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F2S SBK SBQ SBS

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GB 2116666 A	GB 2115903 A	GB 2104186 A
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(54) Piston rod guide for a vibration damper

(57) A vibration damper 1 has a casing tube 3, a pressure tube 5 filled with a damping medium and in which works a piston carried by a piston rod 13 located by a piston rod guide 17, a compensating chamber 7 being formed between the casing tube and the pressure tube, and a piston rod seal (11) closing off the damper from atmosphere. The guide 17 comprises a one-piece sheet metal stepped annular member defining guide or abutment surfaces for a bearing bush 15 for the piston rod, the casing tube 3, the pressure tube 5 and the piston rod seal 11, and also defines a reservoir 25 connected by return flow openings to the compensating chamber. The guide 17 has radially small restrictor passages (29) leading from the return flow openings (27) to the compensating chamber (7) to avoid frothing of the damping medium. The guide is arranged for inexpensive manufacture. In an alternative embodiment (Fig. 3) an extension stop buffer (16) is provided, and return flow openings (27) are formed in a radissued portion of the stepped guide. In a still further embodiment (Figure 4) a venting ring (51) is located adjacent the return flow openings (27).

Fig.1

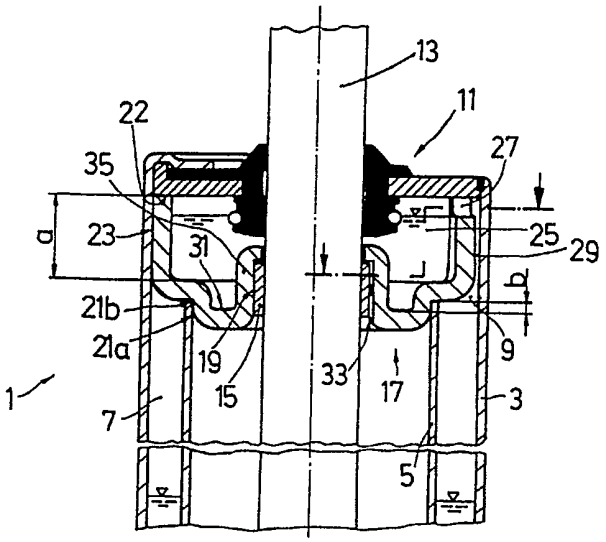

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Fig.1

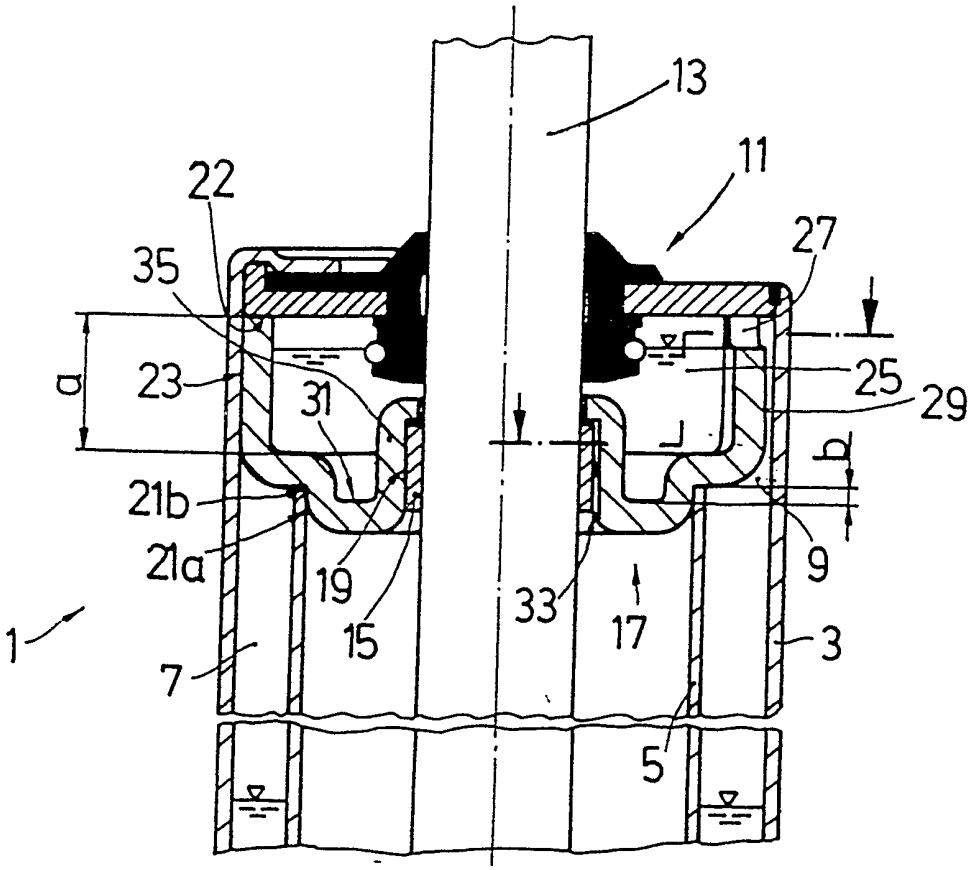

13
11
22
27
35
23
31
25
29
a
b
21b
21a
19
15
33
17
9
1
7
3
5

Fig. 2

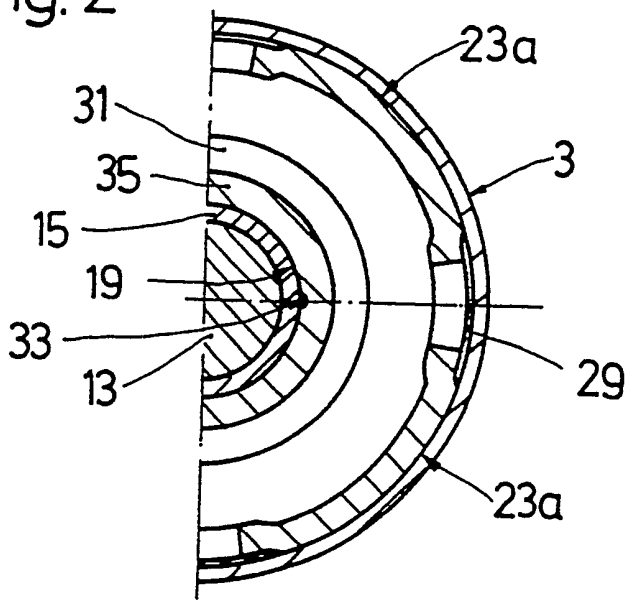

23a
31
3
35
15
19
33
13
29
23a

Fig. 3

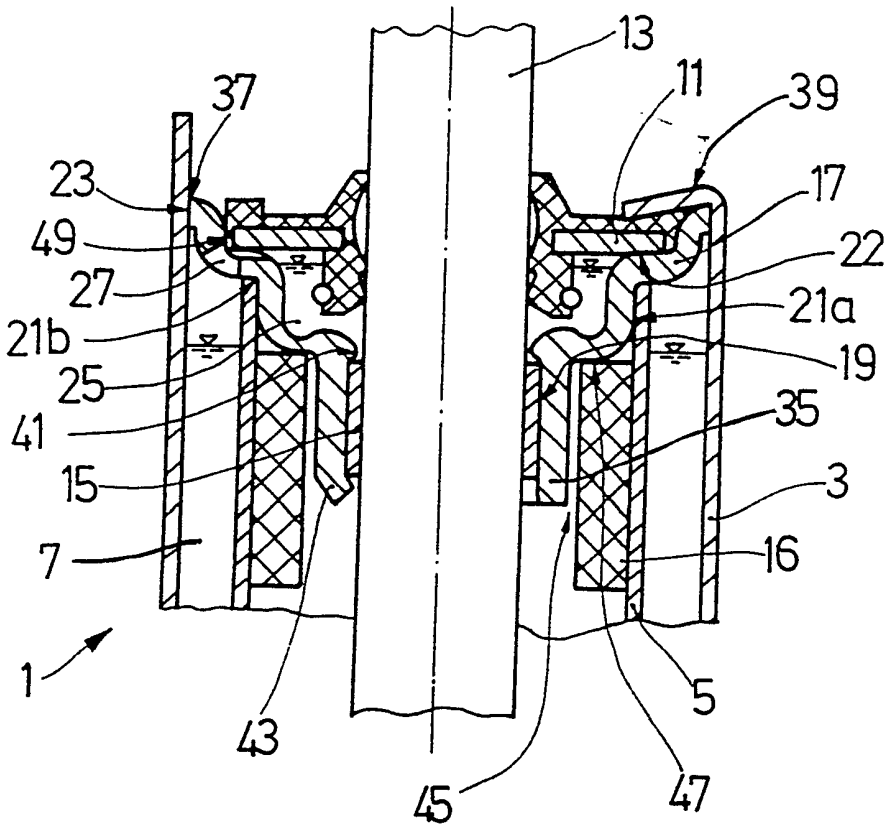
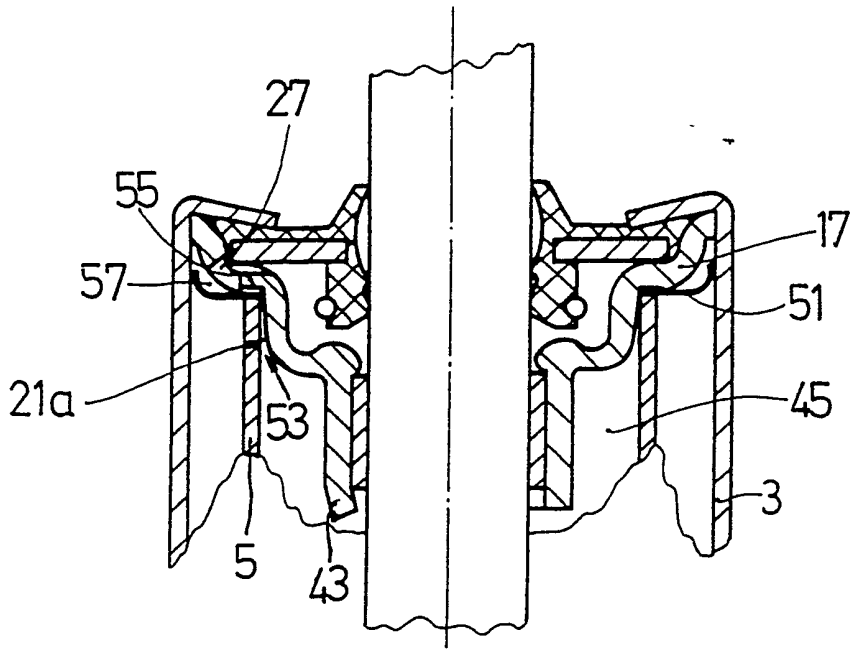


Fig. 4



PISTON ROD GUIDE FOR A VIBRATION DAMPER

The invention relates to a piston rod guide for a vibration damper of the kind including a casing tube, a pressure tube filled with a damping medium and in which works a piston carried by a piston rod, a compensating chamber formed between the casing tube and the pressure tube, and a piston rod seal closing off the damper from atmosphere, the guide comprising a stepped annular substantially cup-shaped body having a first guide surface for a bearing bush for the piston rod, the first guide surface being concentric with the axis of the piston rod, an abutment surface for the piston rod seal, a second guide surface for the casing tube, and defining a reservoir for the damping medium, and having at least one return flow opening connecting the reservoir to the compensating chamber.

In this kind of vibration damper the damping medium, usually oil, which leaks between the piston rod and the guide, and the gas which always arises in the pressure tube above the piston rod guide are conducted away into the compensating chamber. This avoids the piston rod seal being exposed to the high damping pressure, and faulty operation and rumbling noises originating from the presence of gas in the high pressure zone. In highly loaded vibration dampers of this kind it is likewise usual to improve operation by pressurising a gas volume. This gas pressure aids the force resolution of the damper and suppresses the tendency for froth to form in the damping medium. So that the gas does not escape to atmosphere through the piston rod seal, the damper contains in addition a gas block. The gas block is in practice a lightly loaded rubber sleeve-type valve which always ensures that the

piston rod seal remains fully immersed in oil and that the gas passes to the exterior along the surface of the piston rod. If good (but also expensive) sealing materials are used it is sometimes possible to do without a gas block. Usually the piston rod guide comprises mainly a rigid carrier member which is manufactured mostly from sintered or similarly bonded materials, such as by aluminium pressure die casting, or zinc pressure die casting.

A problem in the manufacture of the piston rod guide in this way is in the complicated return-flow openings, which may deform, and produce unwanted burrs. If the burr are machined away, unwanted particles can contaminate the damping medium, which endangers the functioning of the damping valves. Deburring for example by means of local sand-blasting increases significantly the cost of the already expensive guide.

The drawbacks caused by making the guide of sintered material can be reduced by using a sheet metal piston rod guide. DE-A 40 30 788 shows a one-piece sheet metal piston rod guide, which nonetheless has some disadvantages.

The main disadvantage is the large amount of space taken up in an axial direction. If in addition an extension stop buffer is incorporated, this significantly cuts down the available stroke of the damper. A further drawback lies in the mounting of the piston rod seal on the piston rod guide, as its axis can be displaced so that the piston rod seal does not seal uniformly. Further, the danger of frothing is increased by the unsatisfactory arrangement of the return flow openings, as the damping medium falls freely into the compensating chamber. Moreover there

are no measures to keep the vibration damper under a pre-load, in order to suppress the internal sealing faults referred to.

It is an aim of the present invention to provide a sheet metal piston rod guide which avoids the drawbacks indicated and is easy to manufacture.

According to a first aspect of the invention, in a piston rod guide for a vibration damper of the kind set forth, the piston rod guide is a one-piece sheet metal member, and the second guide surface of the piston rod guide and the associated surface of the internal wall of the casing tube are provided with a radially small restrictor passage leading from the or each return flow opening to the compensating chamber, making use of adhesion forces to ensure flow of the damping medium along the internal wall of the casing tube.

The restrictor passages allow the damping medium to flow slowly from the reservoir in the cup-shaped piston rod guide down the internal wall of the casing tube. This eliminates uncontrolled access to the compensating chamber and the associated unwanted frothing. The small radial extent of the restrictor passages eliminates the necessity for a non-return valve, such as the known angle-section ring, as the gas in the pressurised volume cannot pass through the restrictor passages into the reservoir and the stepped portion of the piston rod guide.

It is advantageous that the second guide surface comprises segmental guide portions, between which the restrictor passages extend. This provides a very stiff guiding of the piston rod with respect to the casing tube. The restrictor passages can be made

very easily, by stamping or pressing, preferably in the piston rod guide.

So that the restrictor passages are as long as possible, the return flow openings are provided directly adjacent to the piston rod seal.

To reduce shaping or pressing in the manufacture of the piston rod guide, in comparison with the known guide, the abutment surface for the piston rod seal is formed by the end face of the guide.

Preferably the return flow openings are formed by pressed-out portions in the region of the abutment surface for the piston rod seal. In this way the return flow opening always lie above the level of the damping medium reservoir.

In order to make optimum use of the length of the restrictor passages and to make the damping medium reservoir as deep as possible, the return flow openings are arranged substantially horizontally.

In order to form an elastic member within the vibration damper, the spacing between the abutment surface for the piston rod seal and an axial abutment surface for the pressure tube is greater than that between the base of the piston rod guide and its adjacent stepped portion. If the damper is pre-loaded through the piston rod seal on assembly, then the piston rod guide can deform axially over the length between the abutment surfaces for the piston rod seal and the pressure tube and can exert a spring action.

According to a second aspect of the invention, in a piston rod guide for a vibration damper of the kind

set forth, the piston rod guide is a one-piece sheet metal member, and at least part of each return flow opening is formed by a stamped opening in the abutment surface for the piston rod seal so that each return flow opening is formed by the underside of the piston rod seal and the stamped opening in the abutment surface of the piston rod guide.

The stamped openings reduce the axial space needed by almost the diameter of the return flow openings and an additional surrounding region. At the same time the return flow openings are in a good position in relation to the base of the piston rod guide, so that a satisfactory blocking action is provided for the reservoir, in conjunction with a relatively small quantity of damping medium in comparison with the known constructions.

Preferably the piston rod guide has a locating surface for the piston rod seal, the locating surface being a part of the stepped shape of the guide. This overcomes the problem of displacement of the axis of the piston rod seal, so that it seals uniformly.

In order to keep down manufacturing costs, the first guide surface forms a sliding fit with the bearing bush and the bearing bush is located axially against at least one stop face on the guide by multiple staking of the piston rod guide. In this way the quality of the fit can be chosen to be relatively coarse. On assembly of the bearing bush the staking of the piston rod guide takes place in a single working step.

To improve the utilisation of the space a flange defining the first guide surface and the pressure tube

define an annular space in which an extension stop buffer is mounted.

As an additional measure against the formation of froth in the damper a guide surface for the pressure tube advantageously forms at least one venting passage, which communicates with discharge recesses leading into an space defined by an angle-section venting ring.

The venting passage can be formed simply by a conical shaping of the guide surface, which simultaneously forms an aid to assembly as the piston rod guide centres itself on the cone.

In addition, by the particular construction of the piston rod guide, the wear on the shaping tool can be significantly reduced.

Embodiment of both aspects of the invention are illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a section through a vibration damper in the region of the piston rod guide illustrating a first aspect of the invention;

Figure 2 is a cross-section through the piston rod guide ;

Figure 3 shows a piston rod guide in accordance with a second aspect of the invention; and

Figure 4 is similar to Figure 3, showing a piston rod guide with an angle-section venting ring.

Figure 1 shows only the end of a vibration damper 1 where a piston rod 13 emerges. The damper 1 has a casing tube 3, in which is a pressure tube 5 filled with a damping medium and which, together with the casing tube 3, forms a compensating chamber 7. The chamber 7 is partially filled with damping medium and partially with a gas volume 9. A piston rod seal 11 seals the damper 1 from atmosphere. A bearing bush 15 serves to guide the piston rod 13 and is pressed into a piston rod guide 17. Furthermore the piston rod guide 17 centres the pressure tube 5 relative to the casing tube 3.

The piston rod guide 17 comprises a stepped annular cup-shaped body which is formed from a sheet metal blank. The body incorporates a number of guide surfaces. On the one hand there is a first guide surface 19 for the bearing bush 15, concentric with the piston rod axis. Furthermore the body also contains a radial guide surface 21a and axial abutment surface 21b for the pressure tube 5. The end face of the piston rod guide 17 serves as an abutment surface 22 for the piston rod seal 11. The outside diameter of the piston rod guide 17 forms a second guide surface 23 for the casing tube 3. The stepped profile of the piston rod guide 17 in its turn forms a reservoir 25 for the damping medium, which is filled with damping medium up to the level of return flow openings 27 formed in the guide 17. So that the blocking action of the reservoir 25 is as effective as possible, the return flow openings 27 are set very high, i.e. directly below the piston rod seal 11. The return flow openings 27 are connected to restrictor passages 29 which lead into the compensating chamber 7. The restrictor passages 29 are formed in a chipless manner in the guide surface 23 and divide

the latter into guide segments 23a, the radial extent of the restrictor passages 29 being deliberately kept small in order to reinforce the blocking action against the gas volume 9.

The guide 17 is arranged for use as a resilient compensating member to ensure proper internal sealing in the damper 1. To this end, the dimensions of the guide 17 are chosen so that a spacing a is clearly greater than a spacing b between the abutment surface 21b and the base 31 of the piston rod guide 17. On assembly the ring of length a can be highly pre-loaded. After closure of the damper 1, which can be by means of a welding or seaming process, the ring serves as a kind of spring which pre-loads the pressure tube 5 within the damper 1.

In operation of the damper the damping medium passes in a controlled manner through a gap 33 between the piston rod guide 17 and the bearing bush 15 in the region of the first guide surface 19 and the bearing bush 15, and into the reservoir 25. The damping medium subsequently over-flows into the compensating chamber 7 through the return flow openings 27 and into the restrictor passages 29. The latter are formed by co-operation with the internal wall of the casing tube 3. Consequently high adhesion forces act between the casing tube 3 and the damping medium and these guarantee that the damping medium flows along the inside wall and into the compensating chamber 7. In this arrangement the gas from volume 9 cannot pass into the damping medium reservoir 25, so that the usual non-return valve between the compensating chamber 7 and the damping medium reservoir 25 is not required.

This construction of piston rod guide 17 can achieve the universal action known in the state of the art, since a relatively long lever arm is available, substantially from a flange 35 forming the first guide surface 19.

From Figure 2 it will be seen how the restrictor passages 29 are formed in the piston rod guide 17 by stamping or pressing. The size of the guide portions 23a ensures a high degree of stability in a radial direction. As a whole the piston rod guide 17 is produced by a very small amount of outlay on forming, and so trouble-free manufacture is possible.

Figure 3 shows a modification of the vibration damper 1 of Figure 1, and corresponding reference numerals have been applied to corresponding parts. The vibration damper 1 of Figure 3 also has an extension stop buffer 16 which co-operates with a stop, not shown, on the piston rod.

As in Figure 1, the piston rod guide 17 has the second guide surface 23 which locates the piston rod guide 17 radially in relation to the casing tube 3. The radial guide surface 21a makes a press fit in the pressure tube 5 and thereby locates the pressure tube 5 relative to the casing tube 3. The flange 35 forms the concentric first guide surface 19 for the bearing bush 15.

The piston rod guide 17 also has a number of abutment surfaces. The upper end face forms a stop face 37 for a bead 39 at the end of the casing tube 3. The spacing of the surface 37 from the piston rod seal 11 only plays a subordinate role, as this spacing can easily be eliminated by the beading or seaming

process. The axial abutment face 21b locates the piston rod guide 17 in an axial direction within the damper 1. The piston rod guide 17 has a stop face 41 formed on the flange 35 for the bearing bush 15. The stop face may be shaped to extend all round or only part way round. To secure the bearing bush 15 axially the piston rod guide 17 is staked in several places at the lower end of the flange 35 all round at 43. In this way the clearance provided between the bearing bush 15 and the flange 35 can have relatively coarse tolerances. An annular space formed between the flange 35 and the pressure tube 5 is limited at one end by an extension stop face 47.

The piston rod seal 11 rests against the abutment face 22 and is located radially by a locating or centralising surface 49. This provides a common reference plane for the piston rod seal 11 and the bearing bush 15 so that off-axis errors are minimised.

The stepped body of the piston rod guide 17 again forms the damping medium reservoir 25 which is connected to the compensating chamber 7 through at least one return flow opening 27. To save space each return flow opening 27 is stamped out of the abutment face 22. In this way the underside of the piston rod seal 11 and the abutment face 22 form the entry point into the return flow opening 27. As can be seen in Figure 3, the return flow opening 27 in this embodiment ends in a curved radius so that, in contrast to the known construction, no axial space in the piston rod guide 17 is needed for the return flow opening 27.

Apart from individual bending radii all the surfaces of the piston rod guide 17 have a function, so that in general there is optimum utilisation of space.

Figure 4 shows a modification of Figure 3, in which an additional angle-section venting ring 51 is provided. This forms together with the piston rod guide 17 in the outlet region of the return flow openings 27 and the inner wall of the casing tube 3 a kind of siphon which effectively prevents frothing.

Trapped gas can collect in an annular space 45 between the flange 35 and pressure tube 5. Accordingly the radial guide surface 21a contains at least one venting passage 53 which opens into pressed discharge recesses 55. The venting passage 53 can be made up of a number of swages but equally well by making the radial guide surface 21a slightly conical. The discharge recesses 55 can be formed either in the angle-section venting ring 51 or the piston rod guide 17 (as shown).

In operation of the damper the trapped gas is conducted away through the venting passage 53 and the discharge recesses 55 into an angle-section annular space 57. This is always filled with damping medium so that the gas/damping medium mixture can be conducted in a controlled manner into the compensating chamber 7. When the level of the damping medium overflows the venting ring 51 it flows along the internal wall of the casing tube 3 into the compensating chamber 7.

Claims

1. A piston rod guide for a vibration damper of the kind set forth, in which the piston rod guide is a one-piece sheet metal member, and the second guide surface of the piston rod guide and the associated surface of the internal wall of the casing tube are provided with a radially small restrictor passage leading from the or each return flow opening to the compensating chamber, making use of adhesion forces to ensure flow of the damping medium along the internal wall of the casing tube.

2. A piston rod guide as claimed in claim 1, in which the second guide surface comprises segmental guide portions between which the restrictor passages extend.

3. A piston rod guide as claimed in claim 1 or claim 2, in which the restrictor passages are formed in the piston rod guide.

4. A piston rod guide as claimed in any preceding claim, in which the return flow openings are provided directly adjacent to the piston rod seal.

5. A piston rod guide as claimed in any preceding claim, in which the abutment surface for the piston rod seal is formed by the end face of the guide.

6. A piston rod guide as claimed in any preceding claim, in which the return flow openings are formed by pressed-out portions in the region of the abutment surface for the piston rod seal.

7. A piston rod guide as claimed in any preceding claim, in which the return flow openings are arranged substantially horizontally.

8. A piston rod guide as claimed in any preceding claim, in which the spacing between the abutment surface for the piston rod seal and an axial abutment surface for the pressure tube is greater than the spacing between the base of the piston rod guide and its adjacent stepped portion.

9. A piston rod guide for a vibration damper of the kind set forth, in which the piston rod guide is a one-piece sheet metal member, and at least part of each return flow opening is formed by a stamped opening in the abutment surface for the piston rod seal, so that each return flow opening is formed by the underside of the piston rod seal and the stamped opening in the abutment surface of the piston rod guide.

10. A piston rod guide as claimed in claim 9, in which the piston rod guide has a locating surface for the piston rod seal, the locating surface being a part of the stepped shape of the piston rod guide.

11. A piston rod guide as claimed in claim 9 or claim 10, in which the first guide surface forms a sliding fit with the bearing bush and the bearing bush is located axially against at least one stop face on the guide by multiple staking of the piston rod guide.

12. A piston rod guide as claimed in any of claims 9 to 11, in which a flange defining the first guide surface and the pressure tube define an annular space in which an extension stop buffer is mounted.

13. A piston rod guide as claimed in any of claims 9 to 12, in which a guide surface for the pressure tube forms at least one venting passage which is in communication with discharge recesses leading into an annular space defined by an angle-section venting ring.

14. A piston rod guide as claimed in claim 13, in which the guide surface for the pressure tube is conical.

15. A piston rod guide for a vibration damper of the kind set forth substantially as described herein with reference to and as illustraed in Figures 1 and 2 of the accompanying drawings.

16. A piston rod guide for a vibration damper of the kind set forth substantially as described herein with reference to and as illustrated in Figure 3 of the accompanying drawings.

17. A piston rod guide for a vibration damper of the kind set forth substantially as described herein with reference to and as illustrated in Figure 4 of the accompanying drawings.

ıtents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) 15	Application number GB 9406575.2
Relevant Technical Fields (i) UK Cl (Ed.M) F2S (SBC, SBF, SBK, SBQ, SBS) (ii) Int Cl (Ed.5) F16F (9/00, 9/32, 9/34, 9/346, 9/36, 9/40)	Search Examiner C B VOSPER Date of completion of Search 15 JUNE 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASE: WPI	Documents considered relevant following a search in respect of Claims :- 1-8

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 2243898 A	(ATSUGI) Figures 2-4, note sheet metal rod guide 101	1
Y	GB 2237356 A	(ATSUGI) Drawings - note sheet metal guide 73	1
Y	GB 2115903 A	(BOGE) Figure 1, page 2 lines 75-80	1
Y	GB 2002492 A	(TOKICO) Figures 1 and 2 page 3 lines 24-43	1
Y	GB 1590608	(TOKICO) Figure 2 page 2 lines 111-123 - note passage 9c	1
Y	EP 0535409 A	(AUGUST) Drawings, eg. note sheet metal guide 5 in Figure 7	1
Y,P	US 5211268	(LIZELL/MONROE) eg. Figure 10 - note passage 714	1
Y	US 4724938	(HORVATH/GENERAL) Figures 2 and 3, note passage between members 24 and 34	1
X	DE 4030788 A	(ATSUGI) Figure 7	1

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Patents Act 1977
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Application number
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Relevant Technical Fields

(i) UK Cl (Ed.M) F2S (SBC, SBK, SBQ, SBS)

(ii) Int Cl (Ed.5) F16F 9/00, 9/32, 9/36, 9/40

Search Examiner
C B VOSPER

Date of completion of Search
28 SEPTEMBER 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASE WPI

Documents considered relevant following a search in respect of Claims :-
9 TO 14, 16, 17

Categories of documents

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X:P	GB 2265436 A	(ATSUGI) page 5 line 34 to page 6 line 3, Figure 4 - note return flow passage 271	9
X	GB 2243898 A	(ATSUGI) whole document but note page 4 lines 25 to 30, page 6 lines 3 to 10 and 20 to 24, drawings in particular	9, 10, 11
X	GB 2237356 A	(ATSUGI) page 7 lines 25 to 28, page 8 line 34 to page 9 line 14, Figure 4 - note return flow opening 271	9, 10 at least
Y	GB 2116666 A	(FICHTEL) Figure 2 - note return flow opening 54 in abutment surface	9
Y	GB 2104186 A	(FICHTEL) Figures 2 and 3 - note return flow opening in inner abutment surface of piston rod guide	9
Y	GB 1414810	(ALLINQUANT) Figure 1 - shows sheet material stepped guide having return flow opening in abutment surface for seal 49	9
Y	GB 775195	(ARMSTRONG) Figure - shows return flow opening in seal abutment surface	9
Y	GB 576025	(NEWTON) Figure 1 - shows return opening 33 in seal abutment surface	9

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

Continuation page

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	EP 0535409 A1	(AUGUST) drawings - show sheet metal piston rod guides	9
Y	US 5224573	(AMEMIYA/ATSUGI) column 3 lines 23 to 29	9
Y	US 4482036	(WÖSSNER/FICHTEL) Figure 2 - note return flow passage 4 in seal abutment surface	9