GB 1450775 A (GIRLING LIMITED) 29 September 1976 See page 2 lines 8-112 Figures 1-3.	1-4
X	US 5697475 A (LE DEIT et al.) 16 December 1997 See column 2 line 35 to column 5 line 63 Figures 1-6	1-4



Further documents are listed in the continuation of Box C



See patent family annex

* Special categories of cited documents:	
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
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Date of the actual completion of the international search 03 March 2009	Date of mailing of the international search report 12 MAR 2009
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer L. DESECAR AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2381

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2009/000054

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	4429768	AU	34993/78	BR	7802462	DE	2817389
		FR	2388169	GB	1595492	JP	53137379
		SU	799678				
GB	829866	NONE					
GB	1450775	SU	538669				
US	5697475	BR	9509474	EP	0803031	FR	2730023
		WO	9623985				
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.							
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