(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 045 152 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.10.2000 Bulletin 2000/42

(51) Int. Cl.[7]: **F15B 15/08**

(21) Application number: **00107524.1**

(22) Date of filing: **07.04.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **15.04.1999 IT MI990779**

(71) Applicant: **Migliori, Luciano**
20090 Milano 2, Segrate (MI) (IT)

(72) Inventor: **Migliori, Luciano**
20090 Milano 2, Segrate (MI) (IT)

(74) Representative: **Coloberti, Luigi**
Via E. de Amicis No. 25
20123 Milano (IT)

(54) Carriage and rodless cylinder assembly

(57) A carriage (22) and a rodless cylinder assembly of the type comprising a hollow body (10) defining an elongated piston chamber (11) for a piston member (14) which may reciprocate inside the piston chamber (11) to transmit its reciprocate movement to an external load or work piece. The carriage (22) comprises a base portion (25) and guide arms (26, 27) extending from the base portion (25) of the carriage to slide along longitudinal guide surfaces (31A, 31B) on both sides of the body (10) of the cylinder. Both side arms (26, 27) of the carriage (22) are provided with internal reinforcement by a steel pegs (32A, 32B; 33A, 33B) which extend in the side arms (26, 27) from the base portion (25) of the carriage (22). Elastically yielding and adjustable tightening means (34, 36) are provided into the base portion (25) of the carriage (22) to cause a relative movement between the reinforcement pegs (32A, 32B; 33A, 33B) and in respect to the longitudinal guide surfaces (31A, 31B).

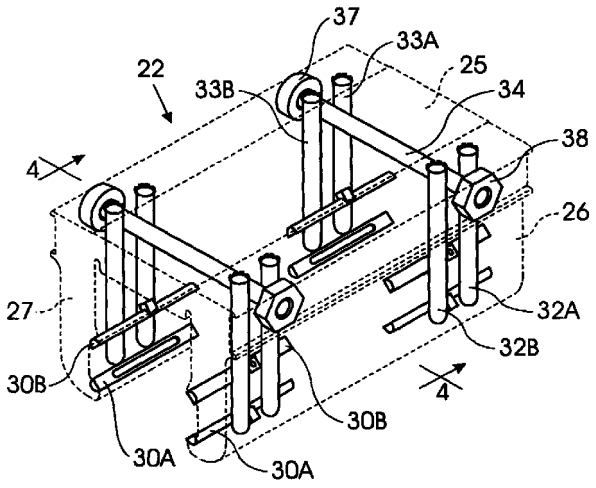

Fig. 3

EP 1 045 152 A2

Description

FIELD OF THE INVENTION

[0001] The present invention relates to rodless pneumatic actuators and, more particularly, is directed to a carriage and rodless cylinder assembly in which the cylinder comprises a hollow body defining an elongated piston chamber, and a piston member which may longitudinally reciprocate inside the piston chamber, wherein the piston member is connected to a carriage sliding along guide surfaces which extend on both sides of the cylinder body, for transferring the reciprocating movement of the piston to an external load or work piece.

STATE OF THE ART

[0002] Various types of pneumatic cylinders are currently available on the market, for example rod cylinders, rodless cylinders, cable cylinders and the like, in which a piston member is connected to a carriage sliding along guide surfaces so as to transmit its reciprocating movement to an external load.

[0003] US-A-4, 724, 744 and US-A-4,852,465, Tol-O-Matic Inc., illustrate a rodless pneumatic cylinder comprising an external carriage provided by a carriage sliding along longitudinal guides on the outer surface of the cylinder assembly; the carriage comprises a central portion and two guide arms which extend outwards from the central portion, each of which is provided with a longitudinal guide rod sliding along a guide surface outside of the body of the cylinder assembly.

[0004] The carriage is also provided with means for facilitating a limited selective movement of the two guide arms, said means comprising a pair of bolts which extend through cross holes in the central portion of the carriage so as to cause a limited flexing movement of the guide arms.

[0005] A rodless pneumatic cylinder is also known from US-A-4,856,415, in which a piston member is connected to a carriage provided with guide rods having a flat side surface sliding along external surfaces of the barrel body of the cylinder, wherein the clearance between the guide rods and the guide surfaces can be adjusted once again through a light selective flexure of the guide arms by means of single tightening screws.

[0006] In both cases, in order to allow a limited flexing movement of the guide arms in respect to the central portion of the carriage, the latter is provided with relatively deep longitudinal slots to define a relatively thin and flexible connecting section, between the central portion of the carriage and the side arms in relation also to the need to maintain a lightweight structure of the same carriage to facilitate the reciprocal movement.

[0007] Moreover, in order to avoid an excessive flexure of the guide arms of the carriage, and the onset of possible clearances, the guide arms extend from the central portion of the carriage for an extremely limited length; therefore the guide surfaces on the cylinder are practically arranged on the side of the same cylinder which is closer to and facing the same carriage; in the case of rodless cylinders the guide surfaces are therefore positioned close to the side of the longitudinal slot provided in the barrel to allow a connection between the carriage and the piston member inside the chamber of the cylinder assembly.

[0008] In both cases the carriages are also made in one single piece, in cast aluminium, or with a material having relatively low mechanical strength properties which, together with the reduced sectional width of the guide arms in the flexible connection parts, make guiding of the carriage unstable or totally unreliable, particularly when considerable loads or work pieces have to be driven or strong stresses, caused at stopping and reversal of movement of the carriage at the work stroke ends, have to be withstood.

[0009] The presence of possible clearance and a misalignment of the carriage in relation to the guide surfaces in both cases contribute to impairing functioning.

OBJECTS OF THE INVENTION

[0010] The main object of the present invention is to provide an improved carriage structure and pneumatic cylinder assembly, particularly but not exclusively for rodless cylinders, designed to overcome the disadvantages mentioned above.

[0011] More specifically an object of the present invention is to provide a carriage structure for rodless cylinders which is appropriately reinforced, so as to prevent excessive flexing of the side arms of the carriage and the onset of hazardous clearance, maintaining at the same time a simple and extremely lightweight structure of the carriage itself.

[0012] A further object of the present invention is to provide a carriage structure and pneumatic cylinder assembly, as referred above, provided with means capable of adjusting and compensating the clearance caused by the stresses or impact forces which the carriage may undergo at the ends of the stroke, and which prevent a free sliding of the same carriage.

[0013] Yet a further object of the present invention is to provide a carriage structure and pneumatic cylinder assembly as defined above, in which the carriage is provided with reinforcement and adjusting means such as to allow and maintain correct centring action of the carriage in relation to the guide surfaces on the cylinder, at the same time guaranteeing a simple and lightweight construction of the carriage and the entire assembly.

[0014] Another object of the present invention is to provide a carriage structure provided with guide runners which can be appropriately oriented, and designed to maintain a parallel disposition with respect to longitudinal guide surfaces on the barrel of the cylinder, irrespective of the possible deformations of the same guide surfaces.

BRIEF DESCRIPTION OF THE INVENTION

[0015] The above can be achieved by means of a carriage and pneumatic cylinder assembly according to claim 1.

[0016] In general terms the cylinder assembly comprises a carriage provided with an internal reinforcement structure including a plurality of metal pegs which extend in side walls of the carriage, from a base portion of the carriage, and in which elastically yielding tightening means are provided to cause a controlled relative movement of the reinforcement pegs and the guide arms at the end near the longitudinal guide surfaces for the same carriage, which therefore may be positioned very far from the slotted side of the barrel form which protrudes the connection shank between the same carriage and the reciprocable piston member of the cylinder assembly.

[0017] According to a preferred embodiment, the elastically yielding tightening means comprise a tie rod transversely extending to the base or bottom portion of the carriage, as well as comprises elastically yielding means, such as Belleville washers which act at the rear ends of the reinforcement pegs to cause a relative and controlled movement of the slide runners provided inside the fore ends of the side arms.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] These and other features of a carriage and pneumatic cylinder assembly according to the invention, will be made clearer from the following description, with reference to the examples of the accompanying drawings, in which:

Fig. 1 is a perspective view of a rodless cylinder assembly, provided with a carriage according to the invention;

Fig. 2 is an enlarged cross sectional view along line 2-2 of Figure 1;

Fig. 3 is a perspective view of the reinforcement structure and the carriage in dotted lines;

Fig. 4 is an enlarged cross sectional view along line 4-4 of Figure 3;

Fig. 5 shows a first enlarged detail of Figure 4;

Fig. 6 shows a second enlarged detail of Figure 4;

Fig. 7 shows an enlarged detail of Figure 5;

Fig. 8 shows the front view at a guide runner, along line 8-8 of Fig. 7;

Fig. 9 shows a perspective view of a guide runner;

Fig. 10 shows a longitudinal sectional view of the guide runner of Fig. 9;

Fig. 11 shows a cross sectional view of the rodless cylinder of Figure 1, provided with a second embodiment of the carriage, made in a plane comprising the reinforcement pegs;

Fig. 12 shows a sectional view similar to that of Figure 11, made in a different plane passing through the tightening and clearance adjusting means.

DETAILED DESCRIPTION OF THE INVENTION

[0019] With reference to Figures 1 to 10, a description will be given of a first embodiment of a cylinder assembly comprising a sliding carriage, and a rodless pneumatic cylinder of the single type chamber, according to the invention.

[0020] As shown in Figures 1 and 2, and as known for example from prior patents mentioned previously, a rodless pneumatic cylinder comprises a body 10 provided for example by a barrel made from an extruded section aluminium bar, defining an elongated piston chamber 11 closed by two end heads 12 and 13 comprising the feeding and discharge ports for the pressurised air.

[0021] Inside the piston chamber 11 of the cylinder a piston member 14 may reciprocate in the direction of the longitudinal axis of the piston chamber, in a manner per se known.

[0022] The piston member 14 is connected to a carriage 15 by means of a shank 16 passing through a longitudinal slot 17 in the body 10 of the cylinder barrel, sealingly closed by an internal sealing barrel 18, and by an external strap 19 both passing through appropriate longitudinal apertures 20 and 21 in the piston member 14 and the carriage 15 respectively, as shown in Figure 2. The carriage 15 is in turn connected to the carriage 22, for example by means of a flat protrusion 23 which extends into an elongated cross hole 24 at the centre of the base wall portion 25 of the carriage 22.

[0023] The carriage 22, therefore comprises the base wall 25 and two side arms 26 and 27, which extend from the base wall 25 beyond the longitudinal axis of the piston chamber 11, towards the side which is opposite to the slot 17.

[0024] As shown in the sectional view of Figure 2, according to a preferred embodiment of the present invention each side wall 26 and 27 of the carriage 22 on their inner surfaces comprises longitudinal runners 30A and 30B sliding along spaced apart guide surfaces 31A, 31B, which are slanted upwards and downwards through 45° on each side of the body barrel 10 of the cylinder.

[0025] The opposite slanting of the guide surfaces 31A, 31B, contributes to maintaining a centred condition of the carriage 22, under the action of vertical and horizontal stresses or forces differently oriented in respect to the longitudinal axis of the piston chamber 11, transmitted to the same carriage 22 by an external load whereto the latter is connected, or for other reasons.

[0026] The base wall 25 of the carriage is also provided with holes 31 for the connection to an external load; the holes 31 can be differently positioned or formed on the wall 25, in that the carriage may be made sufficiently strong or not subject to appreciable deformation by an internal reinforcement structure, as

explained further below, which allows the carriage 22 to maintain a disposition without any substantial deformations or clearance in respect to the guide surfaces 31A, 31B on the body 10 of the cylinder.

[0027] As referred previously, the carriage 22 according to the present invention is provided with a suitable internal reinforcement structure, appropriately adjustable by acting on elastically yielding tightening means, so as to adjust the backlash or clearance between the slide runners 30A, 30B and the respective guide surfaces 31A, 31B; in this way it is possible to reduce the biasing forces and stresses on the side walls 26 and 27 of the carriage, which in this way can be made with an extremely lightweight structure, for example cast in aluminium or another suitable material, having a mechanical strength relatively lower than that of the internal reinforcement structure. In this respect the runners 30A and 30B are positioned far from the slot 17 of the cylinder; in particular each runner 30A is positioned at the end of the arm, on the side of the cylinder body 10 which is opposite to the slot 17, while the runners 30B are provided in an intermediate position, at an height near the central axis of the cylinder, in an areas where the deformation or widening of the central body, caused by the pressure of the air, and hence the movement of the guide surfaces 31A, 31B, is wholly negligible.

[0028] A preferred embodiment of the carriage and internal reinforcement structure is shown in the perspective view of Figure 3 and in the remaining Figures 4 to 6 of the accompanying drawings.

[0029] As shown in Figure 3, the carriage 22 is provided with an internal reinforcement structure substantially comprising pairs of metal pegs 32A, 32B and 33A, 33B, on both side arms of the carriage, appropriately spaced apart one in respect of the other; each peg extends into a corresponding hole in the side walls 26 and 27, from the base wall 25 of the carriage, towards the front ends of the same side walls, up to level of the slide runners 30A, 30B, as shown.

[0030] The reinforcement pegs 32A, 32B and 33A, 33B are preferably made in steel or another suitable metal having high mechanical strength, higher than that of the body 22 of the carriage, and have a resistant section designed to withstand most of the flexure stresses acting on the side walls of the carriage, except for slotted connection portion, which can be appropriately calculated at the design stage. The reinforcement pegs 32A, 32B and 33A, 33B can be directly embedded during the die-casting carriage structure 22, forced or screwed into corresponding housing holes.

[0031] Between the two facing pairs of reinforcement pegs 32A, 32B and 33A, 33B or, more generally, between each pairs of reinforcement pegs, at the base wall 25, a threaded tie rod 34, for example in the form of a bolt extends in a corresponding cross hole 35 passing through the base wall 25, as shown in Figure 3 and in the sectional view of Figure 4.

[0032] From Figure 4, as well as from the enlarged details of Figures 5 and 6, it can also be seen that the adjustable tightening means, provided by tie rods or bolts 34, allow a controlled pivotal movement of the pegs 32A, 32B and 33A and 33B to adjust the backlash or clearance between the runners 30A, 30B and the respective guide surfaces 31A, 31B on the body 10 of the cylinder. According to the example shown, the tightening is made elastically yieldable for example by Belleville washers 36 positioned between the head 37 of the tie rod 34 and the rear end of pegs 33A, 33B, and between the nut 38 and the rear end of pegs 32A, 32B on the opposite side; therefore any small misalignments caused by impact forces and vibrations of the carriage during its reciprocating movement, are directly and automatically dampened by the elastic behaviour of the Belleville washers 36 or another equivalent damping means, thus ensuring a constant sliding pressure between the runners 30A, 30B of the carriage and the guide surfaces 31A, 31B on the body 10 of the cylinder. Since the reaction forces and stresses are directly discharged onto the reinforcement pegs and onto the tie rods, in this way the body of the carriage 22 is freed from every internal stress or forces, so that it can be made in a lightweight and less bulky material.

[0033] Figures 7 to 10 in turn show a particular conformation and arrangement of the runners for the carriage 22.

[0034] In particular, from Figures 7 and 8 it can be seen that each runner 30A, 30B has an elongated, semi-cylindrical body and a flat front face 43, which fits into a corresponding semi-cylindrical seat on the internal surface near the end of each guide arm 26 and 27 of the carriage 22. The body of each runner, in an intermediate position, has a short stud 40 having flat side faces 41. The stud 40 of the runner extends inside a semicircular groove 42 on the internal face of each guide arm 26, 27 of the carriage, to allow the runner to angularly rotate, so as to maintain its flat front face 43 always in contact with the corresponding flat guide surface 31A, 31B of the cylinder body 10 for sliding and support of the carriage 22 on oppositely slanted sliding planes.

[0035] From Figures 9 and 10 it can also be seen that the body of each runner has an elongated chamber 44 for containing a lubricating grease, which opens towards the flat sliding face 43, and which communicates with a hole passing-through 45 which extends in the stud 40, as shown.

[0036] Figures 11 and 12 of the accompanying drawings show a second simplified solution of a carriage structure for pneumatic cylinders, which again uses the innovative concepts of the present invention. Therefore in Figures 11 and 12 the same reference numbers have been used to denote parts similar or equivalent to those of the previous figures.

[0037] Also in the case of Figure 11 and Figure 12, the carriage 22 has reinforcement pegs 32 and 33 which extend in corresponding holes in the two side

walls 26 and 27 of the carriage, from the base wall 25, towards the free ends of the same arms, up to the slide runners 33A, 33B, to act on the latter allowing their adjustment by the elastically yielding tightening means or cross tie rods 34.

[0038] The example of Figures 11 and 12 differs from the previous one in that the reinforcement pegs 32, 33 on each of the side walls 26, 27 are spaced apart, so that the elastically yielding tightening means 34, 36 may be provided in an intermediate position far from the same reinforcement pegs. In both cases a controlled movement of the reinforcement pegs and adjustment of the backlash, in addition to the greater resistance of the pegs themselves, is allowed by a longitudinal groove 46, of extremely reduced depth, which extends near each side wall 26, 27 into the base wall 25 of the carriage, for an extremely reduced portion ending near to or at the longitudinal axis of the hole 35 for the tightening tie rod 34, or slightly beyond.

[0039] In both cases the carriage 22 comprises reinforcement means provided by a set of metal pegs, which extend substantially for the entire length of the side walls of the carriage, and providing elastically yielding tightening means which may be adjusted to cause a relative movement of the same reinforcement pegs, so as to selectively perform a thrust action directly on the runners or guide surfaces of the carriage; in this the backlash or clearance in respect to the corresponding guide surfaces provided on the outside of the cylinder body, may be adjusted.

Claims

1. A pneumatic cylinder (10) and carriage (22) assembly, in which the cylinder comprises a hollow body (10) defining an elongated piston chamber (11) having a longitudinal axis for a reciprocable piston member (14) and in which the piston member (14) is connected to the carriage (22) to transmit the reciprocating movement of the same piston member (14) to an external load, said carriage (22) comprising a base wall (25) and side walls (26, 27) sliding along guide surfaces (31) longitudinally extending on both sides of the body (10) of the cylinder, and in which adjustable tightening means (34) are provided at the base wall (25) of the carriage (22), to adjust the clearances between the side walls (26, 27) and the guide surfaces (31), characterised by comprising reinforcement metal pegs (32, 33) which extend in each side wall (26, 27) of the carriage (22), towards the guide surfaces (31); and in that it comprises elastically yielding tightening means (34, 36) to cause a controlled relative movement of the reinforcement pegs (32, 33) in respect to said guide surfaces (31).

2. A pneumatic cylinder and carriage assembly according to claim 1, characterised in that the reinforcement pegs (32, 33) extend from the base wall (25) of the carriage (22) towards the free ends of the side walls (26, 27).

3. A pneumatic cylinder and carriage assembly according to claim 1, characterised in that the reinforcement pegs (32, 33) extend from the base wall (25) of the carriage (22), beyond the longitudinal axis of the piston chamber (11).

4. A pneumatic cylinder and carriage assembly according to claim 1, characterised by comprising pairs of spaced apart reinforcement pegs (32A, 32B; 33A, 33B), between which a tightening tie rod (34) extends, and in that elastically yielding means (36) are provided between each end of the tightening tie rod (34) and the side walls (26, 27) of the carriage (22).

5. A pneumatic cylinder and carriage assembly according to claim 1, characterised in that each side wall (26, 27) of the carriage (22) is provided with slide runners (30) on the inside surface, and in that the reinforcement pegs (32, 33) extend up to the runners (30).

6. A pneumatic cylinder and carriage assembly according to claim 5, characterised in that each runner (30) is angularly movable on a rotational axis, parallel to the longitudinal axis of the piston chamber (11).

7. A pneumatic cylinder and carriage assembly according to claim 5 or 6, characterised in that each runner (31) comprises an elongated chamber (44) for containing a lubricant, which opens towards the front sliding face of the same runner (31).

8. A pneumatic cylinder and carriage assembly according to claim 1, characterised in that the cylinder is of the rod type.

9. A pneumatic cylinder and carriage assembly according to claim 1, characterised in that the cylinder is of the rodless type.

10. A pneumatic cylinder and carriage assembly according to claim 9, comprising a first and a second guide surfaces (31A, 31B) slanting in opposite directions on each side of the body (10) of the cylinder, characterised in that the guide surfaces (31A, 31B) and the runners (30) are provided in an intermediate position near the longitudinal axis of the piston chamber (11), and near the front end of the side walls (26, 27) of the carriage (22).

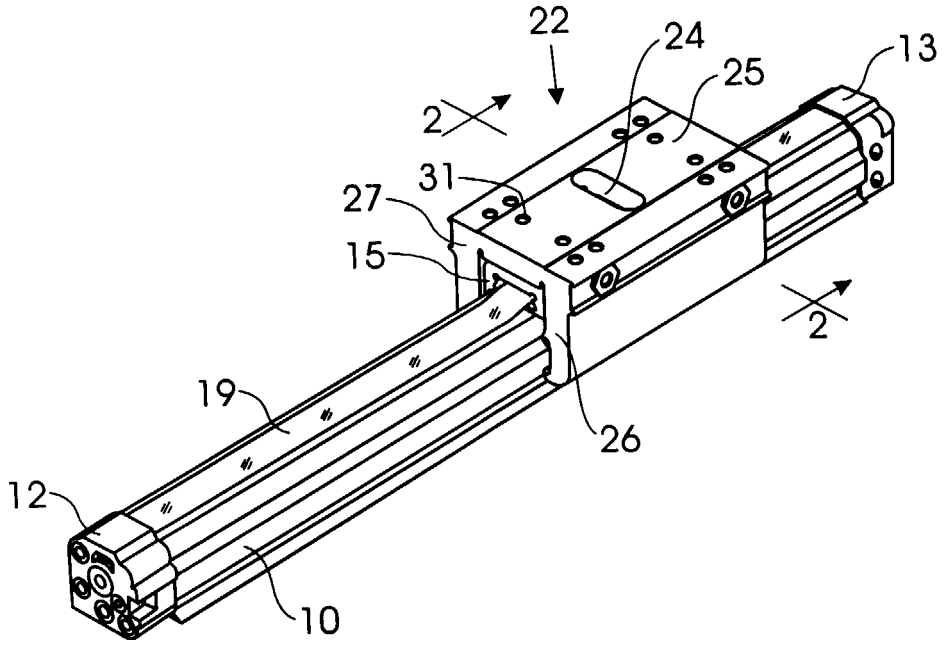
22
24
25
13
2
31
27
15
2
19
26
12
10

Fig. 1

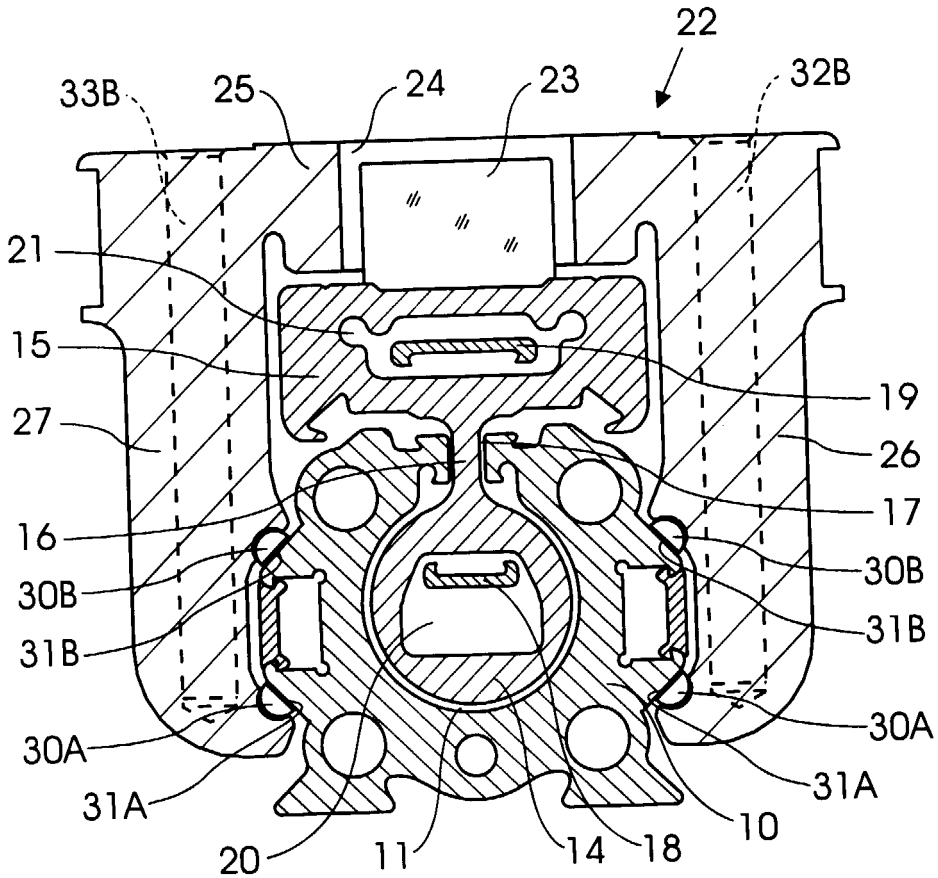
22
33B
25
24
23
32B
21
15
19
27
26
16
17
30B
30B
31B
31B
30A
30A
31A
31A
10
20
11
14
18

Fig. 2

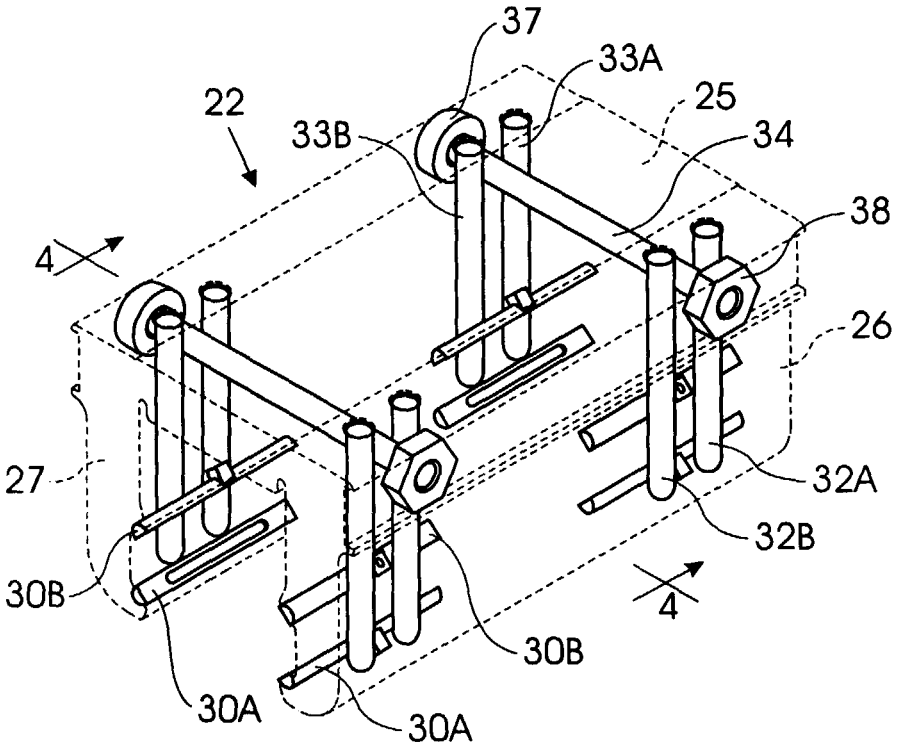
37
33A
22
25
33B
34
38
4
26
27
32A
32B
30B
4
30B
30A
30A

Fig. 3

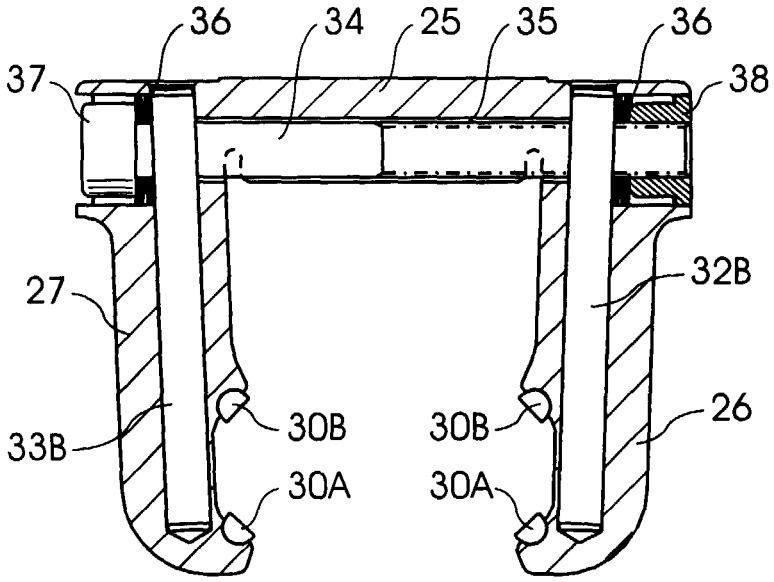
36
34
25
35
36
37
38
27
32B
33B
30B
30B
26
30A
30A

Fig. 4

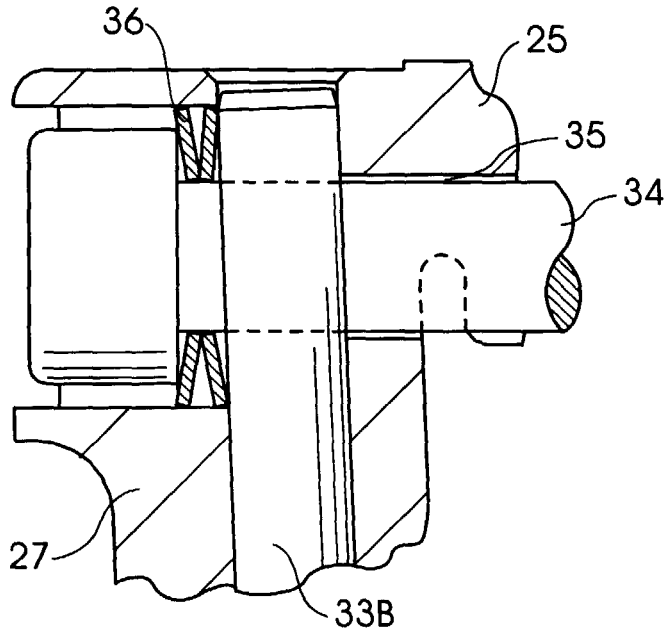

Fig. 5

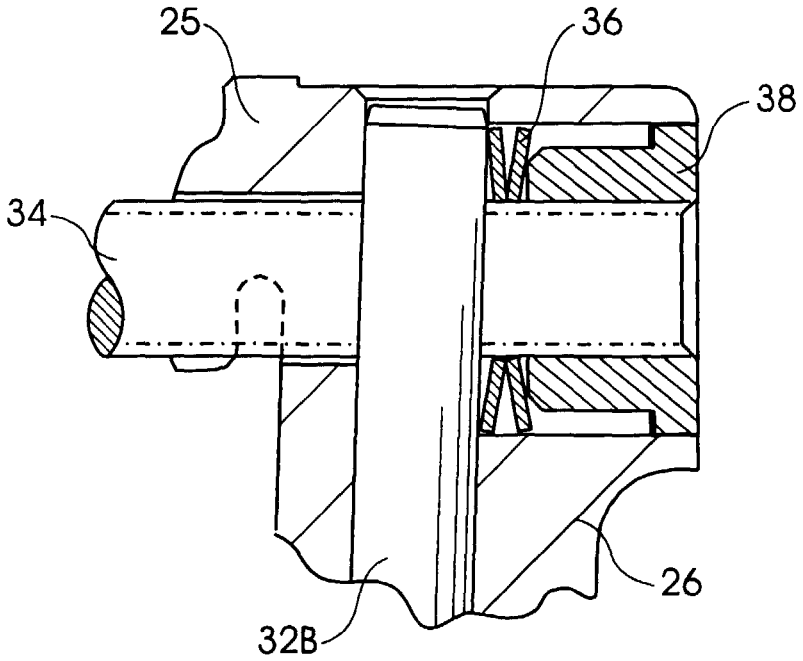

Fig. 6

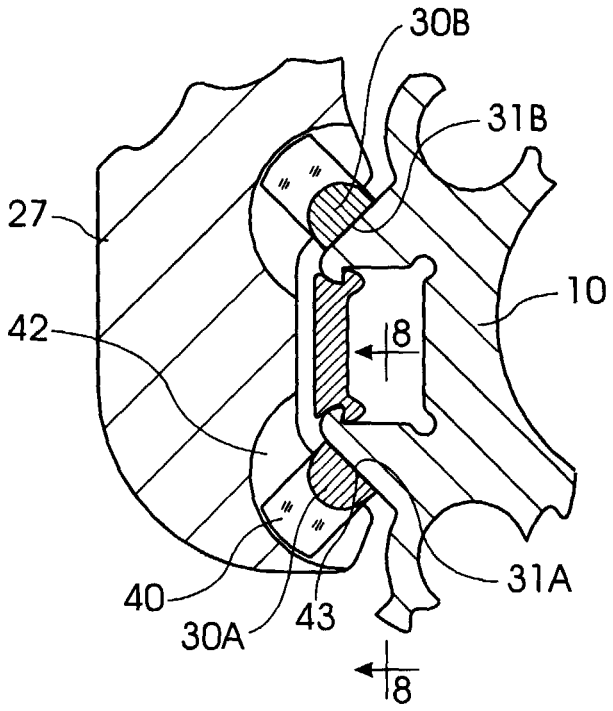

Fig. 7

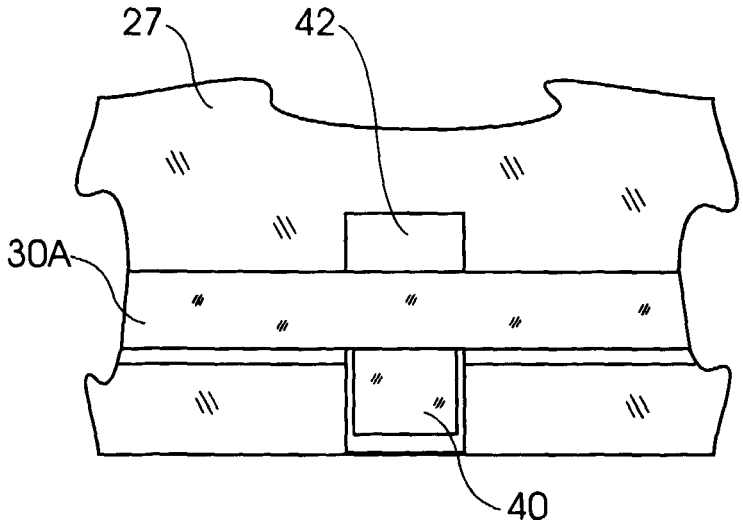

Fig. 8

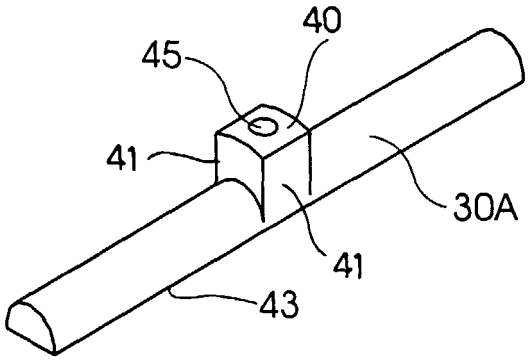

Fig. 9

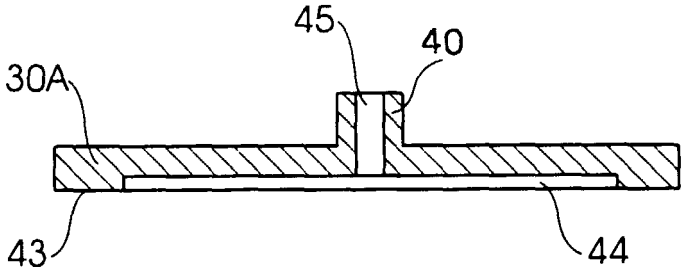

Fig. 10

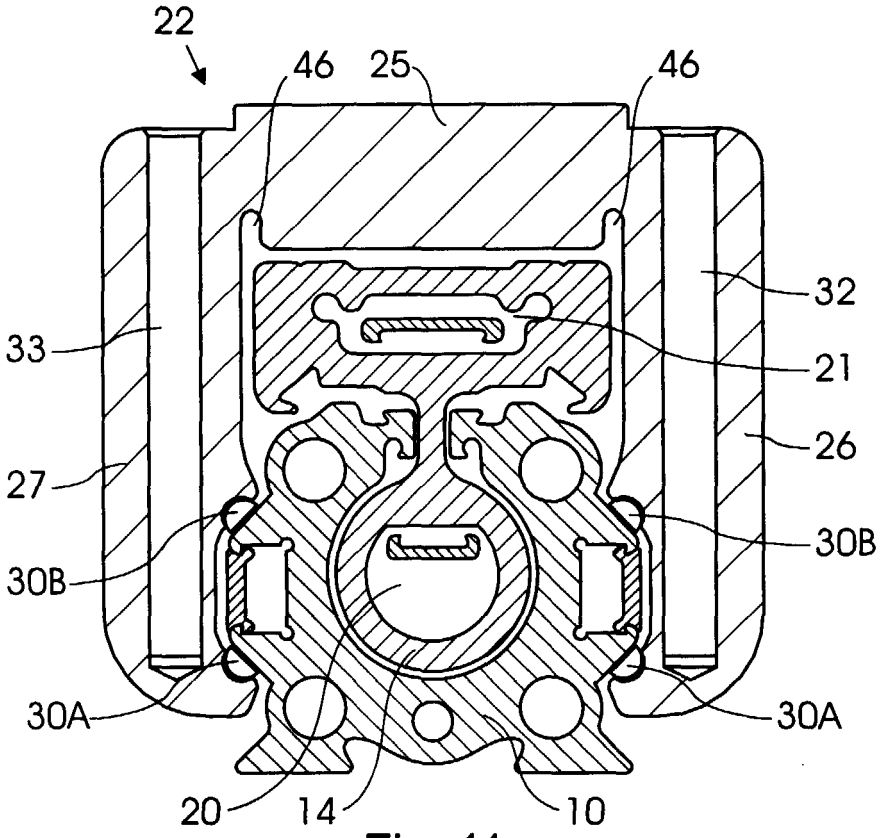
22
46
25
46
32
33
21
26
27
30B
30B
30A
30A
20
14
10

Fig. 11

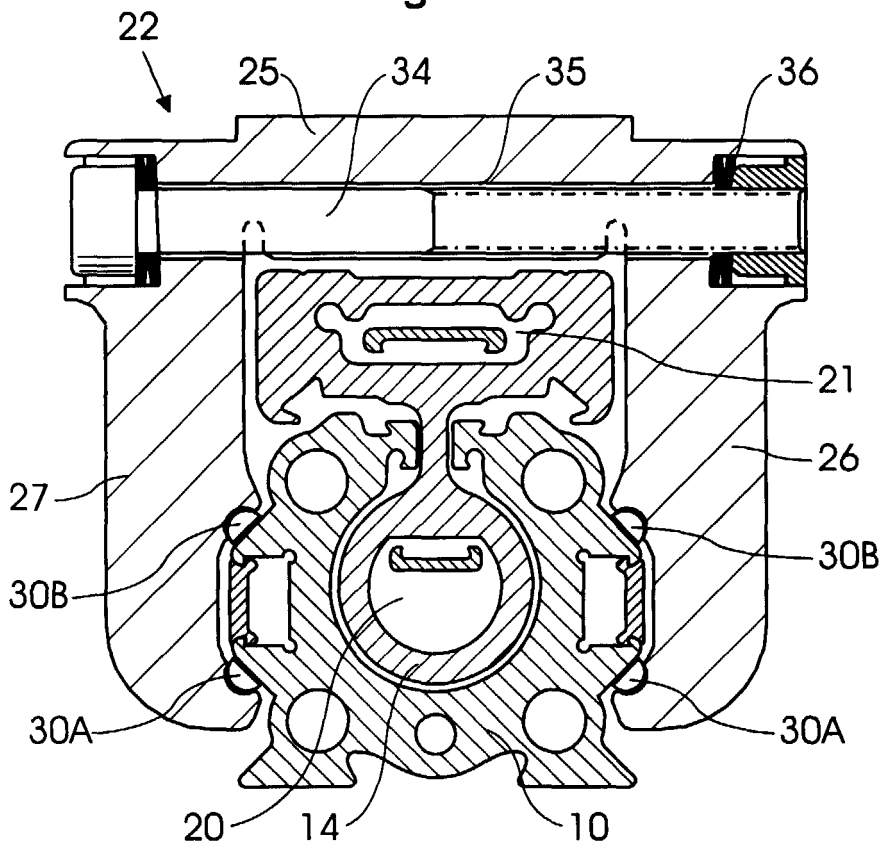
22
25
34
35
36
21
26
27
30B
30B
30A
30A
20
14
10

Fig. 12