Sept. 22, 1959 E. M. MASON 2,905,458

HYDRAULICALLY DAMPED SPRING-BIASED PISTONS AND CYLINDERS

Filed April 15, 1957 2 Sheets-Sheet 1

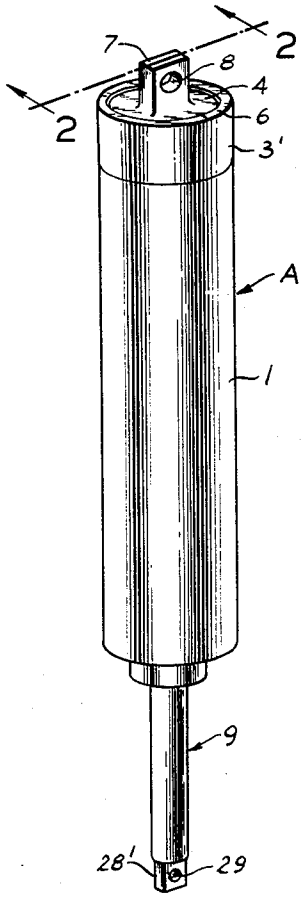


FIG. 1.

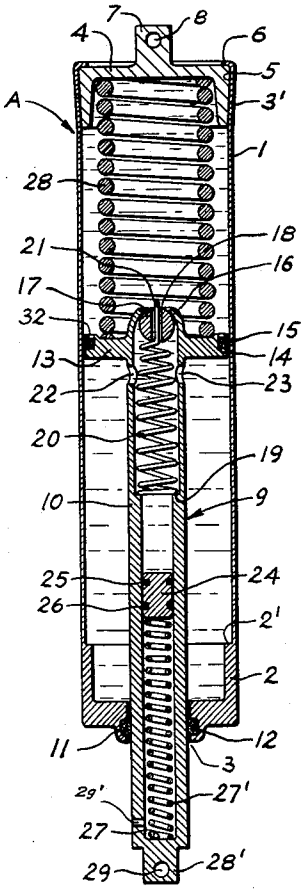


FIG. 3.

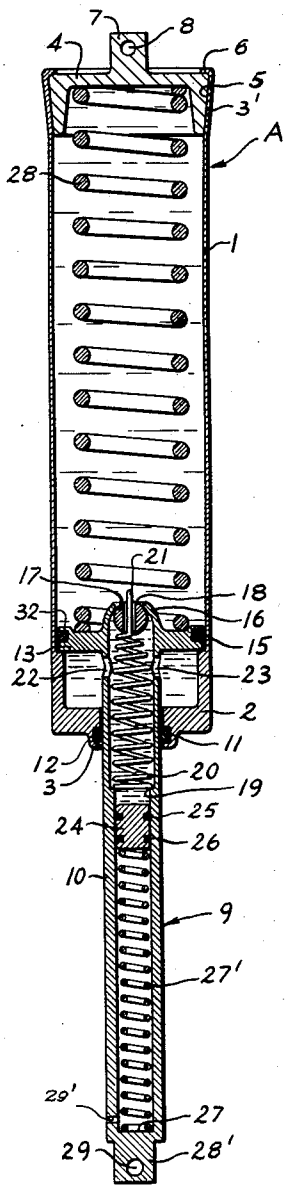


FIG. 2.

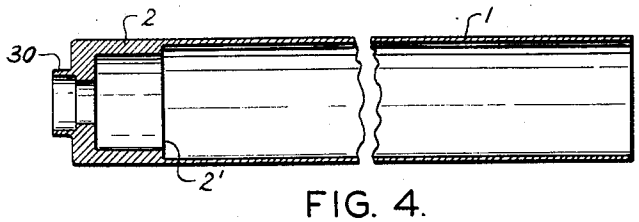


FIG. 4.

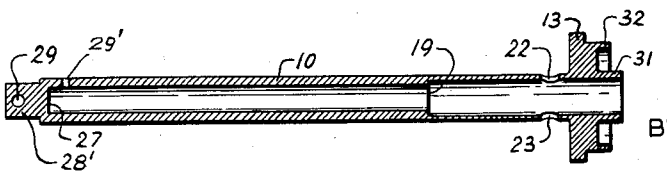


FIG. 5.

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HYDRAULICALLY DAMPED SPRING-BIASED PISTONS AND CYLINDERS

Filed April 15, 1957 2 Sheets-Sheet 2

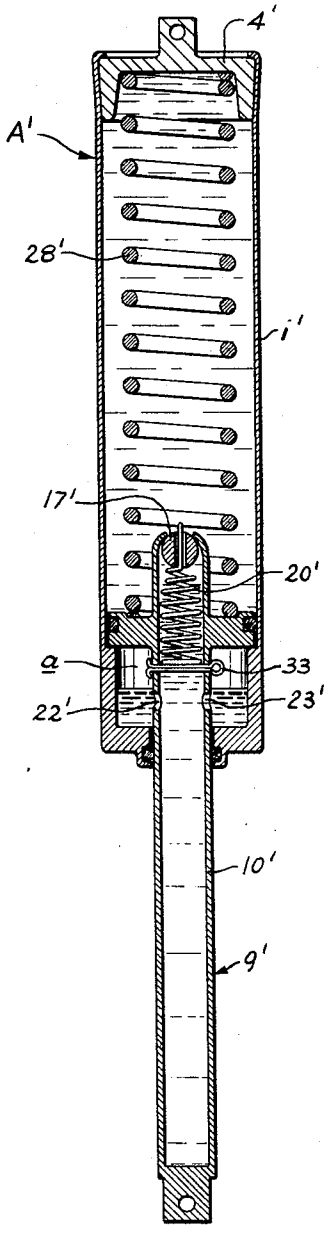


FIG. 6.

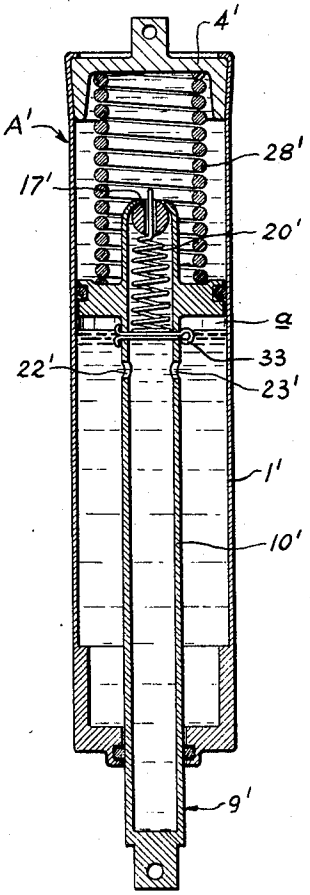


FIG. 7.

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HYDRAULICALLY DAMPED SPRING-BIASED PISTONS AND CYLINDERS

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Application April 15, 1957, Serial No. 652,975

2 Claims. (Cl. 267—1)

This invention relates in general to spring devices and, more particularly, to a hydraulically damped spring-biased piston and cylinder.

Spring operated, hydraulically damped devices are sometimes employed in mechanical toys, such as, for example, in a toy dump truck for elevating the dump body. Similar devices also find use as door closers, in which case the opening of the door compresses a spring so as to energize the device, which energy is later released to provide a positive means for slowly closing the door. These devices usually employ a spring-biased piston and cylinder arrangement wherein the cylinder is filled with hydraulic fluid so as to provide a damping action which retards the movement of the piston as it is forced along the cylinder under the action of the spring. The piston and cylinder are usually machined to very close tolerances so that, upon movement of the piston within the cylinder, the damping action is provided by reason of the hydraulic fluid gradually moving from one side of the piston to the other through the small clearance space between the piston and cylinder as the piston travels within the cylinder. However, notwithstanding the use of carefully selected tolerances between the piston and cylinder, it has been found that frequently the piston will tend to bind within the cylinder, thereby causing the piston to chatter as it moves.

It is, therefore, a primary object of the present invention to provide a hydraulically damped spring-biased piston and cylinder wherein the piston is freely slidable and will move smoothly without chattering or binding within the cylinder.

It is also an object of the present invention to provide a device of the type stated which is inexpensive to construct by reason of the fact that component elements can be impact extruded and thereby precise dimensional tolerances can be achieved very economically.

With the above and other objects in view, my invention resides in the novel features of form, construction, arrangement, and combination of parts presently described and pointed out in the claims.

In the accompanying drawings (two sheets)—

Fig. 1 is a perspective view of a hydraulically damped spring-biased piston and cylinder constructed in accordance with and embodying the present invention;

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1, and showing the device in fully extended or expanded position;

Fig. 3 is a sectional view, similar to Fig. 2, and showing the device in fully contracted position;

Figs. 4 and 5 are longitudinal sectional views of the cylinder and piston, respectively, forming part of the present invention and showing an intermediate stage of manufacture of the invention; and

Figs. 6 and 7 are sectional views, similar to Figs. 2 and 3, and showing a modified form of the present invention.

Referring now in more detail and by reference characters to the drawings, which illustrate practical embodiments of the present invention, A designates a hydraulically damped spring-biased piston and cylinder device comprising a hollow cylinder 1 formed preferably as an impact extrusion and provided at its lower end with a thickened portion 2 which forms a shoulder 2', and at its lower end the thickened portion 2 is provided with an axially extending bore 3. At its upper end, the cylinder 1 is conically flared outwardly at 3' for reception of a cap 4 having a conically tapered side wall 5 which matches the taper of the flared portion 3'. The flared portion 3' is bent over to form an annular retaining lip 6 whereby the cap 4 is held snugly and retentively in place. On its outwardly presented surface, the cap 4 is integrally provided with a lug 7 having an aperture 8 drilled therethrough by which one end of the cylinder 1 may be bolted, pinned, or otherwise secured to a suitable supporting surface (not shown). Mounted within the cylinder 1 for reciprocating movement therein is a plunger assembly 9 including a hollow tubular piston rod 10 which projects through the bore 3, the latter being provided with an annular groove 11 for reception of a seal-forming O-ring 12 which bears against the outer surface of the piston rod 10. Adjacent its upper end, the piston rod 10 is integrally provided with a plate-like piston 13 which is sized to conform substantially to the inner diameter of the cylinder 1. At its outer periphery, the piston 13 is provided with an annular groove 14 for snug-fitting reception of an O-ring 15, the latter being adapted to provide a seal between the piston 13 and the inner surface of the cylinder 1. At its outer end, the piston rod 10 is swaged over to provide an arcuate valve seat 16 for reception of a ball-type check valve 17 which bears thereagainst, the valve 17 being provided with a diametrally extending aperture 18. Intermediate its ends, the piston rod 10 is provided with a shoulder 19 for supporting one end of a small coil compression spring 20, the other end of which bears against the ball valve 17 and normally urges said valve 17 against the arcuate abutment 16. The spring 20 is integrally provided with a short, axially extending rod-like extension 21 which projects loosely through the aperture 18 in the ball valve 17. At a short distance below the piston 13, the piston rod 10 is provided with diametrally opposed ports 22, 23, for communication between the interior of the cylinder 1 and the inside of the hollow piston rod 10. Provided for sliding movement within the piston rod 10 and below the shoulder 19 is a small slidable auxiliary piston 24, the outer periphery of which is grooved for reception of a pair of spaced parallel O-rings 25, 26, which form a seal between the auxiliary piston 24 and the interior wall of the piston rod 10, and disposed between the piston 24 and the lower end wall 27 of the piston rod 10 is a coil spring 27', the latter normally bearing against the auxiliary piston 24 and biasing it in the direction of the piston 13. Extending between the piston 13 and the cap 4 is a strong compression spring 28 which urges the plunger assembly 9 to the position shown in Fig. 2, so that the piston 13 seats on the shoulder 2'. At its lower end, the piston rod 10 terminates in a lug 28' having an aperture 29 by which the piston rod can be secured to a suitable supporting surface (not shown). Slightly above the lower end wall 27 the piston rod 10 is provided with an air vent 29' for permitting communication to atmosphere from the lower side of the auxiliary piston 24.

In the manufacture of the device A, the cylinder 1 and the piston rod 10 and its associated piston 13 are impact extruded so as to provide the two components shown in Figs. 4 and 5. The cylinder 1 so formed includes an extension 30, while the piston rod 10 is formed with concentric axial extensions 31, 32, the latter, in effect, being an extension of the piston 13. In forming the completed plunger assembly 9, the spring 27' fol-

lowed by the auxiliary piston 24 are placed within the hollow piston rod 10; whereupon the spring 20 and ball check valve 17 are placed within the piston rod 10 with the rod-like extension 21 projecting through the aperture 18. The axial extension 31 is then swaged over to form the valve seat 16 previously described. The axial extension 32 is then bent over to form the annular groove 14 and the O-ring 15 is mounted therein. The axial extension 30 of the cylinder 1 is bent inwardly to form the groove 11, whereupon the O-ring 12 is fitted therein. The plunger assembly 9 is then placed within the cylinder 1 so as to assume the relative positions shown in Fig. 2. The ball valve 17 is then depressed with a suitable tool and oil or other hydraulic fluid is then poured into the open end of the cylinder, whereupon the oil will pass through the aperture 18 and fill the portion of the piston rod 10 above the auxiliary piston 24. Oil will also pass through the ports 22, 23, and fill the cylinder 1 on the lower side of the piston 13. The coil spring 28 is then inserted within the cylinder 1 and the remainder of the cylinder 1 above the piston 13 filled with oil, whereupon the cap 4 is fitted in the end of the cylinder 1. In this connection, it should be noted that since the cap 4 is formed with a conical surface 5, the placement of the cap 4 within the cylinder 1 will reshape the end of the cylinder to form the matching flared portion 3', whereupon the end of the cylinder 1 is bent over to form the annular retaining lip 6, previously described.

In use, the device A is normally in the position shown in Fig. 2. However, when the plunger assembly 9 is moved from the position shown in Fig. 2 to that shown in Fig. 3, the coil spring 28 will be compressed and open the check valve 17 to permit oil to flow therethrough and through the ports 22, 23, to fill the cylinder 1 on the lower side of the piston 13. Since the hydraulic fluid is relatively incompressible, the volume occupied by the piston rod 10 will cause an increase in the pressure within the cylinder 1 on the lower side of the piston 13. However, this increase in pressure is relieved by virtue of such pressure acting on the upper surface of the auxiliary piston 24 and forcing the piston 24 downwardly against and compressing the coil spring 27'. Upon release of the force tending to hold the piston 13 in the position shown in Fig. 3, the piston 13 will slowly move under the action of the coil spring 28 to the position shown in Fig. 2, whereupon the piston 13 will rest against the shoulder 2'. During such movement, little or no oil will flow across the sealing ring 15 since the oil will pass through the ports 22, 23, and seep slowly through the aperture 18 in the ball valve 17 to provide a damping action.

It is also possible to provide a modified form of hydraulically damped spring-biased piston and cylinder device A' of the type shown in Figs. 6 and 7. The device A' is similar to the device A, previously described. However, in this form of the invention the auxiliary piston 24 and spring 27' employed in the device A are eliminated and the compression spring 20' is supported at its lower end by means of a pin 33 secured in, and extending diametrally through, the piston rod 10'. In assembling the device A', the plunger assembly 9' is placed within the cylinder 1' in the manner shown in Fig. 6, whereupon the ball valve 17' is depressed by any suitable tool and a measured amount of oil is poured into the cylinder 1' so as to completely fill the hollow piston rod 10' and also the lower end of the cylinder 1' to a level above the ports 22', 23', such as shown in Fig. 6. The compression spring 28' is then inserted into the cylinder 1' and the remainder of the cylinder 1' above the piston 13' is filled with oil, whereupon the cap 4' is placed in the cylinder 1' in the same manner as in the device A, previously described. An air space *a* will then be formed between the oil in the lower part of the cylinder and the piston 13', so that when the plunger assembly 9' is moved from the position shown in Fig. 6 to the position shown in Fig. 7, the increase in pressure due to the volume occupied by the piston rod 10'' will be compensated for by reason of the fact that the air in the space *a* will be compressed and consequently reduced in volume, such as shown in Fig. 7.

It should be understood that changes and modifications in the form, construction, arrangement, and combination of the several parts of the hydraulically damped spring-biased piston and the cylinder may be made and substituted for those herein shown and described without departing from the nature and principle of my invention.

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

1. A device of the character described adapted for use in mechanical toys and the like, said device comprising a cylinder containing hydraulic fluid, a piston mounted for shifting movement within the cylinder and being sealed with respect thereto, a compression spring interposed between the piston and one end of the cylinder, a hollow piston rod extending from the piston and being provided with at least one port therein by which hydraulic fluid can flow into and out of the piston rod, a check valve mounted in said piston rod and having an aperture extending therethrough, and spring means biasing said check valve against and closing off one end of the piston rod, said spring means having a projection passing loosely through said aperture.

2. A device of the character described adapted for use in mechanical toys and the like, said device comprising a cylinder containing hydraulic fluid, a piston mounted for shifting movement within the cylinder and being sealed with respect thereto, a compression spring interposed between the piston and one end of the cylinder, a hollow piston rod extending from the piston and being provided with at least one port therein by which hydraulic fluid can flow into and out of the piston rod, a check valve mounted in said piston rod and having an aperture extending therethrough, spring means biasing said check valve against and closing off one end of the piston rod, said spring means having a projection passing loosely through said aperture, an auxiliary piston slidably mounted in the hollow piston rod and being in spaced relation to said check valve, and means for biasing the auxiliary piston in the direction of the check valve.

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