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Piston and Piston Rod Assembly

This invention relates to a piston and piston rod assembly for use as a flow control device where substantially higher resistance to movement of the piston in one axial direction is required than to movement in the opposite axial direction. The preferred embodiment of the present invention is, for example, suitable for use in a gas spring, for example of the type shown in our British patent specification G.B. 2012913A.

10 The piston and piston rod assembly shown in British patent specification G.B.2012913A has been found satisfactory for many applications, but in some applications difficulty has been experienced in maintaining adequate dimensional control of the orifice provided in the restrictor plate.

15 According to the present invention a piston and piston rod assembly comprises: a piston rod; a piston mounted on the piston rod; a passageway providing a fluid flow path past the piston; and a restrictor device, the restrictor device and piston being movable relative to each other between a first position in which the restrictor device is spaced from the piston and does not substantially restrict flow through the passageway and a second position in which the restrictor device is in abutment with the piston to restrict flow through

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the passageway, wherein said restriction to flow is provided by an elongate channel defined by the opposing surfaces of the abutting piston and restrictor device, said channel restricting flow through the passageway.

5 In the preferred embodiment of the invention the channel is formed by an elongate groove defined by the restrictor device facing the piston. Thus, when the restrictor device and piston are in abutting contact the groove is closed on its normally open side by the
10 surface of the piston to define the elongate channel. The groove may be formed in the surface of a restrictor member, in which case it is preferably shaped such that the channel includes a radially extending exit portion extending from the periphery of the restrictor member, a
15 an arcuate central portion, and a radially extending entry portion extending from the end of the central portion remote from the exit portion. Thus, when the restrictor member is in engagement with the piston fluid flows from the passageway via the entry portion, the
20 central portion, and the exit portion of the elongate channel.

 In an alternative embodiment the restrictor device comprises a support plate and a slotted plate which lies against and is supported by the support plate to define
25 the groove.

 By suitably dimensioning the groove in the restrictor device, the resistance to flow provided by the channel is substantially determined by the length of the channel. By suitably selecting the length of channel
30 the desired restriction can be provided without the need for highly accurate machining of the groove. Further, because the groove is open along its entire length during unrestricted reverse flow through the passageways, any particles of debris becoming trapped in the groove are
35 flushed clear on each reverse stroke of the piston and

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piston rod assembly.

The above and further features and advantages of the invention will become clear from the following description of a preferred embodiment thereof, given by way of example only, reference being had to the accompanying drawings wherein:

Figure 1 shows partially in cross section a piston and piston rod assembly mounted within a cylinder;

Figure 2 is a sectional view taken on the line II-II of Figure 1.

Figure 3 is a view corresponding to Figure 1 showing a second embodiment of the invention;

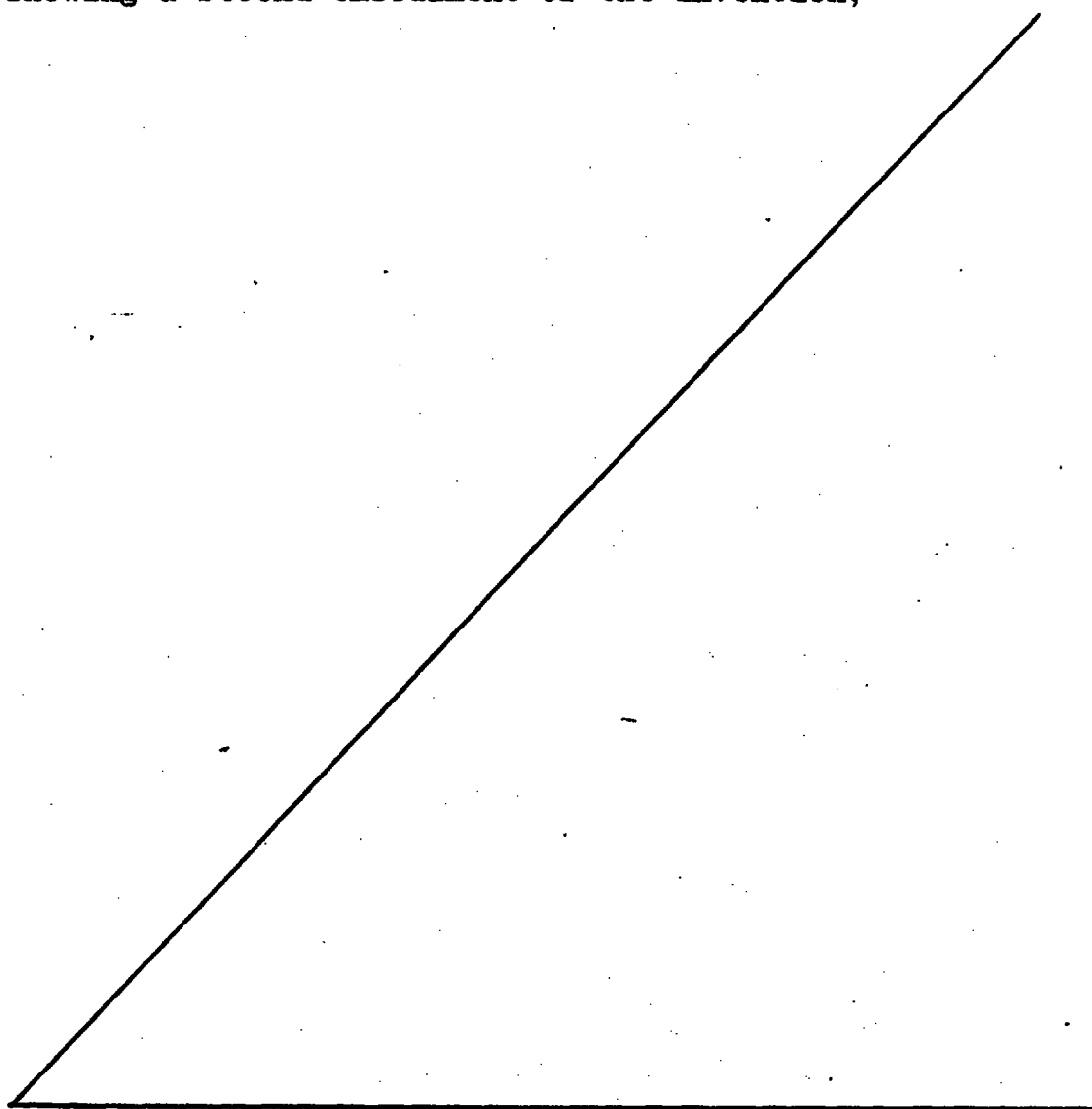


Figure 4 is a plan view of the embodiment of Figure 3; and

Figure 5 shows the slotted disc of the embodiment of Figures 3 and 4.

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Figures 1 and 2 show a piston and piston rod assembly 10 slidably mounted within a cylinder 11, for example of a gas spring. An O-ring seal 12 positioned in a groove in the piston 13 ensures sliding sealing contact between the piston 13 and the cylinder 11. The piston 13 is slidably mounted on a spigot 14 formed at the end of piston rod 15. A restrictor member 16 is secured to the end of the piston rod 15 by suitable means, for example screw 17. A light spring 18 may be provided to bias the piston 13 towards the restrictor member 16.

A passageway 19 comprising a plurality of axially extending drillings 20 opening into an annular groove 21 is provided to allow fluid to flow past the piston. More particularly, during an upward stroke (as viewed in Figure 1) of the assembly 10 the piston 13 will move away from the restrictor member 16 and seat on the shoulder 22 formed at the base of the spigot 14. Fluid may then flow freely around the edges of the restrictor member 16 and through the passageway 19 to the lower side of the piston. The clearance between the restrictor member 16 and the cylinder 11 in association with the cross sectional area of the passage 19 ensures that during such an upward stroke there is little resistance to movement of the assembly 10.

During a downward stroke (as viewed in Figure 1) of the assembly 10, however, the piston 13 moves into abutment with restrictor member 16 as shown in Figure 1 and flow out of the passageway 19 is restricted since the only exit passage from the annular groove 21 is via a channel 23 defined between the piston 13 and the restrictor member 16.

Referring now to Figure 2 the restrictor member 16 is formed with a groove 23 comprising an inlet portion 24, a central arcuate portion 25, and an outlet portion 26. When the piston 13 is in abutment with the restrictor member 16 the land 27 formed radially outwardly of the annular groove 21 closes the groove 23 over the majority of its length to define a restrictor channel. Fluid flowing through the passageway 19 enters the channel via the entry portion 24 of the groove, flows around the arcuate portion 25 of the groove to exit via the exit portion 26. By suitably selecting the length of the groove 23 the desired degree of restriction of flow during a downward movement of the piston can be obtained. In the embodiment shown in Figure 2 a groove of substantially 180° arcuate extent is shown in solid lines, but this length can be extended up to at least 340° (as shown in broken lines) if it is desired to increase the restriction afforded by the groove.

The groove 23 may be formed by any suitable technique.

It will be observed that during upward strokes of the piston during which the piston is spaced from the restrictor member, the groove 23 is open along its entire length, and accordingly any debris which may have become lodged within the groove can fall free and be carried away by the fluid sweeping past the open groove.

Referring now to Figures 3 to 5 a modified embodiment of the invention is shown which is identical to the embodiment of Figures 1 and 2 except that the restrictor member 16 of Figures 1 and 2 has been replaced by a restrictor device 16A comprising a support plate 30 and a slotted plate 31.

The slotted plate 31 is cut from thin strip material and, as can best be seen from Figure 5, is formed with a slot 32 comprising a radially extending entry portion.

33 and an arcuate portion 34. The arcuate portion is illustrated as having an arcuate extent of 180° but may have a greater arcuate extent up to, for example, 340° (as indicated by broken lines) or a lesser arcuate extent as desired. The support plate 30 is in the form of a relatively thick disk and is formed with an axially extending hole 35 which registers with the arcuate portion 34 of the groove 32.

The support plate 30 and slotted plate 31 are secured to the piston rod 15 by the screw 17 such that the slotted plate 31 lies against and is supported by the support plate 30. The surface of the support plate closes one side of the slot 32 whereby the plates 30,31 together define a groove 36 which extends from the entry portion 33 to the hole 35. By manufacturing the slotted disc 31 from material having a known and substantially constant thickness and by forming the slot 32 to close tolerances the dimensions of the groove 36 formed can be accurately controlled more easily than if the groove is formed in a solid restrictor member as shown in Figures 1 and 2.

Further, by relatively rotating the plates 30,31 the effective length of the groove 36 i.e. the arcuate extent of the groove 36 from the entry portion 33 to the hole 35, can be adjusted to a desired value. After the desired relative position has been achieved, the screw 17 is fully tightened to lock the plates relative to each other.

It should be noted that the hole 35 is of sufficiently large diameter for the contribution it makes to flow resistance to be very small compared with that of the groove 36 and thus close control of the tolerances of the hole 35 is not necessary, and the resistance to flow provided by the restrictor device is substantially proportional to the effective length of the groove 36.

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CLAIMS

1. A piston and piston rod assembly comprising:
a piston rod; a piston mounted on the piston rod;
a passageway providing a fluid flow path past the piston;
and a restrictor device, the restrictor device and piston
5 being movable relative to each other between a first
position in which the restrictor device is spaced from
the piston and does not substantially restrict flow through
the passageway and a second position in which the
restrictor device is in abutment with the piston to
10 restrict flow through the passageway, wherein said
restriction to flow is provided by an elongate channel
defined by the opposing surfaces of the abutting piston
and restrictor device, said channel restricting flow
through the passageway.
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2. A piston and piston rod assembly according to
claim 1 wherein the restrictor device is fixed relative
to the piston rod and the piston is slidable on the piston
rod to provide the relative movement between the res-
20 trictor device and the piston.
3. A piston and piston rod assembly according to
claim 2 wherein the restrictor device is secured to the
end of the piston rod.
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4. A piston and piston rod assembly according
to any preceding claim wherein the channel is formed by
an elongate groove defined in the surface of the restrictor
device.



5. A piston and piston rod assembly according to claim 4 wherein the elongate groove includes a radially extending entry portion which, when the piston and restrictor device are in abutment registers with the passageway, and an arcuate portion which is closed on its normally open side by a land on the piston when the piston and restrictor device are in abutment.
6. A piston and piston rod assembly according to claim 5 wherein the restrictor device is a unitary restrictor member and the groove includes a radially extending exit portion which extends from the end of the arcuate portion remote from the entry portion of the periphery of the restrictor member.
7. A piston and piston rod assembly according to claim 5 wherein the restrictor device comprises a support plate and a slotted plate abutting the support plate, the slotted plate including a slot which is closed on one side by the support plate to define the entry portion and the arcuate portion of the groove.
8. A piston and piston rod assembly according to claim 7 wherein the support plate includes an axially extending through hole which registers with the arcuate portion of the groove to form an exit from the channel.
9. A piston and piston rod assembly according to claim 8 wherein the support plate and the slotted plate are rotatable relative to each other to vary the position of the hole along the arcuate portion of the groove and thus vary the effective length of the channel.

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10. A piston and piston rod assembly, substantially as hereinbefore described with reference to Figures 1 and 2 or Figures 3 to 5 of the accompanying drawings.
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