March 10, 1970 W. C. DILG 3,499,546

HYDRAULIC CUSHION DEVICE

Filed Jan. 25, 1968 2 Sheets-Sheet 1

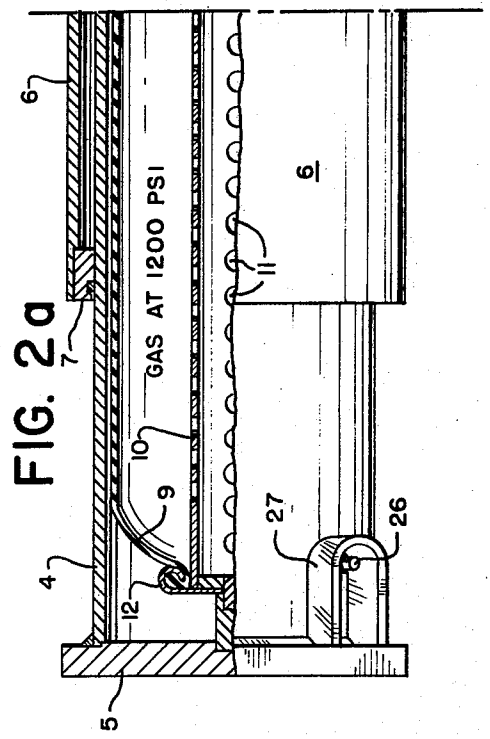


FIG. 2a

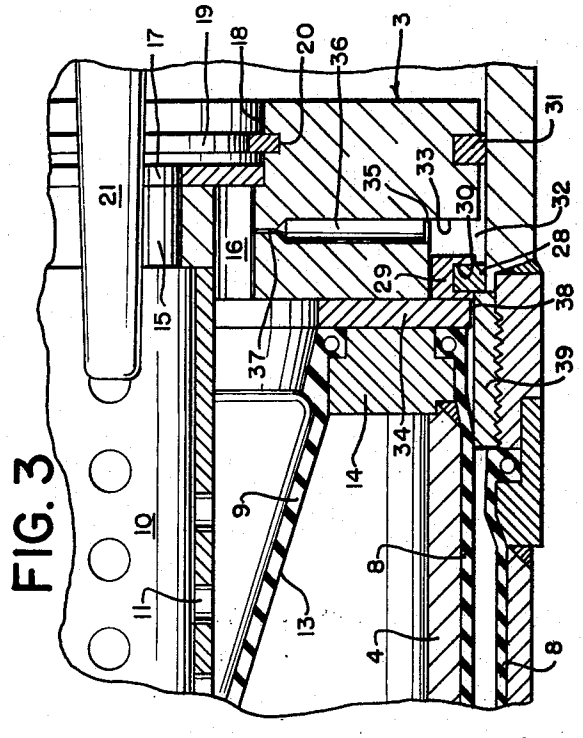


FIG. 3

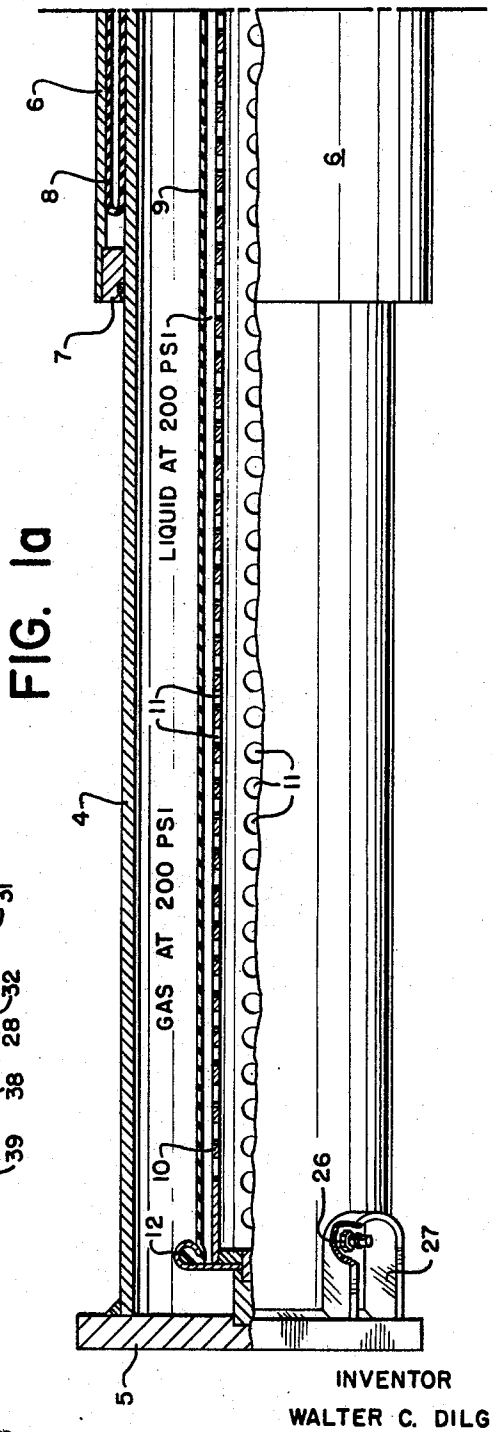


FIG. 1a

INVENTOR
WALTER C. DILG
BY Pennie, Edmonds, Morton, Taylor & Adams
ATTORNEYS

March 10, 1970 W. C. DILG 3,499,546

HYDRAULIC CUSHION DEVICE

Filed Jan. 25, 1968 2 Sheets-Sheet 2

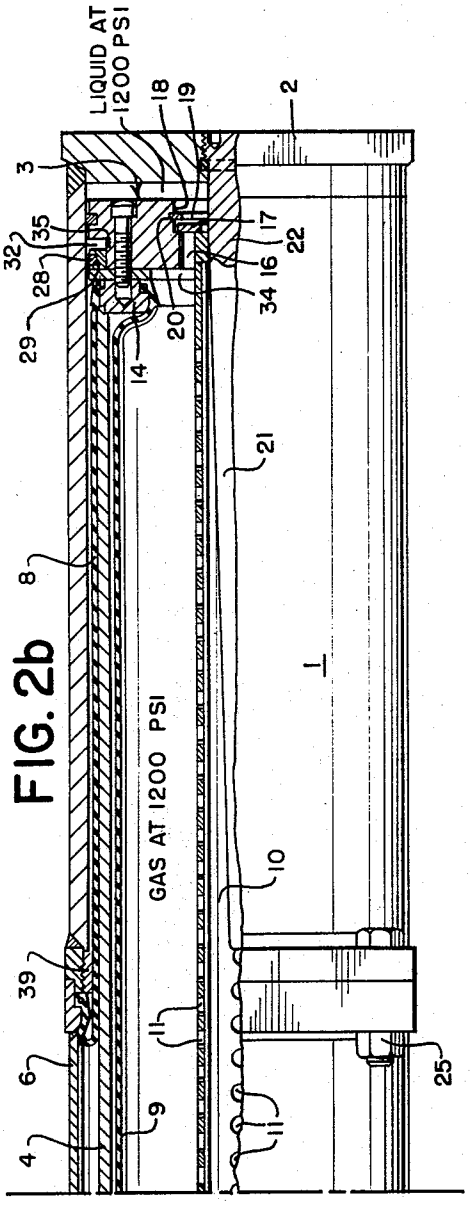


FIG. 2b

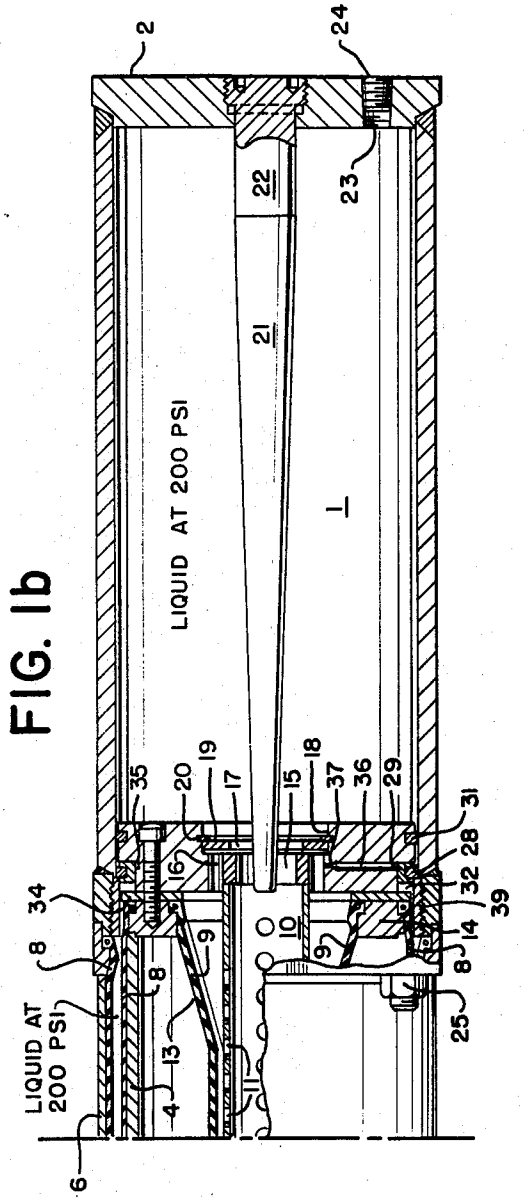


FIG. 1b

INVENTOR
WALTER C. DILG

BY Pennie, Edmonds
Morton, Taylor & Adams

ATTORNEYS

United States Patent Office

3,499,546

Patented Mar. 10, 1970

3,499,546

HYDRAULIC CUSHION DEVICE

Walter C. Dilg, Glen Ellyn, Ill., assignor to Hydra-Cushion, Incorporated, Chicago, Ill., a corporation of Maryland

Filed Jan. 25, 1968, Ser. No. 700,448

Int. Cl. B61g 11/12, 9/08, 9/16

U.S. Cl. 213—43 4 Claims

ABSTRACT OF THE DISCLOSURE

A hydraulic cushion device the principal use of which is as a part of a hydraulic draft gear for railroad car couplings or the like. The cushion device includes a hollow piston rod and piston operating in a cylinder, the cushion effect being obtained at least in part by a throttled flow of hydraulic liquid from the cylinder into the piston chamber during a compression stroke. The restoring force for the return stroke is provided by a special boot arrangement producing an air spring in combination with a rolling sleeve for sealing the interior of the device against the escape of the hydraulic liquid. A special ring construction is associated with the piston and arranged to produce a snubbing action at the end of the return stroke. A further feature is the provision in this special ring construction for maintaining the supply of hydraulic liquid in the rolling sleeve.

PRIOR ART

Patent 2,841,294, July 1958, Henrikson et al.; Patent 3,003,436, October 1961, Peterson; and Patent 3,035,827, May 1962, Peterson.

The Henrikson et al., patent relates to a hydraulic device including a piston and cylinder and having a rolling sleeve forming a seal between the two and an expansible gas bag within the chamber for hydraulic liquid. The earlier Peterson patent relates to a hydraulic cushion device including a piston and hollow piston rod containing a closed chamber operating within a cylinder in which the cushion effect is produced by throttling the flow of the liquid from the cylinder into a hollow piston rod and also by means of a compression spring. The feature of this device is exceptionally long cushion travel, 20 to 40 inches. The later Peterson patent shows a device which is generally similar to that of the inventor's earlier patent but is intended for use where an even longer cushion travel is desired, that is to say, "on the order of 30 inches, or any other desired travel."

SUMMARY OF THE INVENTION

The special diaphragm or boot construction and rolling sleeve seal is represented by a cylindrical flexible resilient boot member which surrounds a perforated tube extending lengthwise of the piston rod chamber. In normal position this boot is adjacent the surface of the tube. The piston rod chamber space outside the boot is filled with gas at a desired p.s.i. and the hydraulic liquid in the cylinder is at the same pressure. During a compression stroke the liquid flows into the boot through the tube and causes it to expand. This expansion raises the pressure of the gas, thus storing energy which is released during a return stroke and produces the restoring force required during the return stroke. The rolling sleeve forms a seal between the cylinder and piston and prevents the escape of cylinder liquid.

The snubbing action on the piston and piston rod close

to the end of a return stroke after a compression stroke is accomplished by mounting a piston seal ring not directly in a groove in the piston itself, but in a groove formed in a second ring, referred to as a floating ring because it is mounted within an extra wide groove in the piston so that the floating ring can move lengthwise of the piston within this groove. One or more radial passages extend inwardly from the bottom of such wide groove adjacent its inner end. These passages each contain a restricted portion.

These passages are at all times in communication, at least indirectly, with the interior of the cylinder so that the hydraulic liquid within the cylinder is supplied through these radial passages to the extra wide groove and thus fill the space between the inner end of the groove and the inner end of the floating ring when the ring is against the outer wall of the wide groove. During the return stroke of the piston the floating ring is in this position until the piston arrives very close to the end of the return stroke.

At that point the seal ring which is carried within the floating ring strikes a stop member on the wall of the cylinder. The continued motion of the piston forces the floating ring inwardly thus forcing the hydraulic liquid on the inner side of the ring through the radial passages having the restricted portions. This produces and applies a piston snubbing force against the stop referred to.

The extra wide groove for the floating ring is in communication with the rolling sleeve which forms the seal between the outer end of the piston and the outer end of the cylinder. The cylinder and the interior of the rolling sleeve are filled with hydraulic liquid at the desired pressure. The construction of the floating ring and its wide groove is such as to maintain the interior of the rolling sleeve filled with hydraulic liquid. This is accomplished by providing a loose fit around the interior surface of the floating ring and the cylindrical surface of the wide groove so that the liquid may flow outwardly through the radial passages referred to, thence beneath the floating ring and into the rolling sleeve through a clearance space between the outer end of the piston and the cylinder.

BRIEF DESCRIPTION OF THE VIEWS OF THE DRAWINGS

FIG. 1*a* is a view in elevation with parts broken away and shown in central vertical section of the left-hand portion of the hydraulic cushioning mechanism, the mechanism being in extended position. This figure is to be considered jointly with FIG. 1*b* the figures being joined along the dot and dash lines;

FIG. 1*b* is a view similar to FIG. 1*a* showing the right-hand portion of the hydraulic mechanism in extended position;

FIGS. 2*a* and 2*b* are similar to FIGS. 1*a* and 1*b* and correspond respectively to these figures, the parts of the hydraulic unit being shown at the end of the compression stroke, and

FIG. 3 is a fragmentary vertical central section showing parts illustrated in FIG. 1*b* but drawn to a larger scale, certain parts being in different positions.

Referring to the drawings the hydraulic cushion device comprises a cylinder **1** closed at its right end by a cylinder head **2** and within which a piston **3** is arranged to slide. Piston **3** is mounted at the inner end of a hollow piston rod **4** only slightly smaller in diameter than the inside diameter of cylinder **1** and having a plate **5** welded to its outer end so that the interior of the piston rod forms a closed chamber. The cylinder head **2** and piston plate **5** in use are secured, one to the under carriage frame of

a freight car and the other to the draft gear at one end of the car, either member to either part of the car.

FIGS. 1*a* and 1*b* show the parts in their extended or uncompressed position, piston **3** being at the extreme left end of cylinder **1** whereas FIGS. 2*a* and 2*b* show the parts at the end of a compression stroke where piston **3** has moved close to the cylinder head **2**. Such a compression stroke may be brought about for example, during a coupling operation of one car to another. After the force of the impact during coupling has subsided the piston and piston rod move on a return stroke back to the extended position of FIGS. 1*a* and 1*b*, such movement being accomplished in a manner to be described.

Cylinder **1** is provided with a cylindrical extension **6** which is approximately the same length as the cylinder. The parts have a tightly fitted joint and are held together by four bolts located at the corners of square flanges, one bolt being shown at **25**. One of the functions of extension **6** is to support a guiding ring **7** for maintaining piston rod **4** in alignment with cylinder **1**. Another function is to provide a space between extension **6** and the piston rod for a rolling sleeve **8** which is a cylindrical member, one end of which is secured to piston **3** and the other end of which is secured to the left end of cylinder **1** as shown. These connections are fluid tight so that the sleeve serves as a seal between the piston and cylinder. Extension **6** also has a function in connection with the operation of the snubbing mechanism which is mounted on piston **3** and which will be described later on.

The interior or hollow piston rod **4** is subdivided by means of a cylindrical diaphragm or boot **9** which is of flexible elastic material not unlike that of rolling sleeve **8**. Mounted at the center of hollow piston rod **4** is a rigid metal tube **10** which is supported at its right end on piston **3** and at its left end on plate **5**. Tube **10** is provided with **4** rows of perforations **11** equally spaced lengthwise of the tube. Diaphragm or boot **9** is supported at its left end by means of a member **12** to which it is secured by a fluid-tight joint. At its right end boot **9** is flared as indicated at **13** and secured in fluid-tight relation to piston **3** by means of a ring **14** which is of generally rectangular cross section and considerably larger in internal diameter than tube **10**.

Piston **3** is a metallic member having considerable thickness and formed with a central opening **15** which is surrounded by a circular series of longitudinal ports or passageways **16** extending through the piston. Cooperating with the outer ends of ports **16** is a valve ring **17** which is mounted within a circular recess **18** in the outer surface of piston **3**. Valve ring **17** moves lengthwise between its closing position against the ends of ports **16** and a snap ring **19** which is engaged in a circular recess **20** in the periphery of recess **18**.

A metering pin **21** is mounted in fixed position at the center of cylinder head **2** and extends throughout the length of the cylinder so that when the hydraulic device is in the extended position of FIGS. 1*a* and 1*b* the smaller end portion of the metering pin is within the circular opening **15**. At its right-hand end the metering pin has a cylindrical portion **22** which fits the internal diameter of the central piston opening **15** with minimum clearance when the piston is closed to the end of a compression stroke.

With the parts in the extended position of FIGS. 1*a* and 1*b*, the interior of cylinder **1** is filled with an appropriate hydraulic liquid under a suitable pressure, for example, 200 p.s.i. It is filled through a filling opening **23** in cylinder head **2** which is a threaded opening and may be closed with a conventional plug member **24**. This liquid flows from cylinder **1** through the piston central opening **15** into perforated tube **10** and fills the space within this tube and within boot **9** with liquid at the same pressure. When the apparatus is first filled the cylinder extension **6** may be removed and rolling sleeve **8** filled separately with hydraulic liquid. Extension **6** is then remounted on the end of cylinder **1**, and the pressure on this liquid is equalized with the pressure within cylinder **1** in a manner which will be hereinafter described.

The space between the outer surface of diaphragm or boot **9** is filled with a suitable gas at 200 pounds p.s.i., a valved opening **26** being provided for this purpose in the side of hollow piston **4** near its left end. This valve member is protected by a guard member **27**.

A mechanical stop member (not shown) limits the extent of movement of the piston **3** and piston rod **4** on the compression stroke during which the pressure on both the liquid and gas sections of the hydraulic device may be raised to 1200 p.s.i., for example, or even higher. Consequently when the force causing the compression stroke is relieved, for example, by the completion of a car coupling operation, the piston and piston rod are returend to the extended position of FIGS. 1*a* and 1*b* with considerable force, the pressure of the gas at 1200 p.s.i. on the exterior of boot **9** producing a rapid flow of the hydraulic liquid back into cylinder **1**. It is important therefore to provide a snubbing action on the piston rod at the time they reach the fully released position shown in these two figures. This is accomplished in the following manner:

Referring to FIG. 3 a piston seal ring **28** is mounted in a grooved shiftable or floating ring **29**, the groove in this ring being indicated at **30**. A second and conventional piston ring **31** is provided near the inner end of piston **3**. Floating ring **29** is mounted within a very wide groove **32** so that the ring may shift lengthwise of the piston, this groove having an inner wall **33** and an outer wall formed by the surface of a retainer ring **34** which is mounted between the main member piston **3** and ring **14** previously referred to.

A circular shallow groove **35** is formed on the inner surface of groove **32** adjacent wall **33**. The piston has at least one radial bore **36** which terminates at its inner end in a restricted portion **37** that communicates with one of the ports **16**. Hence hydraulic liquid can flow from cylinder **1** into the wide groove **32**.

The fit between the inner surface of floating ring **29** and the bottom of groove **32** is sufficiently loose so that when there is a difference in pressure between the liquid in cylinder **1** and the liquid in rolling sleeve **8** liquid will flow into this sleeve through bore **36**, thence between the adjacent faces of floating ring **29** and retainer ring **34**, and thence through a thin cylindrical space **38** between the periphery of ring **34** and the inner surface of a threaded sleeve member **39**. In this way the liquid can flow slowly into rolling sleeve **8** so as to keep the sleeve filled.

In the operation of the apparatus, assuming that it is in the extended position of FIGS. 1*a* and 1*b* and that it is subjected to a shock, as by the blow of another car during a coupling operation, and that this shock drives the piston **3** and piston rod **4** to fully compressed position as shown in FIGS. 2*a* and 2*b*, during this compression stroke the energy of the shock is absorbed by the throttling association of metering pin **21** with piston central opening **15**. The hydraulic liquid flows through perforated tube **10** and its perforations **11**, thereby expanding the boot **9** which compresses the gas within the hollow piston rod **4** and outside of boot **9**. The pressure of the liquid in cylinder **1** and on the interior of boot **9**, and the pressure of the gas outside of boot **9**, at the end of the compression stroke may reach 1200 p.s.i. However during the compression stroke the change in shape of rolling sleeve **8** will cause an increase in volume of the space within it or between the sleeve and the interior of cylinder **1**. Because of this increase in volume caused by the rolling sleeve the pressure decreases, and the pressure of the liquid within spaces **32–35–36** (FIGS. 2*b* and 3) becomes greater than that on the sleeve **8** side of floating ring **29**, thus causing floating ring **29** to stay in location as shown in FIG. 3 until ring **28** contacts stop **39** on the return stroke. This posi-

tion of seal ring **28** and floating seal ring **29** protects sleeve **8** from a high force of impact at the end of the compression stroke (FIG. 2*b*).

Before the start of the compression stroke the seal ring **28** and floating ring **29** are in the position shown in FIG. 1*b* with ring **29** against the inner side of its groove. As the piston starts to move on the compression stroke, because of the friction of ring **28** with the surface of cylinder **1**, these parts move to the opposite position shown in FIG. 3 leaving space for snubbing liquid at the right of ring **29**. Also at the start of the compression stroke valve ring **17** moves from the position of FIG. 1*b* and closes the ports **16**. At the end of the compression stroke which is limited by the stop on the car, and after the release of the shock energy, valve ring **17** reopens port **16** allowing the high pressure liquid to re-enter cylinder **1** through these ports. It also re-enters the cylinder through central opening **15** as soon as the cylindrical portion **22** of the metering pin moves out of this opening.

As the piston **3** approaches close to the end of the return stroke it is important to provide a snubbing action to soften the shock to which the device would otherwise be subjected. This is accomplished by seal ring **28** engaging the right end of threaded sleeve **39** which forms a stop and forces the floating ring **29** from its position of FIG. 3 to the right so that the hydraulic liquid in the snubbing space between ring **29** and the wall **33** of its groove is forced through the bore **36** and its restricted passage **37** as well as under ring **29** into sleeve **8**. The snubbing space contains a sizeable quantity of liquid and when this is forced through a small restricted opening a snubbing force is applied to the end of sleeve **39** by seal ring **38** which softens the blow against the stop sleeve **39**.

I claim:

1. A hydraulic cushion device comprising in combination, a cylinder, a piston slidable in the cylinder, a hollow piston rod slightly smaller than the inside diameter of the cylinder and forming a closed cylindrical chamber, a tubular member extending centrally from end to end of the hollow piston chamber and mounted at one end on the piston and at the other on the end wall of the piston rod chamber, a flexible resilient cylindrical boot member surrounding the tubular member, its outer end being connected by a leak-tight joint to said end wall and also having a leak-tight joint connection with the piston, said tubular member being connected at its inner end with a central liquid passage through the piston and having perforations extending in spaced relation lengthwise thereof, a metering pin mounted on the end wall of the cylinder and cooperating with said central liquid passage, the cylinder being filled with hydraulic liquid under pressure and the space within the piston rod chamber on the exterior of said boot member being filled with a gas under similar pressure, and a rolling sleeve having one end secured to the cylinder by a leak-tight joint and its opposite end to the piston on the exterior of the hollow piston rod, said sleeve serving as a seal to prevent the escape of liquid from the cylinder and the interior of said boot, the flow of hydraulic liquid from the cylinder into said boot member during a compression stroke causing the expansion of said member and the compression of the gas on the exterior thereof, and the pressure of said gas providing the restoring force causing a return stroke after the release of the force on the cushion device which caused the compression stroke.

2. In a hydraulic cushion device, a cylinder, a piston, slidable in the cylinder, a hollow piston rod forming a closed chamber the cylinder being filled with hydraulic liquid under pressure, the liquid flowing from the cylinder into the piston chamber during a compression stroke, and means for throttling the liquid during such flow thereby providing an energy absorbing cushion, the improvement in combination therewith for producing a snubbing action as the piston on its return stroke nears its fully released position which comprises a floating ring mounted in a groove in the surface of the piston, said floating ring having a groove in its outer surface for receiving a seal ring, the groove for the floating ring being wider than said floating ring and forming a chamber for snubbing liquid on the inner side of the floating ring, a restricted passageway from said chamber communicating with the interior of said cylinder, and a stop member on the cylinder close to said fully released position for stopping further movement of the floating ring to cause it to force the liquid in said snubbing chamber on the inner side of the floating ring through said restricted passageway, thus applying a piston snubbing force against said stop.

3. In a hydraulic cushion device, a cylinder, a piston slidable in the cylinder, a hollow piston rod only slightly smaller than the inside diameter of the cylinder and forming a closed chamber, the cylinder being filled with hydraulic liquid under pressure, means for throttling the liquid as it moves from the cylinder into the hollow piston during a compression stroke, a rolling sleeve serving as a seal between the open end of the cylinder and the piston, the opposite ends of said sleeve being secured respectively to the end of the cylinder and the piston, and the cylinder having an extension only slightly larger in diameter than the piston for protecting the rolling sleeve, the improvement in combination therewith for producing a snubbing action as the piston approaches close to its fully released position which comprises a floating seal ring mounted in a groove in the surface of the piston, said floating ring having a rectangular groove in its outer surface, a piston seal ring rectangular in cross section mounted within said groove, the groove for the floating seal ring being wider than said floating ring and forming a chamber for snubbing liquid on the inner side of the floating ring, at least one restricted passageway extending from said chamber in communication with the interior of said cylinder, and a stop member projecting inwardly from the surface of the cylinder near its open end for engaging said seal ring and causing the floating ring to force the liquid in said groove on the inner side of the floating seal ring through said restricted passageway, thus applying a snubbing force against said stop member.

4. In a hydraulic cushion device, a cylinder, a piston slidable in the cylinder, a hollow piston rod slightly smaller than the inside diameter of the cylinder and forming a closed cylindrical chamber, a tubular member extending centrally from end to end of the hollow piston chamber and mounted at one end on the piston and at the other on the end wall of the piston rod chamber, a flexible resilient cylindrical boot member or diaphagm surrounding the tubular member, its outer end being connected by a leak-tight joint to said end wall and also having a leak-tight joint connection with the piston, said tubular member being connected at its inner end with a central liquid passage through the piston and having perforations extending in spaced relation lengthwise thereof, a metering pin mounted on the end wall of the cylinder and cooperating with said central liquid passage, the cylinder being filled with hydraulic liquid under pressure and the space within the piston rod chamber on the exterior of said boot member being filled with a gas under similar pressure, and a rolling sleeve seal having one end secured to the cylinder by a leak-tight joint and at its opposite end to the piston on the exterior of the hollow piston rod, the flow of hydraulic liquid from the cylinder into said boot member during a compression stroke causing the expansion of said member and the compression of the gas on the exterior thereof, and the pressure of said gas providing the restoring force causing a return stroke after the release of the force which caused the compression stroke, the improvement in combination therewith for producing a snubbing action as the piston on its return stroke nears its fully released position which comprises a floating ring

mounted in a groove in the surface of the piston, said floating ring having a groove in its outer surface for receiving said seal ring, the groove for the floating ring being wider than said floating ring and forming a chamber for snubbing liquid on the inner side of the floating ring, a restricted passageway from said chamber communicating with the interior of said cylinder, and a stop member on the cylinder close to said fully released position for stopping further movement of the floating ring to cause it to force the liquid in said snubbing chamber on the inner side of the floating ring through said restricted passageway, thus applying a piston snubbing force against said stop.

References Cited

UNITED STATES PATENTS

2,841,294	7/1958	Henrikson et al.	213—43
3,175,699	3/1965	Price et al.	213—43
3,232,443	2/1966	Smith	213—8
3,334,757	8/1967	Peterson	213—8
3,378,149	4/1968	Powell	213—43
3,410,416	11/1968	Peterson	213—43

DRAYTON E. HOFFMAN, Primary Examiner

U.S. Cl. X.R.

188—88; 213—8; 267—115, 118