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 [21] Appl. No. **840,631**  
 [22] Filed **July 10, 1969**  
 [45] Patented **Apr. 13, 1971**  
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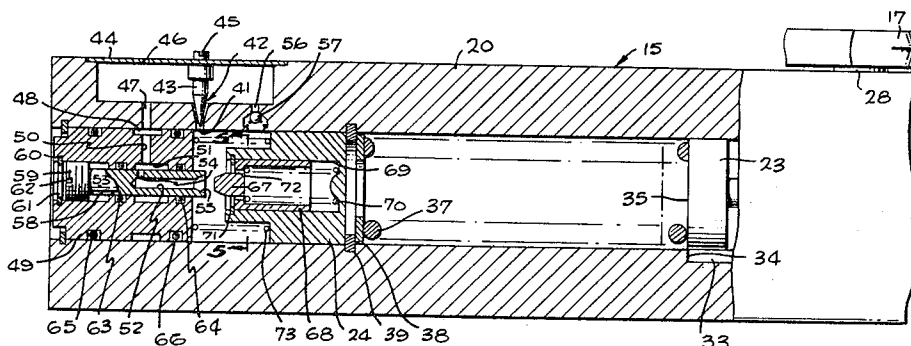
[54] **POSITION CONTROL HYDRAULIC SNUBBER**  
 9 Claims, 7 Drawing Figs.

[52] U.S. Cl. .... **16/51,**  
 16/52, 16/58, 16/62, 188/87, 188/94  
 [51] Int. Cl. .... **E05f 3/12**  
 [50] Field of Search ..... 16/51, 52,  
 56, 61, 62, 58; 188/94, 87

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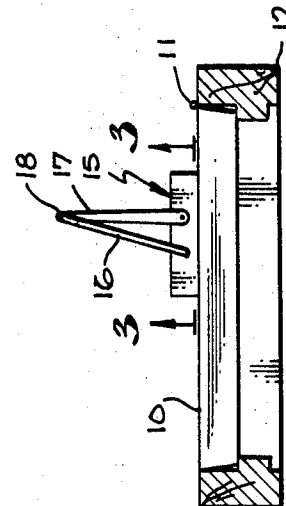
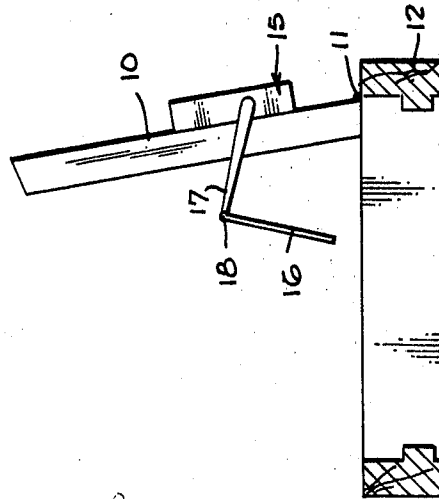
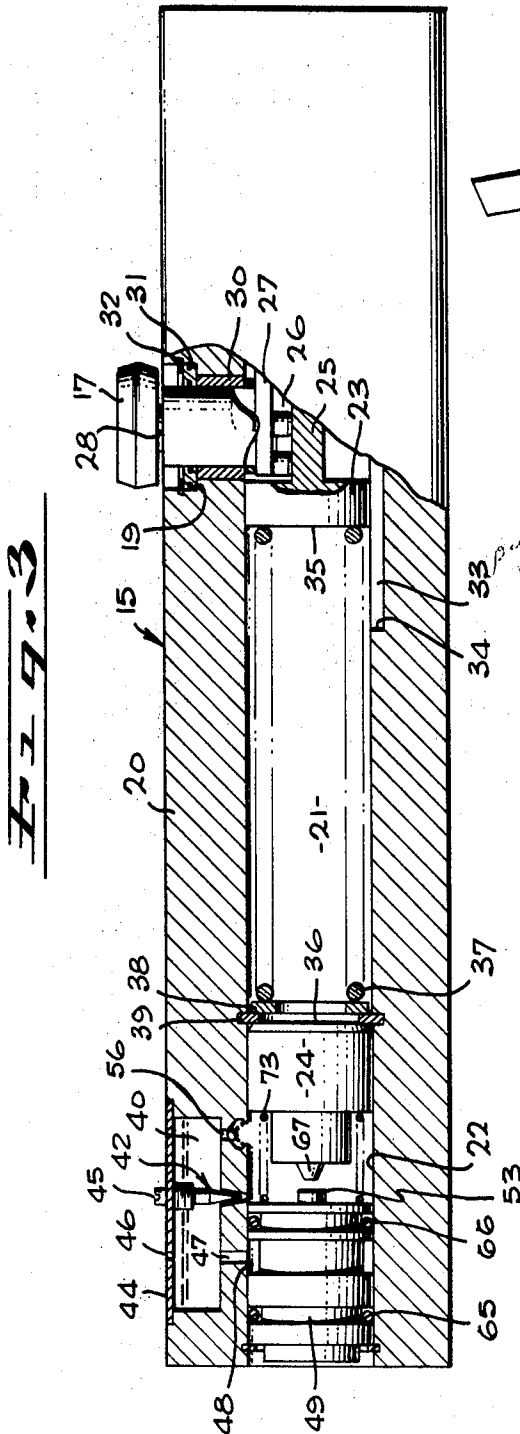
**ABSTRACT:** A hydraulic snubber for such use as a door closer in which a main piston connected to an actuator arm slides in a main chamber containing a bypass which, once passed, allows hydraulic liquid to be trapped ahead of the main piston and then actuate a control piston which is reciprocated in a control chamber. From the control chamber there are paths through which hydraulic fluid can flow to a reservoir. One path is an unrestricted passage and the other path is a restricted passage. During part of the movement cycle of the control piston, the hydraulic fluid flows freely through the unrestricted passage until a valve element carried by a separate resiliently mounted shutoff piston closes the unrestricted passage. At this point hydraulic fluid is forced through the restricted passage to the reservoir and retards movement of the control piston, which continues to move relative to the shutoff piston because of the resilient connection between them. Movement of the control piston finally stops when it bottoms against the stationary end of the control chamber. Upon the return cycle, hydraulic fluid first flows freely from the reservoir through the check valve passage to the control chamber while the shutoff valve remains closed and later, when the shutoff valve is opened, the hydraulic liquid also flows freely from the reservoir through the corresponding passage and shutoff valve seat into the control chamber.



**Patented April 13, 1971**

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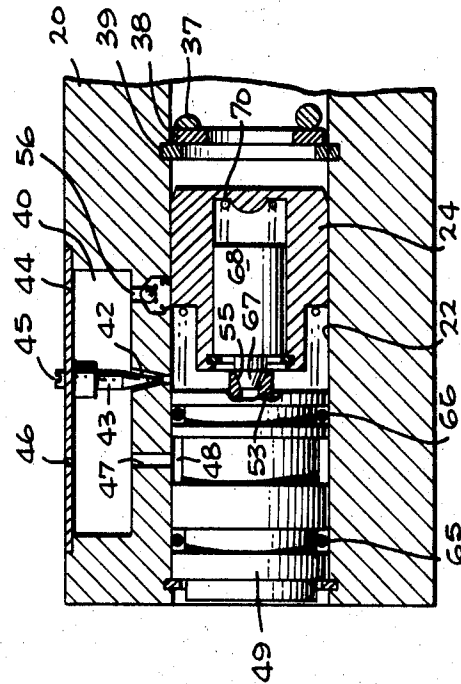
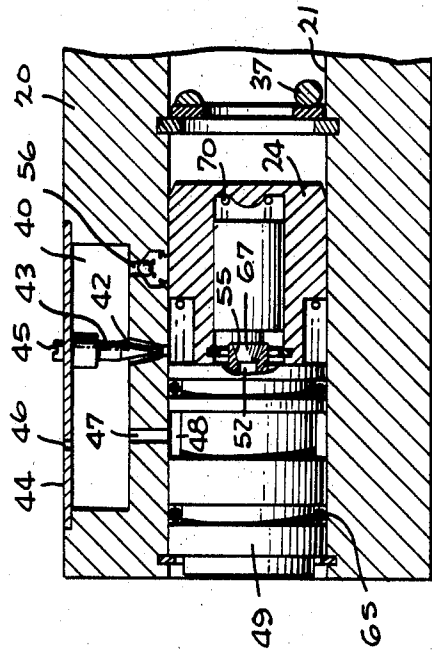
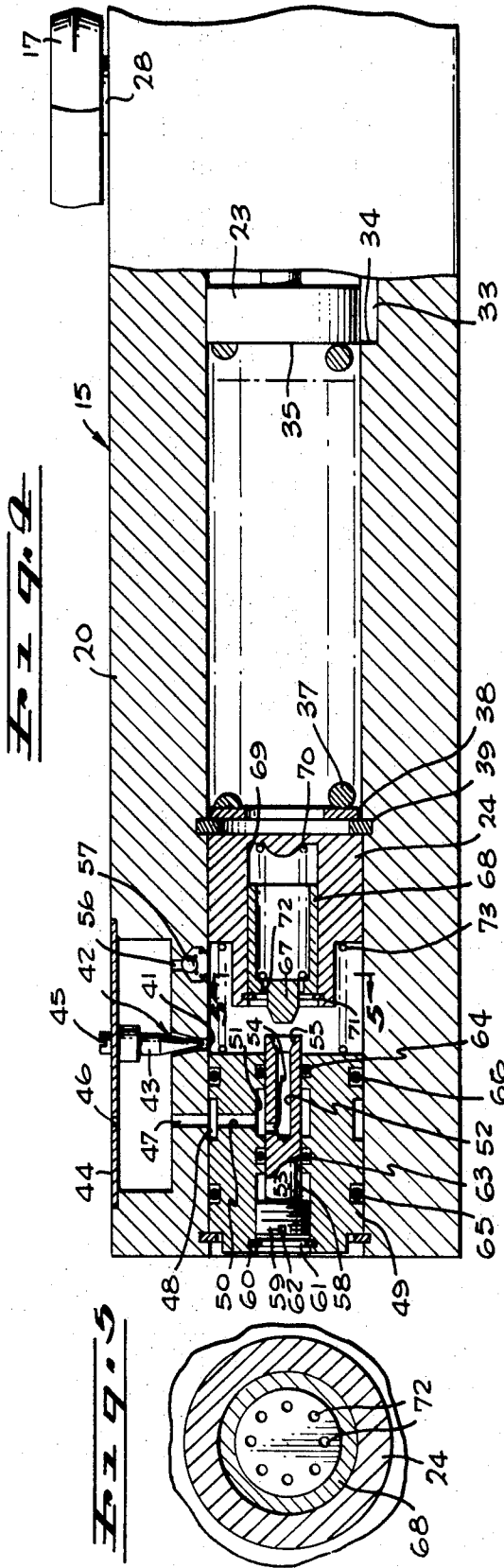


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## POSITION CONTROL HYDRAULIC SNUBBER

Pneumatic and hydraulic controls of sundry types have commonly been employed to modify the movement of a mechanical drive typified by devices used on doors to modify the swing. Doors frequently making use of such devices are those used in public buildings where there is frequent opening and closing of the door and some control is desirable to prevent the door swinging unrestrained to full open position. Another frequent use of a device of the type made reference to is on doors which are relatively heavy and where the swing of the door needs to be snubbed or restricted as it approaches full open position.

Pneumatic devices heretofore employed have experienced difficulty in proper adjustment and control partly because of the fact that the fluid employed is air which is compressible. Hence, mechanism employing a compressible gas for the operating fluid must always include mechanical agencies, sometimes complex and delicate in their adjustment, to compensate for the compressibility of the fluid. Hydraulic devices which have been contrived to meet a similar problem have been to a large degree complex to the extent that they require servicing on a schedule which is too frequent. Where such devices are used in accordance with their common purpose, namely on public buildings where the door is opened and closed innumerable times every day, devices needing frequent servicing are highly objectionable.

Further still, inasmuch as such doors vary in weight to a considerable extent and in the type of swing desired, controls which cannot be readily adjusted in the field to meet each particular need have a handicap which cannot always be tolerated. Where such controls need to be removed from the door for adjustment and then replaced, adjustment to meet an individual need becomes a constantly recurring problem.

It is therefore among the objects of the invention to provide a new and improved hydraulic snubbing device which is simple in its construction and positive in its operation in that once adjusted there is little prospect of the adjustment being disturbed through long periods of use.

Another object of the invention is to provide a new and improved hydraulic snubbing device, the operation of which can be easily and readily adjusted from the exterior without need for disassembling any parts of the device, the adjustment being made possible by use of ordinary tools such as a screwdriver.

Still another object of the invention is to provide a new and improved hydraulic snubbing device which can be compactly contained within a relatively small housing and which is comprised of parts operating in line so that the machining of the housing is a simple and inexpensive operation.

Still further among the objects of the invention is to provide a new and improved hydraulic snubbing device particularly useful as a control for the swing of a door which permits the door to swing freely throughout a portion of its opening operation and which thereafter initially slows down the swing at a predetermined rate before providing a positive stop.

With these and other objects in view, the invention consists in the construction, arrangement, and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims, and illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is a cross-sectional view through a doorway showing a door in closed or initial position with a hydraulic snubber mounted thereon.

FIG. 2 is a cross-sectional view similar to FIG. 1 but showing the door in open position.

FIG. 3 is a longitudinal sectional view through the hydraulic snubber taken on the line 3-3 of FIG. 1, showing parts in initial position.

FIG. 4 is a longitudinal sectional view similar to FIG. 3, but showing the parts in one advanced position.

FIG. 5 is a cross-sectional view on the line 5-5 of FIG. 4.

FIG. 6 is a fragmentary longitudinal sectional view showing the position of certain parts when the shutoff valve is closed.

FIG. 7 is a fragmentary longitudinal sectional view similar to FIG. 6, but showing the relative position of parts at the end of the door-opening cycle.

In an embodiment of the invention chosen for the purpose of illustration there is shown a door 10 mounted upon hinges 11 in a doorframe 12. A position-control hydraulic snubber indicated generally by the reference character 15 is shown mounted on the door 10 and provided with an arm 16 which is designed for attachment to the doorframe 12, the arm 16 being attached to the hydraulic snubber 15 through a link 17 at a joint 18. The hydraulic snubber 15 is shown in association with a door and frame by way of example, but the mechanism is such as to be capable of controlling a wide variety of actuators making use of the same principles.

More particularly, the snubber 15 is embodied in a housing 20 which contains a main chamber 21 and a control chamber 22. In the chosen embodiment the main chamber 21 and control chamber 22 are in axial alignment as is also a main piston 23 slidably mounted in the main chamber 21 and a control piston 24 slidably mounted in the control chamber 22.

The main piston 23 has attached thereto, on the right-hand side as viewed in FIG. 3, a main piston rod 25 on which is a rack 26 which cooperates with a pinion 27, nonrotatably mounted on a shaft 28 which in turn is nonrotatably attached to the link 17. The shaft 28 rotates in a bearing sleeve 30. A seal assembly 31 held in position by a snap ring 32 prevents hydraulic fluid in the main chamber 21 from escaping past the shaft 28 and bore 19 in housing 20.

Adjacent to the main piston 23 and extending for a portion of the length of the main chamber 21 is a bypass passage 33 which has an end 34 intermediate opposite ends of the main chamber 21. In the position of FIG. 3, the bypass passage 33 is open, permitting the main piston 23 to move freely until it reaches the position shown in FIG. 4, at which time the bypass passage 33 is closed and hydraulic fluid is trapped between a face 35 of the main piston 23 and a face 36 of the control piston 24. A spring 37 acting between the face 35 of the main piston 23 and a washer 38 retained by a snap ring 39 serves normally to hold the main piston 23 in the initial position shown in FIG. 3.

In the housing 20 is a reservoir 40 of hydraulic fluid from which are several paths of communication to the control chamber 22. One of the paths is a restricted passage 40 in which is mounted a flow regulating valve element 42 in the form of a needle valve having a valve stem 43 which extends upwardly through a cover 44 for the reservoir 40 so as to expose a screwdriver slot 45 by means of which the valve element 42 can be adjusted up or down to increase or decrease the restriction in the restricted passage 41. A vent hole 46 in the cover 44 allows hydraulic fluid to freely flow into and out of the reservoir 40.

A second path for hydraulic fluid between the reservoir 40 and the control chamber 22 consists of a composite passage comprising a transverse bore 47 in communication with an outer annular recess 48 in an end plug 49, a radial bore 50 and an inner annular recess 51. An axial bore 52 in a shutoff valve stem 53 communicates with the inner annular recess 51 through a hole 54. A shutoff valve seat 55 serves the axial bore 52 and provides direct access into the control chamber 22.

A third path is provided by a check valve passage 56 in which is a conventional ball check 57.

The shutoff valve stem 53 is reciprocatably mounted in an axial recess 58 in the end plug 49 where it is adapted to be advanced and withdrawn by threads 59 on the shutoff valve stem 53 engaging similar threads in the plug 49. The shutoff valve stem 53 is retained from removal by employment of a snap ring 60 having an opening 61 through the middle to provide access to a screwdriver slot 62 for adjusting the position of the shutoff valve stem 53. Seals 63 and 64 surround the shutoff valve stem 53 to prevent escape of hydraulic fluid. Seals 65 and 66 extend around the end plug 49 for the same purpose.

In cooperation with the shutoff valve seat 55 is a shutoff valve element 67 carried by a shutoff piston 68. The shutoff piston 68 is reciprocatably mounted in a recess 69 in the control piston 24 and spring-urged outwardly by a spring 70 against a snap ring 71 which limits its outward movement. Holes 72 provide access of hydraulic liquid to the inside of the shutoff piston 68 so as to prevent entrapment of hydraulic liquid. A spring 73 serves normally to hold the control piston 24 against the snap ring 39 in initial position.

In operation it can be assumed that the parts are in initial position as shown in FIG. 3 which would be the position of the parts when used as a hydraulic snubber to control the opening of a door 10 as in FIGS. 1 and 2. As the door 10 is moved through an initial portion of its swing, the arm 16 and link 17 are swung at the same time which movement results in rotation of the shaft 28 and also the pinion 7, serving to extend the rack 26, thereby to move the main piston 23 from the position shown in FIG. 3 leftward to the position shown in FIG. 4. There is no restriction to movement of the main piston 23 during this portion of the cycle because hydraulic fluid in the main chamber 21 is free to flow around the main piston 23 through the bypass passage 33. Upon the main piston 23 reaching the end 34 of the bypass passage 33, flow into the bypass passage 33 is stopped and hydraulic fluid trapped between face 35 of the main piston 23 and the face 36 of the control piston 24. Continued movement from right to left of the main piston 23 then causes force to be exerted upon the control piston 24 moving it from right to left as viewed in FIGS. 3, 4, 6, and 7. When movement of the control piston 24 begins, hydraulic fluid in the control chamber 22 is free to flow through the unrestricted passageway to the reservoir 40 and also through the restricted passageway 41, the main flow being naturally through the unrestricted passageway, namely past the shutoff valve seat 55 through the axial bore 52, the hole 54 to the inner annular recess 51, then through the radial bore 50, the outer annular 48 and the transverse bore 47 into the reservoir 40.

Intermediate opposite ends of the control chamber 22 the shutoff valve element 67 seats upon the shutoff valve seat 55 thereby closing the unrestricted passage. From this point on, hydraulic fluid must flow from the control chamber 22 through the restricted passage 41 past the flow regulating valve 42. Since there is restriction to the free flow of hydraulic fluid, the rate of movement of the control piston 24 is slowed down. The control piston 24, however, continues to move relative to the shutoff valve piston 68 and at the same time to build up tension in the spring 70 which tends to hold the shutoff valve element 67 on the valve seat 55 until the left end of the control piston 24, as viewed in FIG. 7, stops or bottoms against the end plug 49. Further movement of the control piston 24 is stopped by this engagement, and in view of entrapment of hydraulic fluid between the pistons 24 and 23 movement of the main piston 23 is likewise stopped which causes movement of the door 10 to be stopped.

Upon release of the door 10, in the embodiment chosen for illustration, the springs 37 and 73 act to return respectively the main piston 23 and control piston 24 toward their initial positions. During the first portion of the return movement cycle as the space within the control chamber 22 enlarges hydraulic fluid will be drawn, partially through the restricted passageway 51, but primarily through the check valve passage 56 so that there is no restriction to return movement of the control piston 24 to initial position. During the latter portion of the return stroke, after the snap ring 71 is drawn into engagement with the shutoff piston 68, the valve element 67 is unseated from the valve seat 55 and the unrestricted passage opened to the flow of hydraulic fluid from the reservoir 40 into the control chamber 22. Further still, once the main piston 23 passes toward the right of the end 34 of the bypass passage 33 the main piston 23 can continue to move to the initial position shown in FIG. 3 after the control piston 24 is stopped in its movement by engagement with the snap ring 39.

Two adjustments are possible in the device. One is adjustment of the flow-regulating valve 42 which can be used to vary

the rate of movement allowed the control piston 24 after the shutoff valve element 67 seats upon the shutoff valve seat 55. This in turn varies the rate of movement of the door 10 through the final portion of its opening swing, in the chosen embodiment. The point at which this restricted movement becomes operative can also be changed by shifting the position of the shutoff valve stem 53 endwise toward either the right or left as viewed in FIGS. 3, 4, 6, and 7. Adjustment is possible by rotating the shutoff valve stem 53 by use of a screwdriver in the screwdriver slot 62 to either inner or outer positions, thereby either starting the restricted movement cycle earlier or later than as illustrated in FIG. 6. Both adjustments as described can be made by use of a screwdriver from the exterior of the housing 20 without there being any need for removal of any portion of the mechanism or removal of the device from its position on the door 10.

While the invention has herein been shown and described in what is conceived to be a practical and effective embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

I claim:

1. A position-control hydraulic snubber comprising a housing having a main chamber and a control chamber therein, a main piston slidably mounted in said main chamber, a control piston slidably mounted adjacent one end of said control chamber and in hydraulic communication with said main chamber and a closure structure closing the other end of said control chamber, an actuator operably connected to said main piston for moving said main piston within said main chamber, a bypass passage around said main piston having a port intermediate opposite ends of said main chamber adapted to be closed by movement of said main piston to a corresponding intermediate position, a reservoir in said housing for hydraulic fluid and passage means interconnecting said reservoir with said control chamber, a shutoff stem reciprocatably mounted in said closure structure, said shutoff stem having an axial bore therethrough in communication with said control chamber, and an outwardly facing shutoff valve seat for said axial bore, said passage means comprising an unrestricted passage between said reservoir and said axial bore and a restricted passage between said reservoir and said control chamber, a shutoff piston reciprocatably mounted in said control piston and having a normally open outwardly facing shutoff valve element adapted to seat on said shutoff valve seat, and yieldable means acting between said shut-off piston and said control piston enabling movement of said control piston against fluid resistance created by said restricted passage after closure of said unrestricted passage by the seating of said shutoff valve element on said shutoff valve seat.
2. A position control hydraulic snubber as in claim 1 wherein there is an adjusting means acting between said shutoff stem and said closure structure adapted to change the location of said shutoff valve seat whereby to vary the point where said actuator commences to be subject to control by said restricted passage.
3. A position-control hydraulic snubber as in claim 2 wherein there is access means in the housing from the exterior to said shutoff stem.
4. A position control hydraulic snubber as in claim 1 wherein there is an adjustable flow regulating valve in said restricted passage.
5. A position control hydraulic snubber as in claim 4 wherein there is access means in the housing from the exterior to said flow regulating valve.
6. A position control hydraulic snubber as in claim 1 wherein said chambers and said pistons are in axial alignment.
7. A position control hydraulic snubber as in claim 1 wherein there is a check valve passage means between said reservoir and said control chamber including a check valve acting to allow flow from said reservoir to said control chamber.

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8. A position control hydraulic snubber as in claim 1 wherein there is spring means acting between said housing and respectively said control piston and said main piston for returning said pistons to initial position.

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9. A position control hydraulic snubber as in claim 1 wherein said control piston has a position bottomed on said closure structure at a forward end of its stroke whereby to stop motion of said main piston and said actuator.

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