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(54) **A telescopic strut.**

(57) A telescopic strut comprises a sealed cylinder (10) containing a fluid, a piston (12) fitted in the cylinder and sealed to the cylinder wall, and a hollow piston rod (20) extending from one side of the piston (12) and having a closed end (22) which extends out of one end of the cylinder. A hollow actuating rod (26) extends axially of the strut

through the piston (12) to communicate with the hollow piston rod (20) and extends at its closed end through the other end of the cylinder. A valve (34) is operable by axial displacement of the actuating rod (26) to open and close fluid communication from one side of the piston (12) to the other, to vary the effective length of the strut.

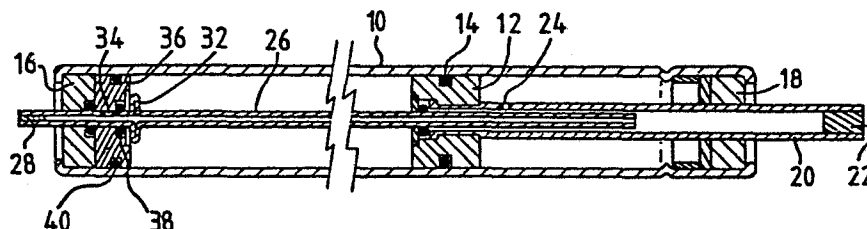


Fig.1

Title: A Telescopic Strut.

DESCRIPTION.

Field of invention.

This invention relates to telescopic struts. One example of the use of such struts is in supporting office chairs, whilst allowing variation of the height of the chair. Such struts are often filled with a compressible fluid, generally a gas, but they may also be filled with a non-compressible fluid such as oil.

Summary of the invention.

According to one aspect of the present invention, a telescopic strut, lockable in stepless increments of extension, comprises an outer cylinder separated into first and second chambers by a piston, having an inner cylinder passing through the piston to connect the first and second chambers when a valve associated with the inner cylinder is open.

Fluid seals are provided between the piston and the inner walls of the outer cylinder and between the piston and the outer walls of the inner cylinder. The inner cylinder preferably runs substantially the length of the outer cylinder and is connected to the outer cylinder at a point at or adjacent the end of the outer cylinder remote from

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the end of the outer cylinder through which a piston rod attached to the said piston passes. The connection of the inner cylinder to the outer cylinder is therefore preferably at a point outside the normal range of movements of the piston within the outer cylinder.

The valve arrangement through which passage of fluid between the inner and outer cylinders occurs is preferably located at or adjacent to the point at which the inner cylinder is connected to the outer cylinder, again at a point outside the normal range of movement of the piston within the outer cylinder as the mechanism by which the valve may be opened and closed may be in accordance with known arrangements. Alternatively, and in accordance with a particularly preferred aspect of the invention, the valve and inner cylinder are constructed as a unit. In this form the valve/inner cylinder unit comprises a tube extending through a sealing arrangement in the end of the outer cylinder, sealed at its outer end. The arrangement is such that pressure on the outer end of the valve/cylinder arrangement causes an otherwise obstructed passage to the interior of the inner cylinder to come into communication with the interior of the outer cylinder and thereby allow fluid to pass between the two. In this form of the invention the inner cylinder can be considered to be an extension of the valve body. A flange formed on the cylinder by welding or for example by crimping of the cylinder surface is provided to limit movement of the inner cylinder in relation to the outer cylinder and the seals therebetween.

According to another aspect of the invention, there is provided a telescopic strut comprising a sealed cylinder containing a fluid, a piston fitted in the cylinder and

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sealed to the cylinder wall, a hollow piston rod extending from one side of the piston and having a closed end which extends out of one end of the cylinder, a hollow actuating rod extending axially of the strut through the piston to
5 communicate with the hollow piston rod and extending at its closed end through the other end of the cylinder, and valve means operable by axial displacement of the actuating rod to open and close fluid communication from one side of the piston to the other.

10 The valve means is preferably provided by sealing the outermost end of the actuating rod, providing an aperture through the wall of the hollow piston rod on said one side of the piston, there being an annular fluid passage between the outer diameter of the actuating rod and the
15 inner diameter of the piston rod, providing an aperture through the wall of the actuating rod and arranging the actuating rod so that the aperture through its wall is normally blocked off, but can be displaced axially to allow the interior of the actuating rod to communicate,
20 through the aperture, with the fluid space in the cylinder on the other side of the piston.

The aperture through the wall of the actuating rod is preferably blocked off by a plug fitted at one end of the cylinder into which the aperture enters when the actuating
25 rod is not axially displaced. The plug may include a pair of 'O' rings which will seal around the actuating rod on either side of the aperture therein, thereby forming a spool valve.

The portion of the actuating rod containing the aperture
30 may be necked, so that the edges of the aperture do not move against the 'O' ring seals which might reduce the

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life of these seals.

The cylinder is preferably sealed, at the end from which the piston rod extends, by a lubricated or self lubricating seal.

- 5 In another aspect the invention provides a telescopic strut comprising a sealed cylinder containing a fluid, a piston fitted in the cylinder and sealed to the cylinder wall, a hollow piston rod extending from one side of the piston and out of one end of the cylinder, a hollow
10 actuating rod extending axially in the cylinder on the other side of the piston with one end of the actuating rod extending out of the other end of the cylinder and the other end of the actuating rod extending through the piston and inside the piston rod, and valve means operable
15 by axial displacement of the actuating rod to open and close fluid communication from one side of the piston to the other.

The fluid is preferably compressible and is preferably a gas.

- 20 The valve means may be provided as set forth above and can be produced very simply.

- The strut is preferably used with the piston rod projecting downwards from the cylinder, and the exposed end of the actuating rod at the top of the strut. The
25 seal which closes the bottom end of the cylinder may include two back-to-back seals to prevent fluid leaving the cylinder and also to prevent any possibility of any foreign matter entering the cylinder under extreme conditions of use.

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According to a yet further aspect of the invention, there is provided a telescopic strut comprising a sealed cylinder with two pistons in the cylinder, a first of the pistons separating a first space containing a non-
5 compressible fluid from a second space containing a compressible fluid with the second piston being located in the first space, a piston rod connected to the second piston and an actuating rod extending axially of the strut and through the second piston, and valve means operable by
10 an axial displacement of the actuating rod to open and close fluid communication from one side of the second piston to the other.

The use of a non-compressible fluid, occupying the major part of the internal volume of the cylinder, means that
15 the strut, when locked, is relatively rigid. In contrast, when gas or another compressible fluid is used, the strut will have a certain amount of "give" when locked.

The valve means may be constructed in a similar manner to that set forth above. The first piston preferably is
20 freely movable in the cylinder, in response to the pressures of the fluids on either side, but may be limited by a stop fixed in the cylinder in the non-compressible fluid space. Additionally, it may be advantageous to provide a second stop on the other side of the first
25 piston. The first piston can be on the piston rod side of the second piston.

Brief description of the drawings

The invention will now be further described, by way of example, with reference to the accompanying drawings, in

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which:-

Figure 1 is a section through a first embodiment of strut in accordance with the invention;

Figure 2 is a detail of one end of a modification of the
5 strut shown in Figure 1;

Figure 3 is a detail of part of the actuating rod;

Figure 4 is a detail of part of a modified actuating rod;

Figure 5 is a section through a second embodiment of strut in accordance with the invention;

10 Figure 6 is a detail of part of the strut of Figure 5;

Figure 7 is a section through a third embodiment of strut according to the invention;

Figure 8 illustrates a practical application of a strut in accordance with the invention, and

15 Figure 9 is a fragmentary view of another embodiment of strut according to the invention.

Detailed description of drawings.

The strut shown in Figure 1 has a cylinder 10 containing a piston 12. The piston 12 is sealed against the cylinder
20 walls by an 'O' ring 14. The two ends of the cylinder 10 are closed by plugs 16 and 18. A hollow piston rod 20 extends from the piston 12 and out of the right-hand end (as shown in Figure 1) of the cylinder. The end of the

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piston rod 20 is closed by a plug 22. An aperture 24 in the wall of the piston rod 20 allows communication between the interior of the cylinder to the right of the piston 12 and the interior of the piston rod.

- 5 The strut shown contains gas under pressure. In order to maintain efficient working of the O-ring seal 14 and of seals in the end plugs 16 and 18, a small quantity of lubricant is introduced into the cylinder 10 on assembly.

10 An actuating rod 26 is also hollow and is closed at its outer end by a plug 28. The actuating rod extends through the piston 12 where it is sealed by means of an 'O' ring 30 and into the interior of the piston rod 20. The actuating rod is provided with a radial enlargement 32 which limits its movement out of the cylinder, and has an
15 aperture 34 through the wall of the rod.

In the position shown in Figure 1, gas under pressure is contained within the cylinder on both sides of the piston 12. However, there is no path which the gas may follow to escape from one side of the piston to the other. The
20 strut is therefore locked, although there may be a certain amount of give resulting from the compressability of the gas. It will be seen that the aperture 34 is blocked off within a plug 36 which is provided with 'O' rings 38 and 40.

- 25 To adjust the length of the strut, the actuator rod 26 is pressed axially into the cylinder. When this happens, the aperture 34 will communicate with the interior of the cylinder on the left-hand side of the piston 12, and gas can then flow from one side of the piston to the other.
30 If there is a load on the piston rod 20 at the time, the

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piston 12 will move to the left and gas from the left-hand side of the piston will flow through the aperture 34, along the hollow wall of the rod 26, into the hollow interior of the rod 20, out through the aperture 24 and
5 into the cylinder 10 on the right-hand side of the piston 12.

If the actuator rod 26 is pressed in when there is no load on the piston rod 20, then the piston will move in the opposite direction and gas will flow in the opposite
10 direction to that just described.

Figure 2 shows the same components as Figure 1, but in Figure 2 the end of the cylinder 10 is tapered so that the strut can be used in applications where a standard sized, tapered end is required to mate with standard end fittings.

15 Figure 7 shows an alternative assembly where the end of the cylinder 10 is tapered. Here the plugs 16 and 36 and the O-rings 38 and 40 are fitted at the end of the parallel-sided part of the cylinder and therefore do not have to conform to the tapered walls of the cylinder.

20 It is necessary for an actuating member to be exposed at the end of the cylinder 10. To this end, either the actuating rod 26 can be extended through the tapered end of the cylinder or, as shown, a slidable plug 39 with a boss 41 can be used to transmit an actuation pressure to
25 the actuating rod.

Figure 3 shows the actuating rod 26 on its own. It will be seen that the rod is upset to provide the abutment 32 which limits outward movement of the rod relative to the

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cylinder 10.

Figure 4 shows a modification where the part of the rod 26 containing the aperture 34 is reduced in diameter. This is done to prevent the edges of the aperture 34 from contact with the 'O' rings 38 and 40. Because the aperture must move past at least the 'O' ring 38 on its actuation, it is important that the 'O' ring should not wear against the edges of the aperture and the modification shown in Figure 4 will prevent undue wear taking place.

Figure 5 shows a strut for use with a non-compressible medium inside the cylinder. Oil is an example of such a medium. In certain applications, it may be advantageous to use a non-compressible medium since this will make the strut more rigid when locked. However, as the strut extends or retracts, the trapped volume within the cylinder 10, actuating rod 26 and piston rod 20 will vary. A non-compressible fluid cannot cope with this variation in volume, so it is necessary to provide a facility whereby compensation is provided for such changes in the working cylinder volume.

In Figure 5, parts which are equivalent to those shown in Figures 1 and 2 bear the same reference numerals.

In Figure 5, an auxiliary piston 50 is provided in the cylinder. This auxiliary piston is free to move in the cylinder and separates an oil-filled space 58 on its left-hand side from an air-filled space 54 on its right-hand side. The piston will be moved as a result of the prevailing pressures on either side.

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An internal 'O' ring 52 serves to seal the piston on the piston rod 20. An external 'O' ring 56 seals the piston 50 against the cylinder walls.

5 In use, the piston 12 moves along the cylinder in the same manner as described for previous embodiments, and oil transfers from one side of the piston 60 to the other side 58. As the piston moves to the right, there is a small increase in the internal volume of the combined oil spaces 58 and 60, and this increase is taken up by expansion of
10 the air in the space 54 and consequent movement of the auxiliary piston 50 to the left. When the piston 12 moves in the other direction, there is an opposite effect.

Figure 6 shows one type of lubricated seal which can be used adjacent the end plug 18 which bounds an air-filled
15 space. The seal is held in place by an annular rib 62 formed out of the cylinder wall. A disc 64 holds an O-ring 66 in an annular cavity in a metal support 68. At the other end of the support 68 is a rubber sealing ring which prevents oil contained in a space 69 from leaking
20 out. The oil lubricates the O-ring 66, and it is this O-ring which acts as the seal to maintain the air space 54 airtight.

Figure 7 shows an alternative seal 67, which has a number of annular ribs in contact with the rod 20. If necessary,
25 the grooves between the ribs may be filled with grease. Additionally or alternatively, a bush 65 of nylon, ptfe or acetal may be included to reduce the friction on the piston rod. Possibly the seal 67 itself could be of a low friction material.

30 Figure 8 shows a telescopic strut 10 according to the

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invention used in an office chair. The strut 10 is located by a guide bush 84 secured in an outer support tube 82 supported in a chair base 78. The base 78 has castors 80 and the lower end of the tube 82 is supported by a thrust swivel bearing generally indicated at 76. The
5 upper end of the strut 10 is attached to the seat framework 72 which carries a seat cushion 70. An operating knob 74 is movable to operate the button 26 of the telescopic strut. Hence, movement of the knob 74
10 opens the valve means of the strut 10 and thereby enables the effective length of the strut to be varied, in stepless increments, to adjust the height of the seat.

In the previous embodiments, the rod 26 is axially movable in the outer cylinder and forms an actuating rod. This is preferred but not essential. The embodiment of Figure 9
15 shows an inner transfer tube 86 which is axially fixed in the outer cylinder 88. One end of the tube 86 is attached to or integral with an end plug 90 having an annular recess 92 communicating with an axial passage 94 extending
20 through the plug 90.

A valve body 95 and an adjacent outer end plug 96 accommodate a slidably operating rod or button 98 of the valve means. The body 95 has a passage 102 which communicates with the annular recess 92 and the passage
25 94. In the closed position of the valve means (as illustrated in Figure 9), a chamber 104 at one end of the interior of the inner transfer tube 86 is sealed from the passage 102 by an O-ring seal 108. When the operating rod or button 98 is moved to the right as viewed in Figure 9,
30 a neck 106 of the rod or button 98 clears the O-ring seal 108 and the chamber 104 is in consequence placed in communication with the passage 102, and thence with the

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chamber 110.

It will be appreciated that the right-hand end of the tube 86 projects through a piston 14 and extends into a hollow piston rod 20, like the embodiment of Figure 1. Hence,
5 when the chamber 104 is placed in communication with the passage 102 the two sides of the piston 14 are placed in communication, in a manner comparable to the previously described embodiments.

CLAIMS

1. A telescopic strut, lockable in stepless increments of extension, comprising an outer cylinder separated into first and second chambers by a piston, and an inner cylinder passing through the piston to connect the first
5 and second chambers when a valve associated with the inner cylinder is open.
2. A telescopic strut according to Claim 1, wherein the inner cylinder is axially displaceable within the outer cylinder and the valve means are operable as a result of
10 axial movement of the inner cylinder.
3. A telescopic strut according to Claim 1, wherein the inner cylinder is axially immovable with respect to the outer cylinder, the valve means being operable in dependence upon axial displacement of an actuating member
15 slidable with respect to the outer cylinder.
4. A telescopic strut comprising a sealed cylinder containing a fluid, a piston fitted in the cylinder and sealed to the cylinder wall, a hollow piston rod extending from one side of the piston and out of one end of the
20 cylinder, a hollow actuating rod extending axially in the cylinder on the other side of the piston with one end of the actuating rod extending out of the other end of the cylinder and the other end of the actuating rod extending through the piston and inside the piston rod, and valve
25 means operable by axial displacement of the actuating rod

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to open and close fluid communication from one side of the piston to the other.

5. A strut as claimed in Claim 4, wherein the fluid is a compressible fluid.

5 6. A strut as claimed in Claim 5, wherein the compressible fluid is a gas.

7. A strut as claimed in Claim 4, wherein the hollow actuating rod is sealed at its outermost end, an aperture is provided through the wall of the hollow piston rod on
10 said one side of the piston, there being an annular fluid passage formed between the outer diameter of the actuating rod and the inner diameter of the piston rod, a second aperture is provided through the wall of the actuating rod which is normally blocked off, but is exposed on axial
15 displacement of the actuating rod to effect communication through the two apertures and the annular passage between the fluid space in the cylinder on the two sides of the piston.

8. A strut as claimed in Claim 7, wherein the said second
20 aperture is blocked off by a plug fitted at one end of the cylinder through which the actuating rod passes and with which the said second aperture normally registers.

9. A strut as claimed in Claim 8, wherein the plug
includes a pair of 'O' ring seals which form with the a
25 spool valve.

10. A strut as claimed in Claim 9, wherein the portion of the actuating rod containing the aperture is necked, so that the edges of the aperture do not move against the 'O'

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ring seals.

11. A strut as claimed in any of Claims 4 to 10, wherein the cylinder is sealed at the end from which the piston rod extends, by a lubricated or self lubricating seal.

5 12. A strut as claimed in Claim 11, wherein the seal which closes the bottom end of the cylinder includes two back-to-back seals.

13. A telescopic strut comprising a sealed cylinder with two pistons in the cylinder, a first of the pistons
10 separating a first space containing a non-compressible fluid from a second space containing a compressible fluid with the second piston being located in the first space, a piston rod connected to the second piston and an actuating rod extending axially of the strut and passing through the
15 second piston, and valve means operable by axial displacement of the actuating rod to open and close fluid communication from one side of the second piston to the other.

14. A strut as claimed in Claim 13, wherein the first
20 piston is freely movable in the cylinder, in response to the pressures of the fluids on either side, but is limited by a stop fixed in the cylinder in the non-compressible fluid space.

15. A strut as claimed in Claim 12, wherein a second stop
25 is provided on the other side of the first piston.

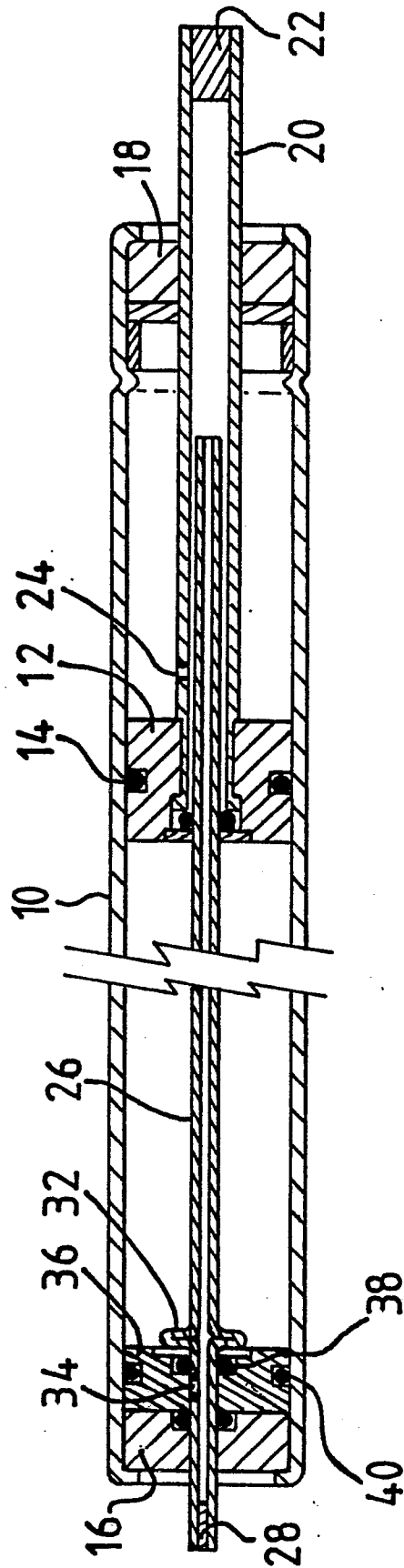


Fig. 1

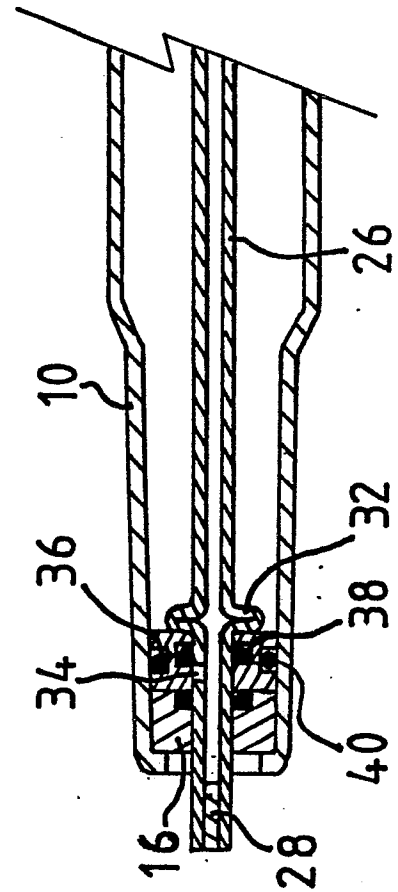


Fig. 2

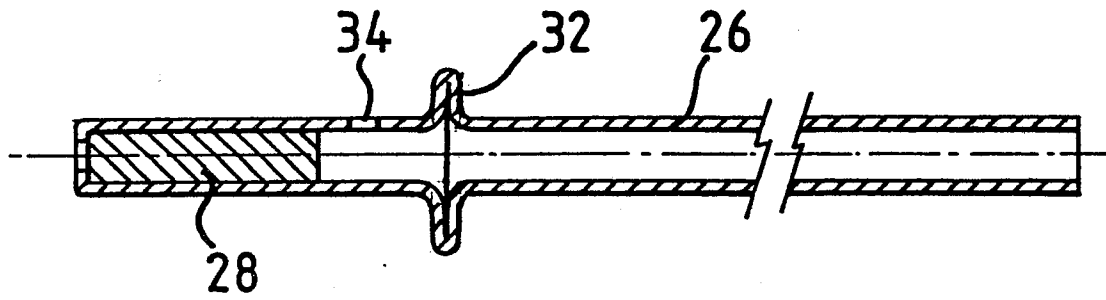


Fig.3

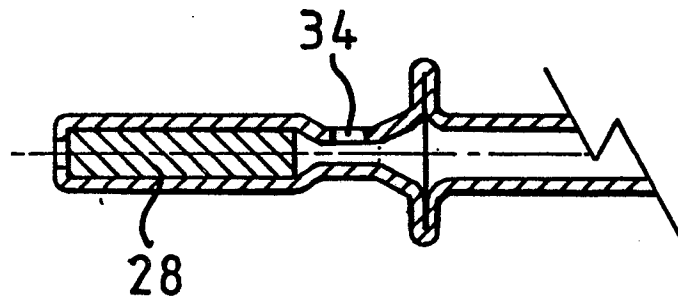


Fig.4

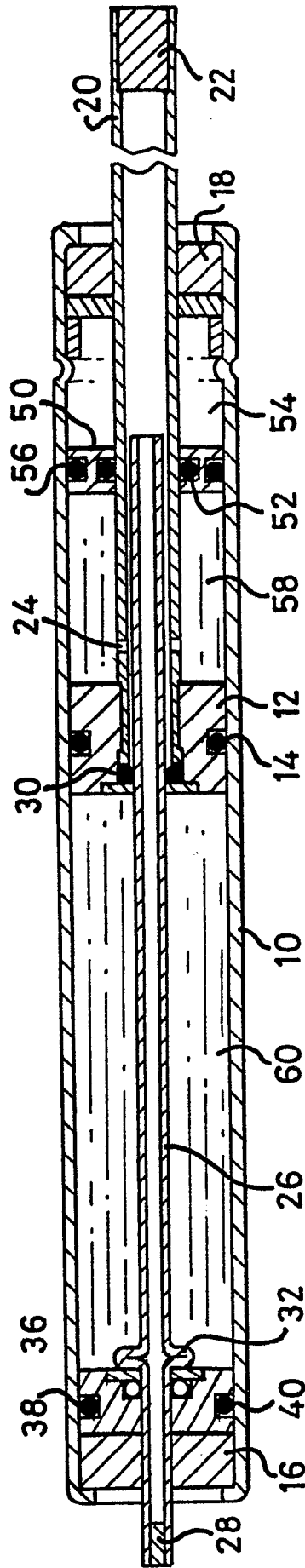


Fig. 5

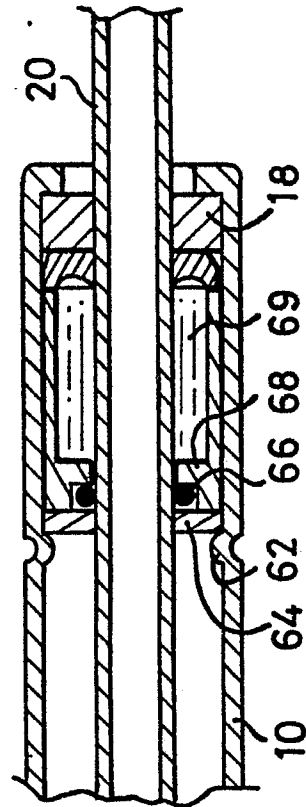


Fig. 6

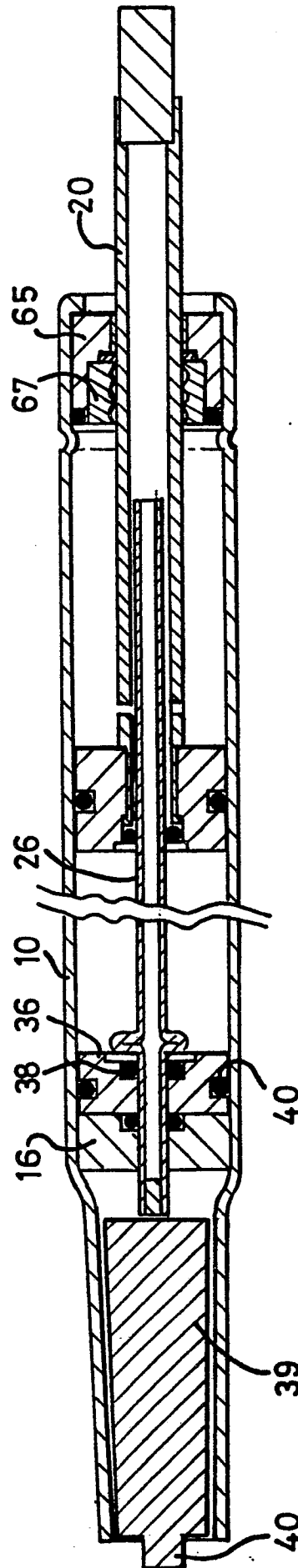
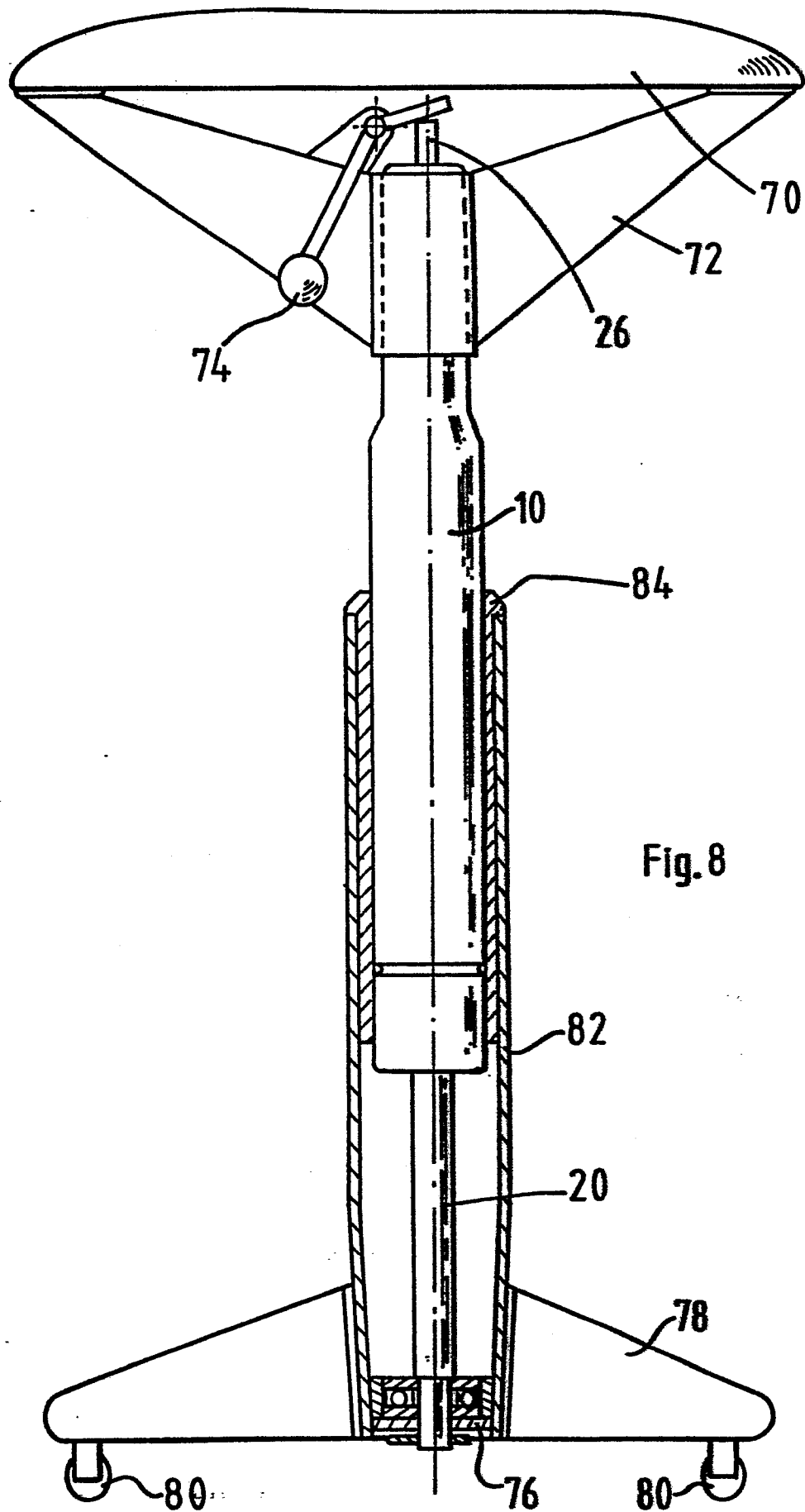


Fig. 7



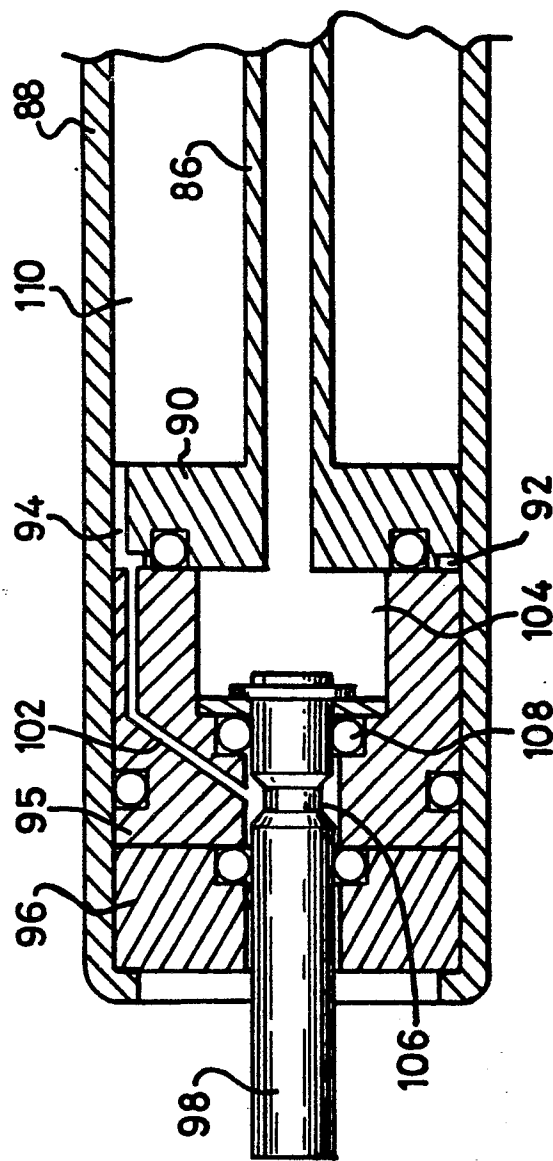


Fig. 9