Oct. 4, 1955 J. R. ELDER 2,719,510

CUSHION CONSTRUCTION FOR AIR CYLINDERS

Filed July 21, 1951 2 Sheets-Sheet 1

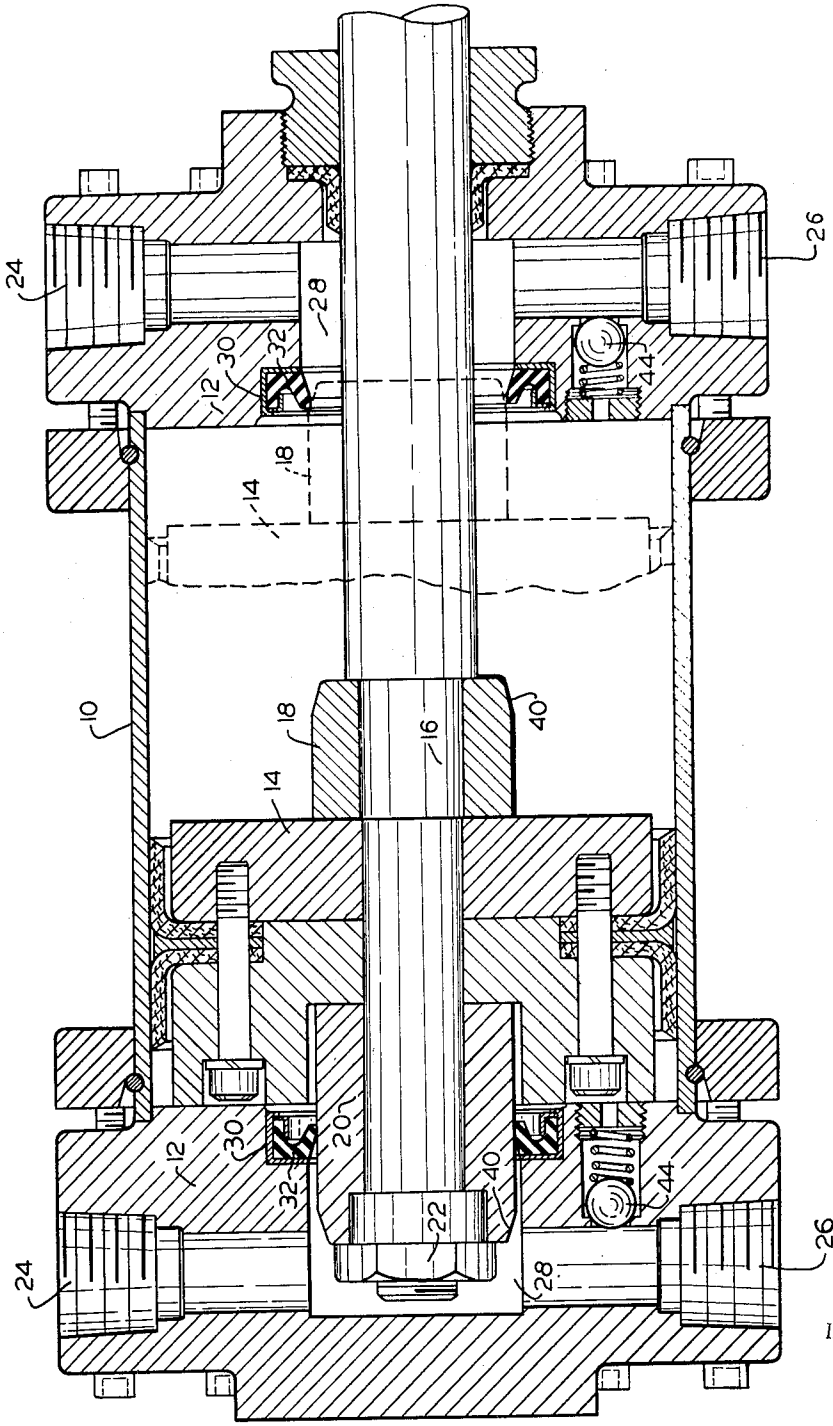

FIG I

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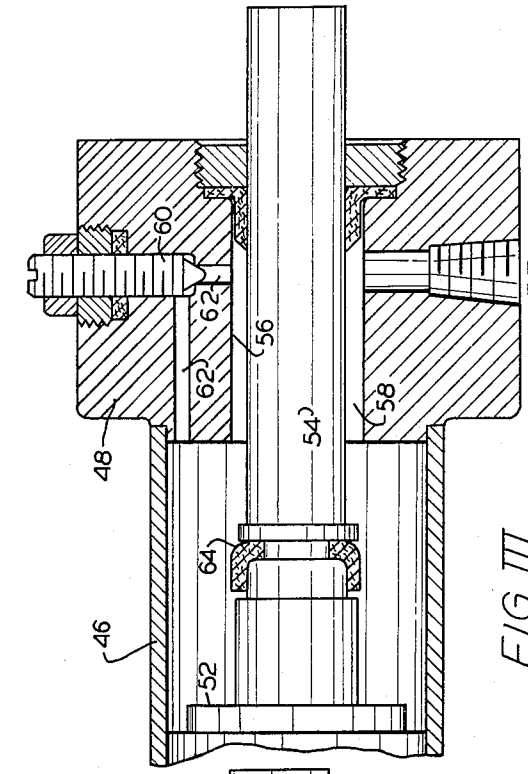

FIG. III

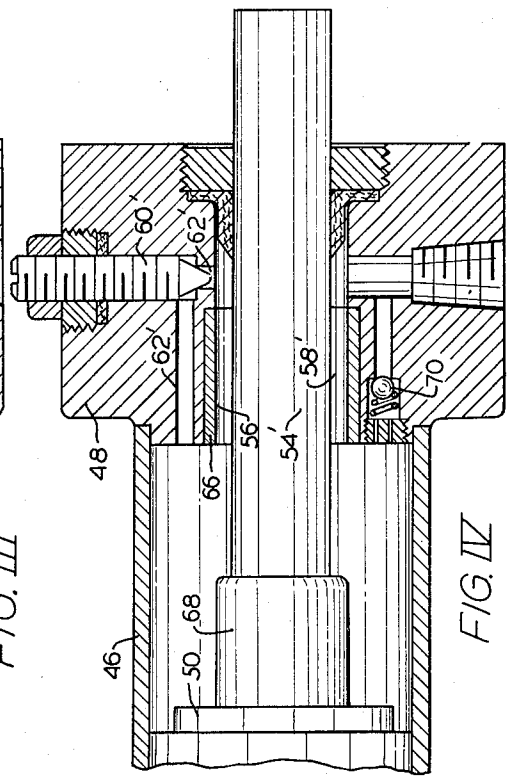

FIG. IV

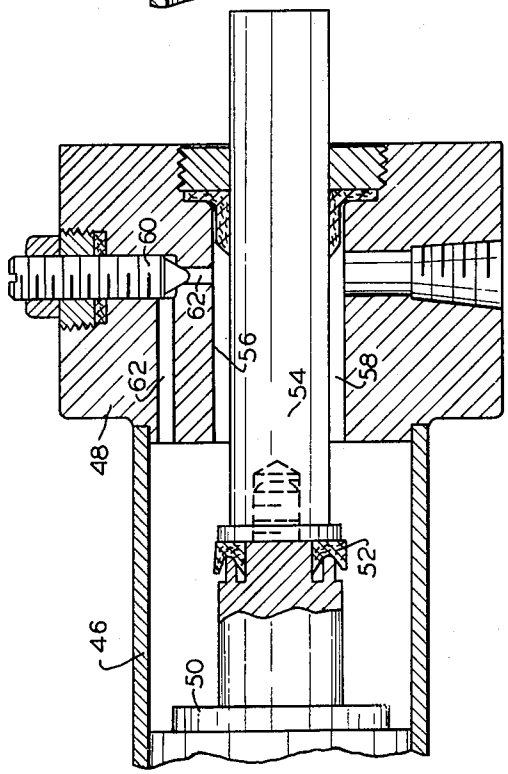

FIG. II

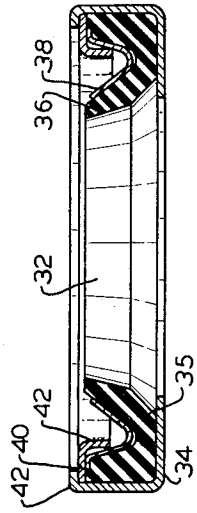

FIG. V

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CUSHION CONSTRUCTION FOR AIR CYLINDERS

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2 Claims. (Cl. 121—38)

The present invention relates to improvements in construction for cushioning the movement of reciprocated pistons actuated by elastic fluid such as air.

As a reciprocated piston approaches the end of its stroke within its cylinder it is often desirable to arrest the movement of the piston with a cushioning action. Coil springs have been employed within the cylinder for such a purpose. It has also been proposed heretofore to employ structure movable with the piston which would restrict the flow of air moving ahead of the piston as it approached the end of its travel to build up an air cushion. The present invention is an improvement over this latter type of structure.

It is an object of the invention to provide piston cushioning structure which avoids the necessity of close manufacturing tolerances as to the relative diameter of telescoping parts as well as the degree of concentricity that is maintained between the parts making up the assembly.

Another object is to provide an improved steel for producing an air cushion ahead of a piston as it approaches the end of its stroke.

Another object of the invention is to provide a structure of the type described in which means are provided for reducing the energy required to move the piston in the opposite direction following the cushioning action.

These and other objects and advantages residing in the specific construction, arrangement and combination of parts will more fully appear from a consideration of the following specification and the appended claims.

In the drawings, wherein several forms of the invention are illustrated:

Fig. I is a vertical cross-sectional view through a cylinder embodying the principles of the present invention in one of its forms,

Fig. II is a fragmentary cross-sectional view through a cylinder assembly illustrating another form of the invention,

Fig. III is a view similar to Fig. II showing a slightly different form of sealing structure from that illustrated in Fig. II,

Fig. IV is a view similar to Fig. II of another form of the invention, and

Fig. V is an enlarged cross-sectional view of the sealing member employed in the assembly of Fig. I.

In the form of the invention of Fig. I, the air cylinder **10** has heads **12** attached at opposite ends in any suitable manner. The piston **14** is supported for reciprocation in the cylinder **10** and actuates the piston rod **16** connected thereto. On opposite sides of the piston **14** are cylindrical sealing plugs **18** and **20**. A nut **22** holds the plugs **18** and **20** and piston **14** assembled on the rod **16**.

To alternately direct air under pressure against opposite sides of the piston **14** any suitable conduit (not shown) connects the inlet ports **24** and the exhaust ports **26** through a suitable four-way valve, or other suitable structure (not shown) with a source of air pressure and the atmosphere. Central ports **28** in the heads **12** are counterbored at **30** to receive sealing rings **32** with a press

fit. As more clearly shown in Fig. V, the sealing rings **32** comprise an annular metal casing **34**, an annular sealing member **35** and an annular retainer ring **40** which holds the parts assembled through the inturned flange **42**.

The sealing member **35** is preferably of rubber-like material, either natural or synthetic, with a thin lip **36** being readily deformable yet substantially reinforced by the comb spring **38**. In practice, it has been found that the sealing rings **32** taken the form and construction of a well known commercial oil seal ring sold under the trade name "Garlock Klozure."

The nose end of the sealing plugs **18** and **20** are preferably slightly tapered at **40** to assist in leading the plugs **18** and **20** into the lips **36** of the sealing rings **32** as the piston approaches the end of its stroke, as shown in dotted outline in Fig. I. With this arrangement a reasonable amount of excentricity may exist between the cylinder **10**, piston **14**, plugs **18** and **20** and counterbores **30** without detrimental effect upon the sealing engagement between the plugs **18** and **20** and the rings **32**. This is for the reason that the lips **36** are are capable of a limited amount of transverse adjustment in order to receive the plugs **18** and **20** if necessary because of lack of concentricity of the assembled parts.

When air pressure is fitted to the left hand head of Fig. I, the check ball valve **44** is forced from its seat. At the same time some air may flow between the plug **20** and the lips **36** of the sealing member **32**. Air thus directed into the cylinder **10** against the left end of the piston **14** will move the same to the right withdrawing the plug **20** from its telescoping relationship with the sealing member **32**. When this takes place the air may flow, without restriction, into the cylinder **10** through the port **28**.

As the right end of the piston **14** approaches the end of its stroke, when in the dotted line position shown in Fig. I, a seal is established between the sealing member **32** and the plug **18**. This interrupts the exhausting of air ahead of the piston **14** through the port **28** and the pressure of the air trapped is increased to urge the lip **36** into firm sealing relationship with the plug **18** due to the inclined area of the lip which is subjected to the pressure. In this manner an air cushion is provided between one end of the piston **14** and the head **12**. When the piston **14** is moved from right to left in the cylinder **10**, the plug **20** telescopes with the sealing member **32** to provide an air cushion at the opposite end of the piston in the manner just described with reference to the plug **18**.

Another form of the invention is shown in Fig. II wherein the cylinder **46**, head **48** and piston **50** assembly has a flexible annular sealing member **52** carried on the piston rod **54**. Air is admitted and exhausted from the cylinder **46** through the major portion of the movement of the piston **50** through the port **56**. However, as the piston **50** approaches the end of its stroke, the sealing member **52** enters the port **56** and plugs the annular clearance **58** around the rod **54** to provide an air cushion between the right-hand end of the piston **50** as viewed in Fig. II and the head **48**. A needle valve **60**, or other suitable valve structure, is shown regulating the flow of air in the passage **62** to regulate the air cushion. From the cross-section of the flexible sealing member **52** it will be appreciated that it will seal against air pressure from the cylinder side only. When air pressure is directed into the cylinder **46** to move the piston **50** to the left, as viewed in Fig. II, the air will flow through the port **56** past the sealing member **52**. A regulated amount of air will also flow past the valve **60**. After the piston **50** has sufficiently moved to the left to withdraw the member **52** from the port **56**, the air flow in the cylinder **46** is thereafter substantially unrestricted and is through the port **56**.

Fig. III shows the arrangement of Fig. II with a slightly

different form of flexible sealing member 64. Otherwise, the structure is the same as disclosed in Fig. II.

In Fig. IV is shown a modified form of structure which is similar in most respects to that form of Fig. II (corresponding parts being designated by similar prime reference characters) but which requires a greater degree of concentricity of associated parts in its manufacture. As shown, the port 56' is provided with a press fitted annular liner 66 with which the cylinder plug portion 68 telescopes with a relatively close fit as the piston approaches the end of the stroke to provide the cylinder. Being non-flexible, the plug 68 seals the port 56' with the same effectiveness regardless of the direction of the air pressure. For this reason, a check valve 50 may be provided to direct air pressure into the cylinder 46' to move the piston 50' to the left until the plug 68 clears the port 56' and the entering air may thereafter flow substantially unrestricted through the annular clearance 58'.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent is:

1. A piston and cylinder assembly having an air cushion comprising a cylinder, a piston disposed in said cylinder for reciprocation by differential air pressure upon opposite sides of said piston, a head closing one end of said cylinder, a combination air inlet and air exhaust port defined in said head and located therein substantially concentric with said cylinder for exhausting air moving ahead of said piston upon its initial movement toward said head and for the inlet of air into said cylinder upon movement from said head, a cylindrical portion substantially concentric with said piston and cylinder and carried by said piston and disposed to the side of said piston adjacent said head, said cylindrical portion being of substantially lesser axial extent than the stroke of said piston and telescoping with said port as said piston approaches the end of its stroke, an annular sealing member for said port mounted on said head substantially concentric to said port and having a thin flexible lip portion for engaging with said cylindrical portion with a sliding seal to provide an air cushion between said piston and said head as said piston approaches the end of its stroke, the flexible construction of said lip portion providing for lateral adjustment of said lip portion with respect to said cylindrical portion to compensate for any slight eccentricity that might exist between the telescoping cylindrical portion and port, said flexible lip portion extending toward said piston so as to be urged into sealing relationship with said cylindrical portion, said flexible lip portion upon movement of said piston from said head being radially displaced from its sealing engagement with said cylindrical portion by the air entering said port.

2. A piston and cylinder assembly having an air cushion comprising a cylinder, a piston disposed in said cylinder for reciprocation by differential air pressure upon opposite sides of said piston, a head element closing one end of said cylinder, a combination air inlet and air exhaust port defined in said head element and located therein substantially concentric with said cylinder for exhausting air moving ahead of said piston upon its initial movement toward said head element and for the inlet of air into said cylinder upon movement from said head element, a cylindrical element substantially concentric with said piston and cylinder and carried by said piston and disposed to the side of said piston adjacent said head element, said cylindrical element being of substantially lesser axial extent than the stroke of said piston and telescoping into said port as said piston approaches the end of its stroke, an annular sealing member for said port mounted on one of said elements substantially concentric to said port and having a thin flexible lip portion for engaging with said other element with a sliding seal to provide an air cushion between said piston and said head element as said piston approaches the end of its stroke, the flexible construction of said lip portion providing for lateral adjustment of said lip portion with respect to said other element to compensate for any slight eccentricity that might exist between the telescoping cylindrical element and port, said flexible lip portion extending toward said piston so as to be urged into sealing relationship with said other element, said flexible lip portion upon movement of said piston from said head element being radially displaced from its sealing engagement with said other element by the air entering said port.

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