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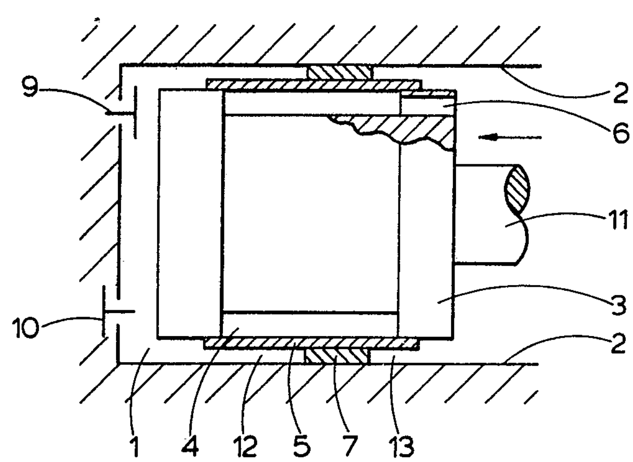
(54) Piston seals

(57) In a piston-in-cylinder type pump incorporating a radial sealing arrangement, wear on the seal is mitigated by the contact pressure with which the seal is thrust against the cylinder wall being adjusted automatically according to the degree of suction in the working chamber of the pump.

In one embodiment the piston (3) has a groove (4) and an elastically resilient tube (5) covers the said groove to form an annular chamber and is associated with a seal-ring (7) fixed thereto, the piston being provided with ports (6) in an end portion thereof for admitting atmospheric pressure to within the annular chamber.

In another embodiment the annular chamber is formed by a resilient stepped tube, the end nearer the working chamber being fixed to the piston and the other end having an outwardly stepped portion resting freely against the peripheral surface of the piston and forming the seal.

Fig.1



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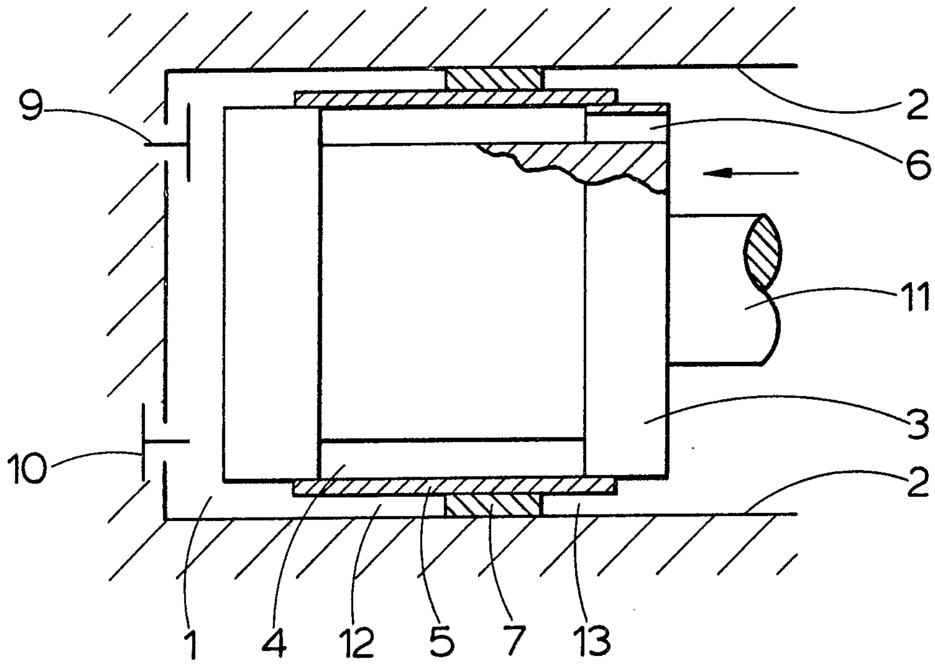

Fig.1

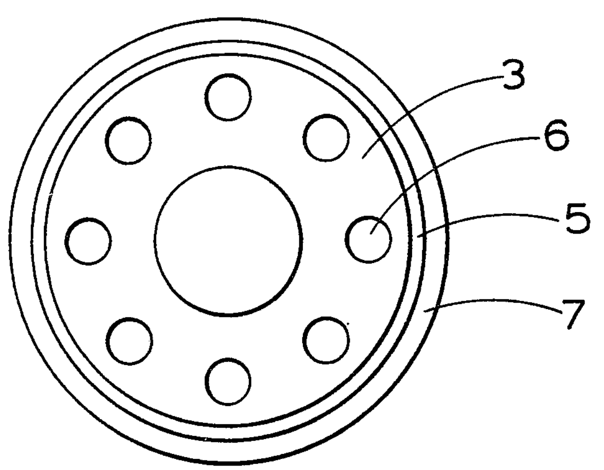

Fig.2

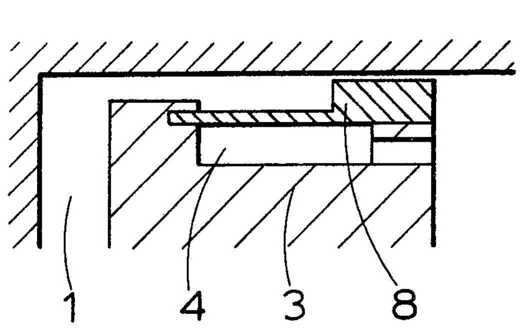

Fig.3

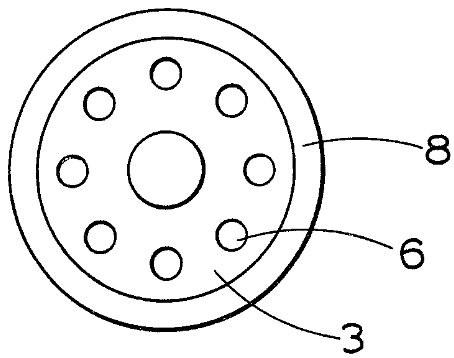

Fig. 4

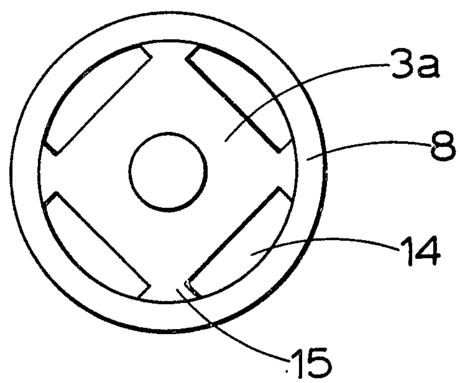

Fig. 5

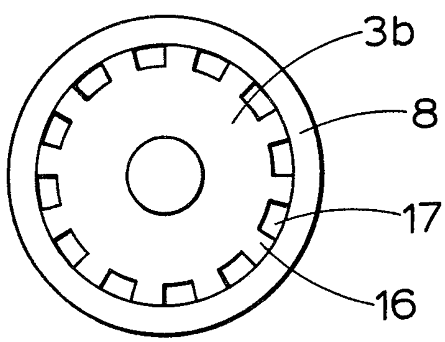

Fig. 6

SPECIFICATION

Radial sealing arrangement for the piston of a cylinder pump

This invention relates to a radial sealing arrangement for the piston of a pump, particularly a vacuum pump, of the piston-in-cylinder kind, particularly for use in motor vehicles for supplying suction to a vacuum-servo braking system. More particularly the invention relates to the sealing of the piston against the cylinder wall so as to ensure that the contact pressure between the seal and the wall depends on the suction reached in the working chamber of the pump.

In the construction of conventional vacuum pumps of the kind set forth for supplying suction to vacuum-servo braking systems in motor vehicles, a difficulty arises in ensuring that a good seal is made between the piston and the cylinder wall. Usually an O-ring is used with a radially superposed sealing ring. The function of the seal e.g. O-ring is to produce sufficient contact pressure between the seal and the cylinder wall to ensure good sealing under all operating conditions. The contact pressure results from a prestressing of an O-ring, but if this is sufficient to ensure a good seal when there is a high degree of suction in the working chamber, then under all other operating conditions the contact pressure is unnecessarily high. A result is rapid abrasion of the sealing ring and degradation of the sealing effect.

The problem is solved in the present invention by arranging the seal so that the contact pressure between the seal and the cylinder wall adjust itself automatically to suit the operating conditions at each instant. This minimises abrasion of the seal, which largely determines the working life of the pump.

The invention will now be described in greater detail with the help of the examples represented diagramatically in the drawing, in which

Figure 1 shows a piston-in-cylinder vacuum pump equipped with the seal of the present invention;

Figure 2 shows the working end of the piston;

Figure 3 corresponds to Figure 1, but illustrates a variant of the seal;

Figure 4 shows the working end of the piston of Figure 3, and

Figures 5 and 6 show further embodiments of the working ends of the piston of Figure 3.

The pump shown diagrammatically in Figures 1 and 2 has a working chamber 1 which communicates through an inlet valve 9 and an outlet valve 10 with appropriate passages and devices of the vehicle. The working chamber 1 has cylinder walls 2 forming a cylinder in which a piston 3 operates driven to reciprocate by for example, a piston rod 11. A seal 5, 7 separates the working chamber 1 from the external atmosphere, shown in the drawing towards the right. The piston has a peripheral neck-like groove 4. Fixed to the piston, for example by adhesive, over the groove 4 is an elastically resilient tube 5 so that the groove 4 is sealed off radially by the said resilient tube forming an annular chamber. The annular chamber communicates with the external atmosphere through ports, in this example apertures 6 are bored regularly around a circle of an end portion of the piston. Fixed to the outer surface of the resilient tube 5 is a seal-ring 7 which is in sliding contact with the cylinder wall 2.

The seal-ring 7 seals the working chamber 1 against the external atmosphere. It is to be observed that the contact pressure thrusting the seal-ring 7 against the cylinder wall 2 depends on the difference between the atmospheric pressure acting on the annular chamber, and at 13, and the suction prevailing in the working chamber 1 and at 12. The greater the suction in the working chamber 1 the greater the contact pressure thrusting the seal-ring 7 against the cylinder wall 2. Thus the contact pressure adjusts itself automatically to suit operating conditions. Abrasion of the seal-ring 7 is minimised, and due to the minimal friction effects, power consumption is also minimised.

It should be understood that the resultant tube 5 and the sliding seal-ring 7 are so dimensioned that when the pump starts up with atmospheric pressure on both sides of the seal the seal-ring 7 is thrust resiliently against the cylinder wall 2 with sufficient contact pressure to ensure the necessary sealing effect even under those conditions.

The embodiments of the working end of the piston shown in Figures 3 to 6 are intended to simplify the construction of the seal. In these examples the two parts 5 and 7 of Figure 1 are in effect combined as a single elastically resilient stepped tube 8. The upper end (to the left in the drawing) of the stepped tube 8 is fixed to the piston 3, for example held by its edge in a cut-back groove as shown in Figure 3. The lower portion (towards the right in Figure 3) of the stepped tube 8 rests loosely in contact with the peripheral surface of the piston 3. The lower portion of the resilient stepped tube 8, of greater external diameter, forms the sliding seal-ring of Figures 1 and 2. The board ports 6 of Figures 1 and 2 are repeated in Figures 3 and 4.

Instead of the board-through ports 6 shown in Figure 2, cut-out passages can be provided as shown at 14 in Figure 5 and at 17 in Figure 6. Between the cut-out passages 14 or 17 the piston 3a or 3b has supporting surfaces 15 or 17, for supporting the lower portion of the resilient stepped tube 8. The example of Figure 5 has four passages 15, whereas in Figure 6 there are more numerous passages 17. Many other arrangements of passages to allow atmospheric pressure to enter the annular chamber 4 are possible.

CLAIMS

1. A radial sealing arrangement for the piston of a pump, particularly a vacuum pump, against the cylinder wall thereof, characterised in that the contact pressure with which the seal (7, 8) is

thrust against the cylinder wall (2) is adjusted automatically according to the degree of suction in the working chamber of the pump.

2. An arrangement according to Claim 1, characterised in that:

a) the piston (3-Fig. 1) has a peripheral neck-like groove (4);

b) an elastically resilient tube (5) is fixed to the peripheral outer surface of the piston (3) over the said groove (4) whereby an annular chamber is formed which is radially sealed off;

c) a sliding seal-ring (7) is fixed to the peripheral outer surface of the resilient tube (5) over the groove (4); and

d) the piston (3) is provided with ports (6) in an end portion thereof for admitting atmospheric pressure to within the said annular chamber

3. An arrangement as claimed in Claim 1, characterised in that:

a) the piston 3-Fig. 3) has a peripheral neck-like groove (4);

b) an elongate elastically resilient stepped tube (8) is arranged over the said groove (4) whereby an annular chamber is formed, the end of the said tube nearer the working chamber (1) of the pump being fixed to the piston;

c) a lower portion of the other end of the stepped tube (8) provided with the said stepped portion remote from the said working chamber (1), rests freely against the peripheral surface of the piston (3), the tube (8) being stepped radially outwardly, whereby the said outwardly stepped portion of the tube forms a sliding seal-ring for sealing the working chamber (1) against external atmosphere; and

d) the piston (3) has ports (6) for admitting atmospheric pressure to the neck-like groove (4).

4. An arrangement according to Claim 1, substantially as hereinbefore described and illustrated in any of the accompanying drawings.

5. A cylinder pump containing a sealing arrangement according to any of Claims 1 to 4.

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