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ADJUSTABLE PISTON CUSHION

Filed Feb. 29, 1960

2 Sheets-Sheet 1

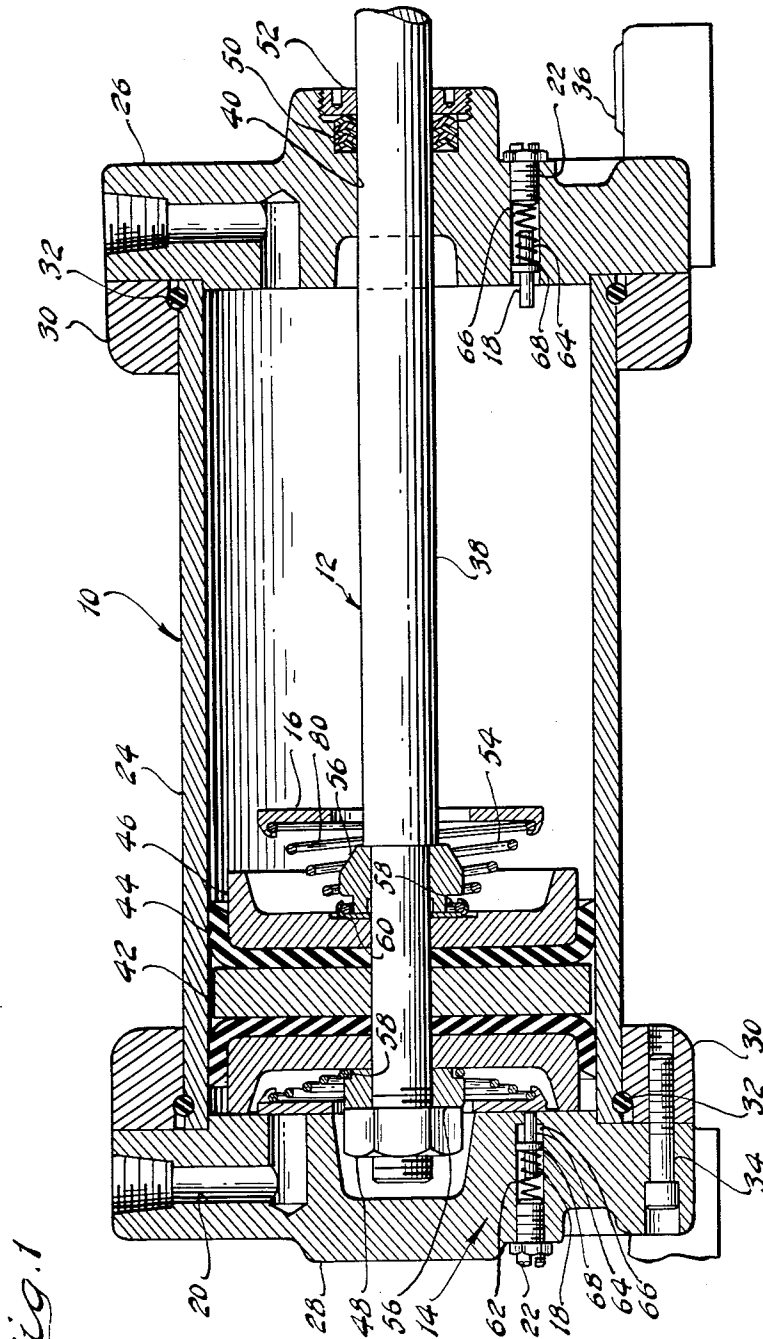


Fig. 1

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Fig. 2

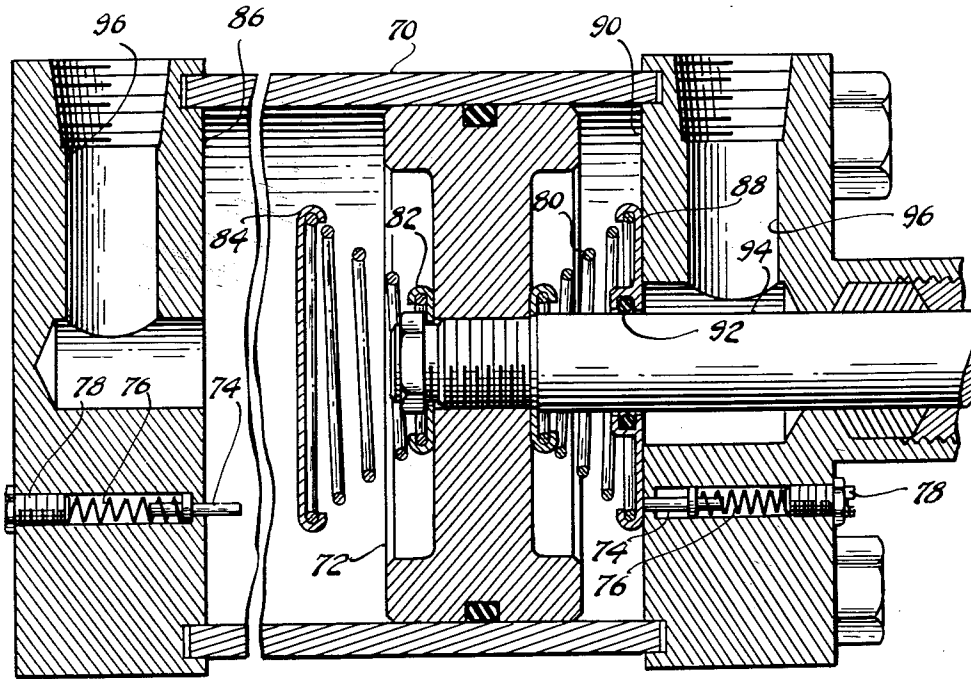


Fig. 3

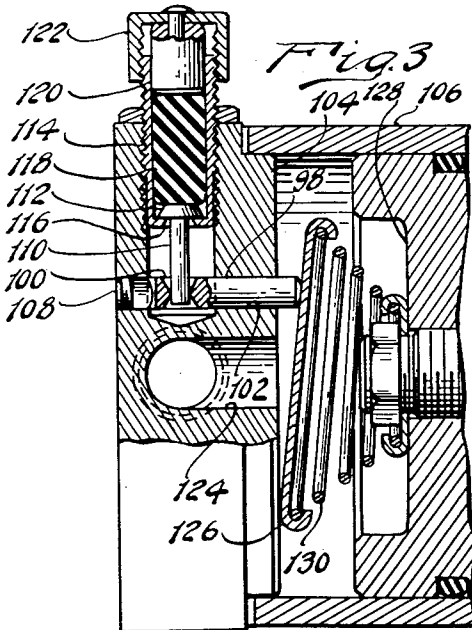
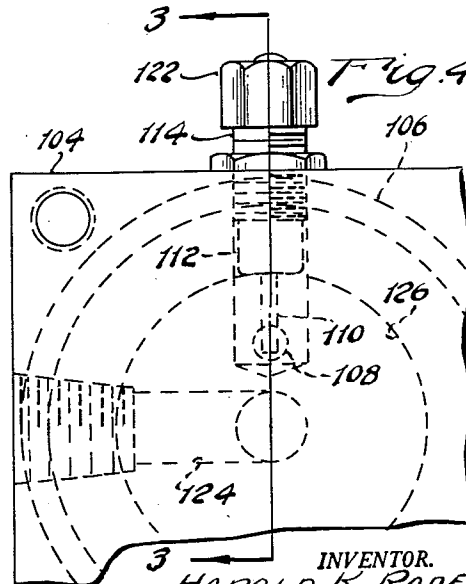


Fig. 4



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## ADJUSTABLE PISTON CUSHION

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The present invention relates to piston and cylinder construction and refers more specifically to improved adjustable piston cushioning means.

In the past it has been known to provide cushions for pistons which pistons are reciprocal within a cylinder. The conventional cushioning means comprises an escape opening in the end wall of the cylinder connecting with a recess in the end wall into which a portion of the piston extends as the piston approaches the end wall to retard the escape of the operating medium through the opening. The operating medium entrapped in the cylinder is thus compressed on further movement of the piston toward this end wall of the cylinder to provide a cushion for the piston. The cushioning effect is controlled in these conventional systems by providing a valve to regulate the escape of the operating medium through the opening.

With the conventional cushioning means no method of adjusting the time at which cushioning is initiated in relation to the position of the piston within the cylinder is provided. In addition with the conventional cushioning means and particularly with the larger cylinders making use thereof the wear between the walls of the recess and the part of the piston which extends thereinto is often excessive and gradually lessens the effectiveness of the cushion until replacement of parts of a cylinder or a piston are necessary.

Also, the cycle time of conventional cushioned pistons is often greater than desired due to the restricting of the fluid flow in the return direction through the valves which provide the cushioning. The end wall of the cylinders are also often unduly thick due to the necessity of providing a relatively deep recess in the wall to provide sufficient cushioning for the piston.

It is therefore one of the objects of the present invention to provide piston cushioning means which are adjustable to initiate cushioning of a piston in accordance with the distance of the piston from the end wall of the cylinder in which the piston is reciprocal.

Another object is to provide improved adjustable piston cushioning means for use with either hydraulically or pneumatically operated pistons wherein the cushioning effect is increased through use of the cushioning means.

Another object is to provide an improved adjustable piston cushion including means for reducing the piston cycle time.

More specifically it is an object of the present invention to provide piston cushioning means for use with either hydraulically or pneumatically operated pistons comprising sealing means resiliently supported adjacent the ends of the piston, abutment means resiliently supported in the end wall of the cylinder in which the piston is reciprocal operable to prevent sealing action of the sealing means to prevent escape of the operating medium from said cylinder as the piston approaches said end wall until the resilient means supporting the sealing means exerts greater force than the resilient means supporting said abutment means.

Still more specifically it is an object of the present invention to provide a sealing disc supported for axial movement by resilient means on the end of a piston reciprocal within a cylinder, and air escape passage in the end wall of the cylinder adjacent said end of the piston adapted to be sealed by the sealing disc on approach of the piston to the end wall, and abutment means extending through the end wall of said cylinder and resiliently

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biased to prevent the sealing disc from sealing the air escape opening until the biasing force of the means supporting the sealing disc is stronger than the resilient force biasing the abutment toward the sealing disc.

Another object is to provide adjustable piston cushioning means as set forth above wherein said abutment means comprises a shaft adapted to extend into the cylinder through the inner surface of the end wall of the cylinder and movable axially with respect to the cylinder, a spring biasing the shaft into the cylinder and a plug in the other surface of said end wall in contact with said spring and adjustable to vary the bias which the spring applies to the shaft.

Another object is to provide adjustable piston cushioning means as set forth above wherein said abutment means comprises a shaft extending axially through said end wall and slidably adjustable between positions wherein one end thereof extends into the cylinder and wherein the entire shaft is held within said end wall, said shaft having a transverse opening therethrough, a sleeve extending radially into said end wall, a second shaft having an enlarged head on one end thereof held by said sleeve at the large end and extending into the transverse opening through the shaft, resilient means within the sleeve and means for adjustably tensioning the resilient means to prevent pivotal movement of the second shaft about said enlarged head with varying force.

Another object of the present invention is to provide adjustable piston cushioning means as set forth above which may be applied to conventional cylinders with only slight modification of said conventional cylinders.

Another object is to provide adjustable piston cushioning means which is simple in construction, economical to manufacture and efficient in use.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a longitudinal section of a piston and cylinder including adjustable piston cushioning means according to the invention.

FIGURE 2 is a fragmentary longitudinal section of a conventional piston and cylinder which have been modified to provide adjustable piston cushioning means therefor according to the invention.

FIGURE 3 is a partial longitudinal section view of a piston and cylinder illustrating a modification of the piston cushioning means illustrated in FIGURE 1.

FIGURE 4 is a partial end view of the piston and cylinder structure illustrated in FIGURE 3.

With reference to the figures a particular embodiment of the present invention will now be disclosed.

A cylinder generally indicated 10 and piston generally indicated 12, including adjustable piston cushioning means generally indicated 14 according to the invention is shown in FIGURE 1. The piston cushioning means comprises sealing discs 16 resiliently supported on piston 12 and adjustable abutment members 18 resiliently mounted in the end walls of cylinder 10 as shown.

In operation abutments 18 present sealing discs 16 from sealing the operating medium escape passages 20 until the piston 12 is in a selected axial position in cylinder 10 as determined by the setting of adjustable plug 22. While the operating medium may be either pneumatic or hydraulic in the embodiment described herein it will be considered that the operating medium is air.

More specifically cylinder 10 comprises the cylindrical body member 24, end walls 26 and 28 mounted on the ends of body member 24 by means of collars 30 and seals 32 in conjunction with bolts 34. As indicated the

cylinder 10 may be mounted on fixed supports such as 36 by convenient means if so desired.

Piston 12 includes the piston shaft 38 extending through passage 40 in end wall 26 of cylinder 10 as shown. Piston 12 further includes a piston head comprising the annular disc 42 and conventional sealing members 44 clamped between the disc 42 and clamping discs 46 forming the ends of the piston head and threaded over the end of piston shaft 38 as illustrated and clamped thereon by means of nut 48.

Piston 12 is adapted to reciprocate within cylinder 10 in the well known manner. Packing 50 for piston shaft 38 is provided in end wall 26 of cylinder 10 as shown in FIGURE 1. The fitting 52 is provided to permit inspection and replacement of the packing 50 as will be understood.

As thus far described the piston and cylinder illustrated in FIGURE 1 are substantially conventional. According to the invention however the piston and cylinder illustrated in FIGURE 1 have incorporated therein unique cushion means for the piston 12, which cushioning means becomes more efficient with use and which cushioning means may be adjusted so that the cushioning of the piston will be initiated with the piston at different distances from the end walls 26 and 28.

The adjustable cushioning means comprises the sealing discs 16 shaped as shown at each end of the piston head in axial spaced relation to the clamping discs 46 as illustrated. The sealing discs 16 are supported on the piston by the conical helical springs 54 which may be held against the clamping discs 46 by a member such as 56, having an annular shoulder 58 thereon or may be supported by means of a plate 60 which is held against the clamping disc 46 by means of a member, such as 56, as indicated.

Thus, as the piston 12 reciprocates in the cylinder 10 the sealing discs 16 are held in position concentric with shaft 38 as shown and are adapted to move axially with respect to the shaft 38 on contacting of the end walls of the cylinder 10 whereby the air escape passages 20 of the cylinder 10 are closed by the sealing discs when the piston 12 approaches the end walls of the cylinder close enough to compress springs 54 sufficiently to provide enough axial thrust on the sealing discs 16 to overcome the axial thrust on abutments 18 provided by springs 62 as will be subsequently considered.

The cushioning means of the invention further include the abutments 18 comprising a cylindrical shaft 64 slidably mounted in a passage 66 within the end walls of the cylinder as shown in FIGURE 1. A radially extending annular flange 68 is provided centrally of the cylindrical shaft 64 against which one end of spring 62 bears to bias an abutment 18 into cylinder 10 as indicated at the right in FIGURE 1. The other end of spring 62 abuts against the adjustable plug 22 threadedly engaged in the outer end of the passage 66 as shown. Adjustment of the plug 22 axially of the passage 66 adjusts the force with which the associated abutment 18 is biased into the cylinder 10 as will be understood.

Thus in over-all operation as the piston 12 moves, for example toward the left end of cylinder 10 as illustrated in FIGURE 1, the sealing disc 16 will first contact abutment 18. Due to the relative strengths of spring 54 and spring 62 the sealing disc 16 will at first be tilted slightly so that it does not fit flat against the end wall 28 and air trapped between the piston head and the end plate 28 in the cylinder 10 will be permitted to escape through air escape passage 20 as previously indicated. On further movement of the piston 12 toward the end plate 28 spring 54 will be compressed until the force exerted thereby on the sealing disc 16 is sufficient to move the abutment 18 toward the plug 22 in opposition to spring 62 whereby the sealing disc 16 assumes a sealing position flat against the end plate 28 as shown at the left in FIGURE 1. Cushioning of the piston is thus effected by the remain-

ing air trapped within the cylinder between the piston head and the end wall 28.

It will be understood that in the operation of the invention as set forth above that the plug 22 may be adjusted to vary the bias on abutment 18 due to spring 62 so that the sealing disc 16 will assume a sealing position as shown at the right in FIGURE 1 with the piston 12 in varying axial positions within the cylinder 10. Further it will be noted that since through use any burrs or irregularities in the sealing surface of the disc 16 will be worn away and that therefore the seal provided by sealing disc 16 and the cushioning of the piston will improve with use of the piston in contrast to conventional structures in which the cushioning deteriorates as the cushioning means wears.

Also, since on subsequently moving the piston 12 to the right a distance such the force due to spring 62 is greater than that due to spring 54 the sealing disc 16 is caused to open the entire passage 20, the return flow of fluid into the left end of cylinder 10 is not restricted by the usual small needle valve whereby the cycle time of the piston is reduced in accordance with the invention.

While the cushioning means of the invention has been shown as applied to a cylinder and piston especially constructed therefor in FIGURE 1, it will be understood that the invention resides primarily in the cushioning means and may be practiced with conventional cylinders and pistons on slight modification thereof as shown in FIGURE 2.

In FIGURE 2 a conventional cylinder 70 having conventional piston 72 reciprocal therein which has been modified to include the adjustable cushioning means of the invention is illustrated. As shown an abutment 74, spring 76 and adjustable plug 78 extending axially through the end walls of the cylinder 70 and which are entirely similar to the abutment 18, spring 62 and adjustable plug 22 described above are included in the conventional cylinder 70 as modified. Further the piston head of the piston 72 in FIGURE 2 has been modified to include conical helical springs 80 secured to the opposite ends thereof by means of annular clamping members 82 as shown. A circular disc 84 is attached to the spring 80 adjacent the end wall 86 of the modified cylinder 70 as shown in FIGURE 2, while an annular sealing disc 88 is secured to the spring 80 adjacent the end wall 90 of the modified cylinder 70 as shown. A sealing member 92 through which the shaft 94 of the piston 72 extends is carried by the sealing disc 88 in the modified piston structure as shown.

The operation of the cushioning means provided on the modified conventional piston 72 and cylinder 70 shown in FIGURE 2 is entirely analogous to the operation of the cushioning means illustrated in FIGURE 1. As the piston 72 moves toward an end wall of the modified cylinder the sealing ring is prevented from sealing the usual air escape passage 96 until sufficient force is exerted by the spring 80 to move the abutment 74 toward the adjustable plug 78 in opposition to the variable bias applied to the abutment 74 by the spring 76. When the sealing ring seats on the end wall of the cylinder 70 the remaining air in the cylinder is trapped to provide a cushion for the piston as indicated above.

In FIGURES 3 and 4 a modification of the adjustable abutment portion of the cushioning means of the invention is illustrated. As shown the adjustable abutment means of FIGURE 3 comprises a cylindrical shaft 98 having a transverse opening 100 therethrough slidably positioned in a passage 102 extending axially through end wall 104 of a conventional cylinder 106 as indicated. Plug 108 functions only to close passage 102. Shaft 98 is biased into cylinder 106 by means of shaft 110 having enlarged head 112 thereon, which shaft 110 extends into the transverse opening 100 of shaft 98. Shaft 110 is held for pivotal movement about its head 112 in sleeve 114 threaded into the end wall 104 of cylinder 106 radially

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thereof as shown. Shaft 110 extends through the circular opening 116 in the end of sleeve 114 as shown and is biased to maintain a perpendicular position with respect to shaft 98 by means of the resilient member 118 inserted in sleeve 114. The bias exerted by resilient member 118 on shaft 110 may be varied by means of the adjustable plunger 120 inserted in sleeve 114 and movable therein on rotation of cap 122 which is threadedly received on sleeve 114 as shown.

In operation the shaft 98 normally is biased into the position shown in FIGURE 3 by means of the resilient member 118 and thus prevents immediate sealing of the air escape passage 124 of the cylinder 106 as the sealing disc 126 of the piston 128 approaches end wall 104 of cylinder 106. When the force exerted by the spring 130 secured to piston 128 is sufficient to pivot shaft 110 about head 112 in opposition to resilient means 118 sealing of the air escape passage 125 by the sealing disc 126 is accomplished as before. It will be understood that the axial position of the piston at which the sealing is accomplished and the cushioning is initiated will depend on the bias applied to shaft 110 through resilient means 118 and is adjustable by means of rotation of cap 122.

Thus there is provided in accordance with the invention adjustable means for cushioning a piston reciprocal within a cylinder, which cushioning means is adjustable to initiate cushioning in accordance with a particular axial position of the piston within the cylinder. Further as set forth above the cushioning means of the invention improves with use in contrast to most conventional cushioning means.

Also while disclosure of a particular embodiment of the invention and particular modifications thereof are indicated, it will be understood that many other variations of the invention will readily suggest themselves to those skilled in the art in view of the disclosure of the invention. It is therefore the intention to include all such suggested modifications within the scope of the invention.

The drawings and the foregoing specification constitute a description of the improved adjustable piston cushion in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. A cylinder having opposed end walls, a piston mounted for axial reciprocation in said cylinder between said end walls, adjustable piston cushioning means for initiating air cushioning of said piston in response to said piston moving into variable predetermined axial positions with respect to said cylinder end walls, and means adjustable from the exterior of said cylinder while said piston and cylinder are in assembly to determine the variable predetermined axial positions.

2. A cylinder having opposed end walls, a piston mounted for axial reciprocation in said cylinder between said end walls, sealing means resiliently supported on said piston operable to restrict air flow from one end of said cylinder on being seated against one end wall of said cylinder at said one end thereof to provide an air cushion for said piston, and abutment means resiliently mounted in said one end wall operable to prevent said sealing means from seating against said one end wall until said piston moves into a variable predetermined axial position with respect to said one end wall.

3. A cylinder having opposed end walls, a piston mounted for axial reciprocation in said cylinder between said end walls, sealing means resiliently supported on said piston operable to restrict air flow from one end of said cylinder on being seated against one end wall of said cylinder at said one end thereof to provide an air cushion for said piston, and abutment means adjustable externally of said cylinder while the cylinder and piston are in assembly resiliently mounted in said one end wall operable to prevent said sealing means from seating against said one end

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wall until said piston moves into a variable predetermined axial position with respect to said one end wall.

4. A cylinder having opposed end walls, a piston mounted for axial reciprocation in said cylinder between said end walls, sealing means resiliently supported on said piston operable to restrict air flow from one end of said cylinder on being seated against one end wall of said cylinder at said one end thereof to provide an air cushion for said piston, abutment means resiliently mounted in said one end wall operable to prevent said sealing means from seating against said one end wall until said piston moves into a variable predetermined axial position with respect to said end wall, and means for adjusting said abutment means from the exterior of said cylinder while the cylinder and piston are in assembly to determine the variable predetermined axial position.

5. Structure as claimed in claim 4 wherein said sealing means comprises an annular sealing disc and the resilient support therefor comprises a helical conical spring secured at one end to said piston and at the other end to said sealing disc to support the sealing disc in axial spaced relation with respect to said piston.

6. Structure as claimed in claim 4 wherein said abutment means comprises a shaft extending axially through said one end wall into said cylinder, resilient means positioned within said end wall in contact with said shaft for biasing said shaft into said cylinder and an adjustable plug mounted in said end wall in contact with said resilient means for regulating said bias.

7. Structure as claimed in claim 4 wherein said abutment means comprises an axial passage extending through said one end wall, the inner end of said passage being offset radially inwardly to provide an annular locating abutment therein, a shaft extending axially through said passage and into said cylinder, said shaft including a radial projection thereon adapted to seat against said locating abutment to retain said shaft within said passage, resilient means within said passage operable to bias said projection against said abutment, and a plug threadedly received in the outer end of said passage in contact with said resilient means and adjustable to vary the bias applied to said shaft by said resilient means.

8. A cylinder having opposed end walls, a piston mounted for axial reciprocation in said cylinder between said end walls, separate sealing means resiliently supported on each end of said piston operable to restrict air flow from said cylinder on being seated against the cylinder end wall adjacent thereto to provide an air cushion for said piston, and abutment means resiliently mounted in said end walls operable to prevent said sealing means from seating against said end walls until said piston moves into externally adjustable variable predetermined axial positions with respect to said end walls.

9. Structure as claimed in claim 8 wherein air passages for said cylinder are located in said end walls centrally thereof and one of said separate sealing means is a disc supported on the end of said piston in spaced relation thereto by a conical helical spring.

10. Structure as claimed in claim 8 wherein air passages for said cylinder are located in said end walls centrally thereof and one of said separate sealing means is an annular disc surrounding the piston shaft and supported concentric with said shaft in spaced relation to said piston by a conical helical spring, and wherein a seal is provided between said shaft and disc.

11. A cylinder having opposed end walls, a piston mounted for axial reciprocation in said cylinder between said end walls, sealing means resiliently supported on said piston operable to restrict air flow from one end of said cylinder on being seated against one end wall of said cylinder at said one end thereof to provide an air cushion for said piston, and abutment means resiliently mounted in said one end wall operable to prevent said sealing means from seating against said one end wall until said piston moves into a variable predetermined axial position with

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respect to said end wall, said abutment means including an axial passage extending through said one end wall, an axial shaft slidably received in said axial passage adapted to extend into said cylinder, said shaft having a transverse opening therethrough, a transverse passage extending through said one end wall intersecting said axial passage, a sleeve having a radially inwardly extending flange at the inner end thereof received in said transverse passage, a transverse shaft having an enlarged head adapted to abut against said flange extending through and pivotal about the inner end of said sleeve, said transverse shaft extending into said transverse opening in said axial shaft, resilient means in said sleeve operable to bias said transverse shaft against pivotal movement about said enlarged head thereof, and adjustable cap means secured to the outer end of said sleeve in contact with said resilient means for adjusting said bias.

12. A cylinder having opposed end walls, a piston mounted for axial reciprocation in said cylinder between said end walls, sealing means resiliently supported on said

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piston operable to restrict flow from one end of said cylinder on being seated against one end wall of said cylinder at said one end thereof to provide a cushion for said piston, abutment means resiliently mounted in said one end wall engageable with said piston to prevent said sealing means from seating against said one end wall until said piston moves into a predetermined axial position with respect to said one end wall and means for adjusting the resilient mounting of the abutment to vary the predetermined axial position.

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