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HYDRAULICALLY DAMPED AIR CYLINDER

Filed Dec. 15, 1965

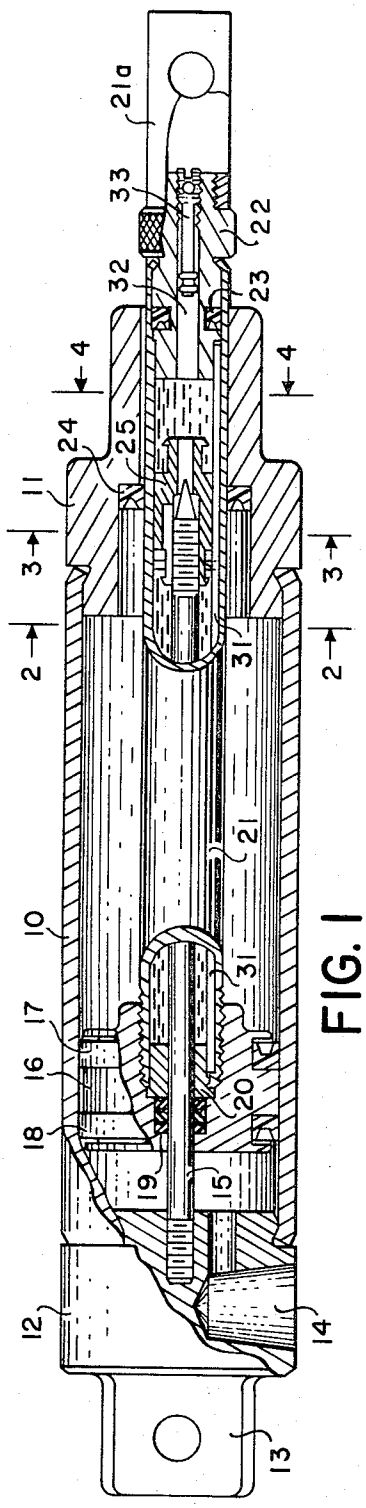


FIG. 1

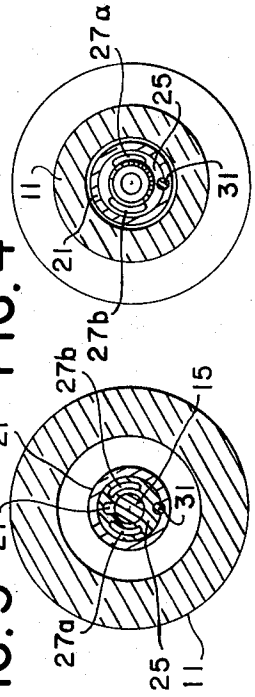


FIG. 4

FIG. 3

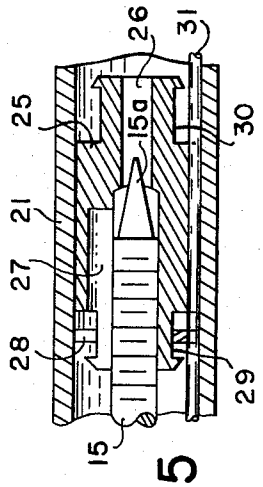


FIG. 5

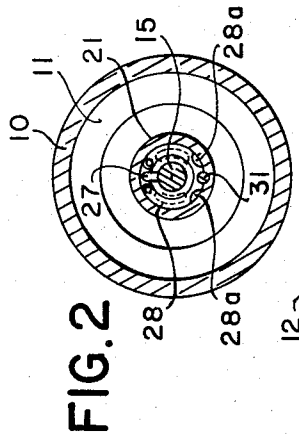


FIG. 2

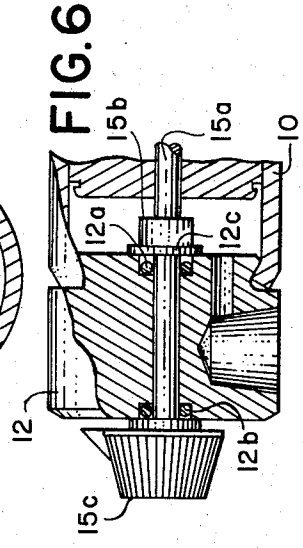


FIG. 6

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HYDRAULICALLY DAMPED AIR CYLINDER

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ABSTRACT OF THE DISCLOSURE

An hydraulically damped air cylinder provided with a main cylinder having a main piston slidable therein, the main piston being attached to a hollow piston rod which extends out of one end of the main cylinder. The hollow piston rod also functions as a cylinder and is provided with a hydraulic piston which is threaded on one end of a check piston rod, the other end of which is fixedly attached to the other end of the main cylinder. The end of said check piston rod in the hydraulic piston forms a needle valve with surfaces in said hydraulic piston. The inside of the hollow piston rod is provided with a member which slidably engages a recess in the hydraulic piston to prevent the hydraulic piston from turning with respect to the hollow piston rod so that the hydraulic piston may be shifted with respect to the check piston rod by turning the hollow piston rod with respect to the main cylinder, whereby the opening through the needle valve may be adjusted. The hydraulic piston is also provided with passageways therethrough which are adapted to be controlled by movable split washers mounted on one or both ends of the hydraulic piston.

This invention relates to hydraulically checked or damped air cylinders, hereinafter referred to as hydraulic air cylinders.

An object of this invention is to provide an improved hydraulic air cylinder of compact construction in which the hydraulic check cylinder is positioned inside of the main cylinder of the device and is concentric therewith.

Another object of this invention is to provide an improved hydraulic air cylinder which may be economically and efficiently manufactured.

Another object of this invention is to provide an improved hydraulic air cylinder in which adjustments such as stroke speed and reversible rapid return are made inside of the hydraulic check piston, thereby providing a device which may be efficiently and economically manufactured, even when the device is provided with a long, slender air cylinder.

Still another object of this invention is to provide an improved hydraulic air cylinder which has high structural strength for a given diameter of the air piston and hydraulic check piston rod provided thereto.

A further object of this invention is to provide an improved hydraulic air cylinder with short fluid flow passages to increase the hydraulic fluid flow therein so that the device may be used for rapid stroking in one or both directions.

Another object of this invention is to provide an improved hydraulic air cylinder, in which the stroke speed adjustment may be made by rotation of the air piston rod relative to the air piston body, or by rotation of a needle valve extending into the hydraulic check piston.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawing, in which, briefly:

FIG. 1 is a side view of an embodiment of this invention partially in section;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is a detail sectional view of the needle valve employed in this device; and

FIG. 6 is a fragmentary view of a modified arrangement for adjusting the needle valve.

Referring to the drawing in detail, reference numeral **10** designates the air cylinder, the ends of which are crimped into suitable grooves formed in the end members **11** and **12** so that this cylinder is sealed to these end members and an air chamber is provided inside thereof. The end member **12** is provided with an extension **13** which is adapted to be attached to the apparatus with which this device is to be employed. End member **12** is also provided with an opening **14** which leads to the space inside of the cylinder **10** and this opening is adapted to be connected to a source of compressed air provided for actuating the device.

One end of the check piston rod **15** is threaded into the end member **12**, and this rod is cemented with "Loctite" or otherwise firmly fastened or positioned in the end member **12** so that it cannot rotate after assembly thereof with respect to this end member. The rod **15** extends through the main or air piston **16** which is slidable in the cylinder **10** and which is also slidable on this rod. The piston **16** is provided with two gaskets **17** and **18** around the outside thereof, positioned in suitable grooves formed in the piston so that these gaskets form seals between the piston and the inside of the cylinder **10**. Additional gaskets **19** are provided in the piston **16** around the rod **15**. These gaskets **19** are held in position by a member **20** which is pressed thereagainst by the hollow piston rod **21**, one end of which is threaded into the piston **16**.

Hydraulic fluid is provided inside of the hollow piston rod **21** and this fluid is prevented from escaping along the rod **15** by the gaskets **19**. The hollow piston rod **21** extends out of the cylinder through the end member **11**. The end cap **22** is provided to the outer end of the hollow piston rod **21** and this outer end is crimped into a suitable groove formed in the member **22** whereby the hollow rod is sealed to this cap member. A gasket **23** is provided in a groove formed around the cap member **22** to provide a seal between the hollow piston rod and the cap member. Another gasket **24** is positioned in a recess formed in the end member **11** and this gasket forms a seal with the hollow piston rod **21** which is slidable through this gasket.

The hydraulic piston **25** is threaded to the free end of the piston rod **15** which is provided with a pointed section **15***a* at this end. The piston **25** is provided with an internal passage **26–27** and the pointed end **15***a* of the rod **15** is adapted to extend partly into the passage **26** to form a needle valve therewith. The opening of this needle valve depends upon how far the pointed end **15***a* extends into the passageway **26**. The opening between the pointed

end 15*a* and the passage 26 may be adjusted by rotating the cap member 22 and the hollow piston rod 21 with respect to the rod 15 so that the piston 25 is moved the desired distance on the rod 15. It will be noted that a small guide rod 31 is attached inside and fixedly positioned in the hollow piston rod 21 between the members 20 and 22. The rod 31 is positioned in a shallow groove formed inside of the hollow piston rod 21 so that it projects partially out of said groove and the piston 25 is provided with a groove or recess for slidably receiving the rod 31. Thus, it is apparent that when the hollow piston rod 21 is rotated, the piston 25 inside thereof is also rotated and in this way this piston may be moved on the threads provided to the free end of the rod 15 so that the opening of the needle valve 15*a* may be adjusted.

The end portions of the piston 25 are provided with grooves 29 and 30 for loosely receiving split check valve washers such as the washer 28 positioned in groove 29. Such washers may be positioned in one or both of the grooves 29 and 30, depending upon the operation desired, as will be explained hereinafter. The piston 25 is provided with passages 27*a* and 27*b* which extend therethrough from groove 29 to groove 30, parallel to the axis of the piston. The washer 28 is provided with a recess for accommodating the rod 31 so that this washer cannot be rotated with respect to the piston 25. Thus, the opening or split in the washer is always aligned with the upper opening to the passage 27 shown in FIG. 2 so that hydraulic fluid may flow through this opening and pass the needle valve 15*a* into passage 26, or vice-versa from the cavity in hollow piston rod 21 on one side of the piston 25 to the cavity on the other side when the piston 16 and rod 21 are shifted in the cylinder.

With a split washer 28 positioned in the groove 29, all three passages 27, 27*a* and 27*b*, shown in FIG. 3, are open when the piston 16 is being moved to the left so that relatively rapid movement of the piston 16 is permitted in this direction. On the other hand, when the piston 16 is being moved to the right, the check valve washer 28 is pressed against the left hand ends of passages 27*a* and 27*b* and only the passage 27 remains open so that hydraulic fluid from the left hand side of piston 25 may be transferred relatively slowly to the right hand side thereof only through opening 27 and, accordingly, motion of piston 16 in this direction is much slower. If it is desired to reverse this action, then the check valve washer 28 may be removed from groove 29 and placed in groove 30. This is readily accomplished since split washer 28 is in the form of a snap ring. With the check valve washer 28 in groove 30 the passages 27*a* and 27*b* are closed when the piston 16 is moved to the left. Thus, the only opening left for the hydraulic fluid to be transferred from the right hand side of piston 25 to the left hand side thereof is by way of the needle valve 15*a* and movement of piston 16 in the left direction is slowed down, since it is controlled by the opening of the needle valve. On the other hand, movement of the piston 16 in the opposite or right direction is at a more rapid rate since the washer 28 is moved away from openings to the passages 27*a* and 27*b* at this time and fluid can pass from the left hand side of piston 25 to the right hand side through these openings as well as pass the needle valve 15*a*. If it is desired, washers 28 may be placed in both grooves 29 and 30 and motion of piston 16 in either direction may thus be dependent on the opening through the needle valve 15*a*.

Hydraulic fluid is placed into the hollow piston rod 21 through the opening 32 in the cap 22. For this purpose, the filler plug 33, which is threaded into the cap member 22 is removed, and the hydraulic fluid is then forced into the hollow piston rod until it is full. The rod 33 is provided with suitable gaskets on the inner end thereof to seal the hole 32. This arrangement makes it possible to force the air out of the hydraulic fluid past the gaskets when the plug 33 is threaded back into the hole to seal the cavity.

A modified arrangement for adjusting the needle valve 15*a* in the hydraulic piston 25 is shown in FIG. 6. In this modification the rod 15 is provided with an extension 15*a* which extends out of the end plug 12. A knob 15*c* is provided on the outer end of this extension for rotating this rod manually from the outside of the device. The end member 12 is also provided with the extension 13 such as shown in FIG. 1 so that the device may be attached to the apparatus with which it is to be employed. Suitable O-rings 12*a* and 12*b* may be provided around the extension 15*a* to seal the rod to the end member 12, and thereby prevent fluid leakage around the rod from the internal cavity of the device. A retaining shoulder 15*b* and washer 12*c* are provided around the rod 15*a* to retain the rod against axial movement. The needle valve 15*a* may be adjusted by rotating the knob 15*c* whereby the piston 25, which is fixed against rotation, is shifted on the threads of rod 15.

While I have shown a preferred embodiment of the invention, it will be understood that the invention is capable of variation and modification from the form shown so that its scope should be limited only by the scope of the claims appended hereto.

What I claim is:

1. In a hydraulically damped air cylinder, the combination of a hollow cylindrical member having end members attached thereto, a main piston in said cylindrical member, a hollow piston rod attached to said piston, said piston rod extending out of said cylindrical member through a hole in one of said end members, hydraulic fluid confined within said hollow piston rod, a check piston rod attached to the other of said end members to prevent axial movement thereof with respect to said other end member, said check piston rod extending through said piston into said hollow piston rod, an hydraulic piston in said hollow piston rod attached to said check piston rod, said hydraulic piston remaining stationary with respect to said cylindrical member as said main piston and said hollow piston rod attached thereto are moved in said cylindrical member, needle valve means in said hydraulic piston formed by said check piston rod and said hydraulic piston, means in said hollow piston rod preventing rotation of said hydraulic piston with respect to said hollow piston rod, but permitting axial displacement thereof with respect to said hollow piston rod whereby said needle valve may be adjusted by relative rotation of said hydraulic piston and said check piston rod, said hydraulic piston having a passage therethrough connected to said needle valve for passing fluid from one side thereof to the other during said movement of said main piston.

2. In a hydraulically damped air cylinder, the combination as set forth in claim 1, further characterized in that said hydraulic piston is provided with an additional passage therethrough and a split check valve washer movably supported on one end of said hydraulic piston to close said additional passage when said main piston moves in one direction and open said additional passage when said main piston moves in the opposite direction whereby said main piston is retarded more in said one direction than in the opposite direction, said split washer also engaging said rotation-preventing means to prevent rotation thereof.

3. In a hydraulically damped air cylinder, the combination as set forth in claim 1, further characterized in that said hollow piston rod is provided with a cap at the end thereof that extends out of said one end member, said cap having a hole therethrough through which hydraulic fluid is adapted to be placed into said hollow piston rod and a plug adapted to be threaded into said hole, said plug having sealing rings thereon to seal the hydraulic fluid in said hollow piston rod, said cap having

a groove around the periphery thereof and the end of said hollow piston rod being peened into said groove.

4. In a hydraulically damped air cylinder, the combination as set forth in claim 1, further characterized in that said check piston rod is provided with an extension extending out of the cylinder body, said check piston rod acting also as a structural member to prevent axial movement of the hydraulic check piston.

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