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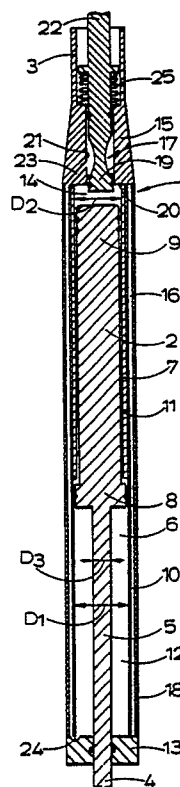
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Birmingham B16 9PW(GB)(54) **Hydraulic strut.**

(57) An hydraulic strut is formed as a piston and cylinder assembly (1, 2) having a first, larger diameter piston (8) working in a larger diameter cylinder bore portion (6) to define a first hydraulic chamber (12) around the piston rod (4), and a second, smaller diameter piston (9) also secured to the piston rod (4) and working in a smaller diameter bore portion (7) of the cylinder assembly (1) to define a second hydraulic chamber (14) between the second piston (9) and the adjacent end (15) of the cylinder assembly. The two chambers (12) and (14) are connected together by a passage means (16, 23) controlled by a valve (17), and the pressure-effective areas of the chambers (12) and (14) are made equal such that the expansion of one chamber is equal to the contraction of the other chamber during adjustment of the length of the piston and cylinder assembly.



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HYDRAULIC STRUT

This invention relates to an hydraulic strut particularly, but not exclusively, for use in a chair, primarily as a column for supporting a chair seat above a chair base.

Office chairs commonly comprise a base, usually a five-limbed (five star) base, on which is carried a vertical column or strut attached at its upper end to the chair seat. Various arrangements have been devised for adjusting the length of the strut to alter the height of the chair seat above the floor. Some struts incorporate a threaded spindle to enable the height of the seat to be altered by turning the seat, and others use a mechanical ratchet adjustment to permit incremental adjustment of the seat height. However it is generally necessary for the user to get off the chair before making the adjustment, and several attempts may be needed to get the correct seat height.

Gas springs have been used in chair column struts to provide a force which is sufficient to lift the chair seat when a locking mechanism is released. Usually it is necessary for the user to take some of his or her weight off the seat whilst the locking mechanism is released. By restricting the gas flow during adjustment, the seat is prevented from shooting to its maximum height. Gas springs have also been used to facilitate adjustment of the inclination of the seat back relative to the seat base in some chairs.

However, such gas springs utilise gas under high pressure, approximately 200 psi, and there have been instances of explosion of such gas springs.

There is therefore a requirement for a strut which can be easily adjusted in length, which is continuously variable in adjustment, and which is capable of providing a damped adjusting action.

According to the invention a strut of adjustable length comprises an hydraulic piston and cylinder assembly comprising first and second larger and smaller diameter pistons respectively carried by a common piston rod which extends sealably through one end of the cylinder body, the cylinder body having a stepped bore comprising first and second larger and smaller diameter bore portions respectively, the first piston working in the first bore portion and the second piston working in the second bore portion, a first hydraulic chamber defined in the first bore portion and bounded by the side of the first piston which is nearest to said one end of the cylinder, a second hydraulic chamber in the second bore portion and bounded by the side of the second piston which is remote from said one end, a fluid passage means connecting the first and second chambers, and a manually operable

valve controlling fluid flow through the passage means, the valve being closable to lock the piston and cylinder assembly against adjustment of its length, the arrangement being such that the pressure-effective area of the first piston exposed to fluid in the first chamber is substantially equal to the pressure-effective area of the second piston exposed to fluid in the second chamber.

It will be appreciated that the pressure effective area of the first piston is the cross-sectional area of the first piston less the cross-sectional area of the piston rod in the first chamber, where the rod passes through said one end of the cylinder.

Thus it is arranged that the volume of fluid displaced from the first chamber during expansion of the strut is equal to the expansion in the volume of the second chamber, and, when the valve is open, fluid can flow from one chamber to the other as the strut is expanded or contracted.

It will be appreciated that this arrangement can be made relatively cheaply since it does not require an expansion chamber to which excess fluid is displaced, as with conventional hydraulic struts, to take account of the piston rod displacement.

When the valve is closed a positive locking of the length of the piston and cylinder assembly is achieved.

The passage means may be provided in the piston rod, but preferably it is provided in the cylinder wall, the means for operating the valve being carried by the cylinder.

The valve can be of any suitable type, but a poppet-type valve will generally be satisfactory, and can be arranged to provide a damped flow during adjustment by partial opening of the poppet valve.

The valve operating means can be arranged in any suitable way but for a chair strut it is preferred that the operating means is an axially movable plunger extending through that end of the cylinder opposed to said one end.

Such a piston and cylinder assembly can have various uses. For example it could be incorporated in a vehicle suspension strut. Primarily, however, a strut in accordance with the invention can be used as the support column of a chair. The strut preferably then comprises resilient means which is arranged to urge extension of the piston and cylinder assembly.

The resilient means may be arranged adjacent to said one end of the cylinder, with the piston rod extending through the resilient means, but the resilient means may be arranged alongside the cylinder, or within the cylinder if desired.

When the strut is used as a chair column the

piston rod is conveniently attached to the chair base, and the closed end of the cylinder to the chair seat, and a lever for operating the valve means is conveniently positioned beneath the chair seat. On operating the lever to open the valve means, the seat will be urged upwards by the resilient means, and the rate of rise of the seat can be controlled by operation of the lever. The hydraulic action can be relatively silent as compared with the noise of a gas spring.

Any suitable hydraulic fluid may be used.

The accompanying drawing is, by way of example only, a schematic longitudinal cross-sectional view of a chair column in accordance with the invention, showing the column in a substantially fully contracted condition.

The column comprises a cylinder assembly 1 in which works a stepped piston assembly 2, the upper end 3 of the cylinder assembly 1 being attached in use to the base of a chair seat, such as a typists chair seat, and the lower end 4 of a piston rod 5 secured to piston assembly 2 being attached to a chair base, such as a five-star base. The attachment of end 3 to the chair seat can be conventional and will often include a pivotal connection to enable the chair seat to swivel about the vertical axis of the cylinder assembly 1. A stepped cylinder bore having larger and smaller diameter bore portions 6 and 7 respectively is provided in any convenient manner to seal respectively with larger and smaller diameter piston portions 8 and 9 of the piston assembly 2. For convenience of manufacture the stepped bore is provided in the illustrated construction by a first cylinder member 10 and a sleeve 11 which is sealably secured within the upper half of member 10 by suitable means, not shown. Of course, if desired, the members 10 and 11 could be replaced by an integrally formed member, but special machining would be required.

A first hydraulic chamber 12 is defined between a lower end closure member 13 of the cylinder assembly 1 and the larger piston portion 8, radially between the piston rod 5 and the first cylinder member 10, and a second hydraulic chamber 14 is defined between the upper end of the smaller piston portion 9 and an upper end closure member 15, internally of the sleeve 11.

In order to provide a passage 16 interconnecting chambers 12 and 14, by way of a valve assembly 17, a second cylinder member 18 is provided co-axial with first cylinder member 10. It should, however, be appreciated that the connection between chambers 6 and 14 could be provided in other ways, by for example a tube external to the cylinder member 10, or by an axial passage in a thicker cylinder member.

The valve assembly 17 is conveniently of the poppet type and is shown as comprising a poppet

valve member 19 normally held in engagement with a valve seat 20 provided at the lower end of an axial bore 21 where the bore leads into second chamber 14. It is emphasised that the poppet valve structure shown is essentially schematic, and those skilled in the art will be able without difficulty to choose a poppet valve of a construction suitable for the purpose of providing in its closed condition a positive shut off, and which in a partially open position, brought about by displacing poppet valve rod 22 downwards relative to end 3, will provide a restricted communication between second chamber 14 and annular passage 16 by way of bore 21 and an inclined port 23 in member 15.

It will be appreciated that the closure member 15 is sealably secured by suitable means, not shown, to upper ends of both the cylinder members 10 and 18. Whilst the cylinder member 18 is sealably secured to the lower closure member 13, one or more passages 24 are provided around the lower end of cylinder member 10 to provide the necessary fluid communication between first chamber 12 and passage 16. Such passages 24 can conveniently be provided by cut-outs in the lower end of member 10 or by recesses, as shown, in the member 13.

The diameters of the larger and smaller cylinder bore portions and the diameter of the piston rod 5 are chosen such that the pressure effective areas of the larger and smaller piston portions 8, 9 respectively exposed to chambers 6 and 14 respectively are substantially equal.

Thus, the following applies:-

$$D_1 \cdot D_3 \approx D_2^2$$

where

D_1 = diameter of larger bore portion 6

D_2 = diameter of smaller bore portion 7

D_3 = diameter of piston rod 5.

This relationship ensures that, on expansion and contraction of the piston assembly, when allowed by opening of the valve assembly 17, the fluid displacements from and to chambers 12 and 14 are substantially equal, thereby providing a positive control of the expansion and contraction.

Poppet control rod 22 is biased upwardly by a suitable spring 25 and is controlled by a suitable lever assembly, not shown, conveniently mounted beneath the chair seat frame.

Claims

1. A strut of adjustable length comprising an hydraulic piston and cylinder assembly (1, 2) the piston assembly (2) being secured to a common piston rod which extends sealably through one end of the cylinder body, characterised in that the cyl-

inder body defines a stepped bore comprising first and second larger and smaller diameter bore portions (6, 7) respectively, the piston assembly comprises first and second larger and smaller diameter pistons (8, 9) secured to the piston rod (4), the first piston (8) working in the first bore portion (6) and the second piston (9) working in the second bore portion (7), a first hydraulic chamber (12) defined in the first bore portion and bounded by the side of the first piston which is nearest to said one end (13) of the cylinder, a second hydraulic chamber (14) in the second bore portion and bounded by the side of the second piston which is remote from said one end, a fluid passage means (16, 23) connecting the first and second chambers, and a manually operable valve (17) controlling fluid flow through the passage means, the valve being closable substantially to lock the piston and cylinder assembly against adjustment of its length, and the arrangement being such that the pressure-effective area of the first piston exposed to fluid in the first chamber is substantially equal to the pressure-effective area of the second piston exposed to fluid in the second chamber.

2. A strut as claimed in Claim 1 in which the passage means (16) is provided in the wall (10, 18) of the cylinder assembly.

3. A strut as claimed in Claim 2 in which the cylinder assembly comprises co-axial cylinder members (10, 18), and the passage means (16) is provided by the annular space defined between the cylinder members.

4. A strut as claimed in Claim 2 or Claim 3 in which the valve (17) is housed in that end (15) of the cylinder assembly remote from said one end (13).

5. A strut as claimed in Claim 5 in which the valve member (19) of the valve (17) is operable by a control rod (22) extending substantially axially of the cylinder assembly.

6. A chair frame assembly comprising a seat supporting frame and a floor base connected together by a substantially vertical strut, the strut being as claimed in any of the preceding claims.

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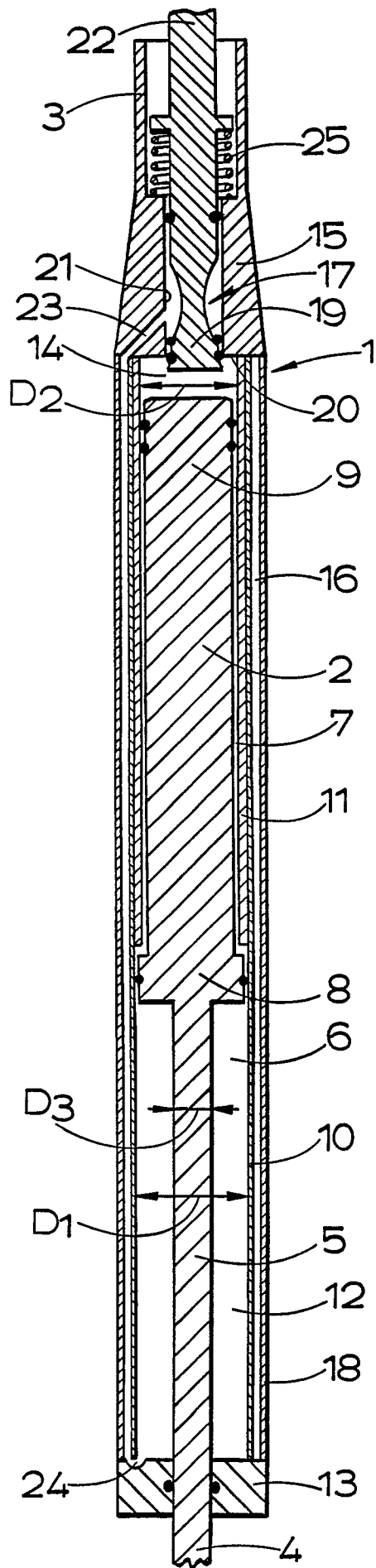
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DOCUMENTS CONSIDERED TO BE RELEVANT															
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)												
Y	DE-A-2 164 943 (SUSPA FEDERUNGSTECHNIK) * Figures 1,5; page 12, lines 2-24; claim 2 *	1-6	A 47 C 3/30												
Y	FR-A-2 482 436 (CORTI) * Figures 1,2,3,5; claims 1-3 *	1-6													
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)												
			A 47 C												
The present search report has been drawn up for all claims															
Place of search THE HAGUE		Date of completion of the search 20-05-1988	Examiner MYSLIWETZ W.P.												
<table border="0"><tr><td>CATEGORY OF CITED DOCUMENTS</td><td></td></tr><tr><td>X : particularly relevant if taken alone</td><td>T : theory or principle underlying the invention</td></tr><tr><td>Y : particularly relevant if combined with another document of the same category</td><td>E : earlier patent document, but published on, or after the filing date</td></tr><tr><td>A : technological background</td><td>D : document cited in the application</td></tr><tr><td>O : non-written disclosure</td><td>L : document cited for other reasons</td></tr><tr><td>P : intermediate document</td><td>& : member of the same patent family, corresponding document</td></tr></table>				CATEGORY OF CITED DOCUMENTS		X : particularly relevant if taken alone	T : theory or principle underlying the invention	Y : particularly relevant if combined with another document of the same category	E : earlier patent document, but published on, or after the filing date	A : technological background	D : document cited in the application	O : non-written disclosure	L : document cited for other reasons	P : intermediate document	& : member of the same patent family, corresponding document
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