July 7, 1959 E. E. HUPP 2,893,721

DASHPOT MECHANISM

Filed Dec. 27, 1956

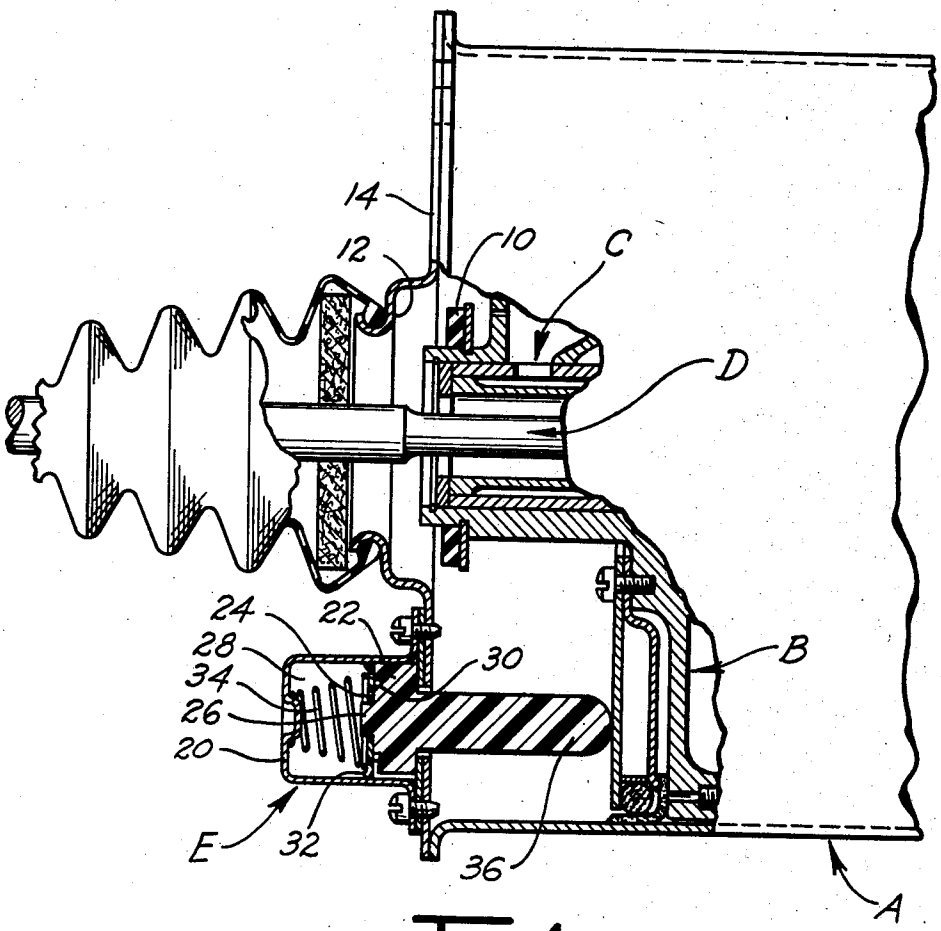

Fig. 1.

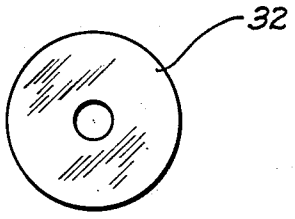

Fig. 2.

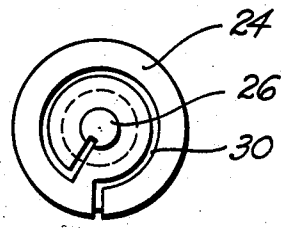

Fig. 3.

INVENTOR.
EDWARD E. HUPP.
BY
William P. Hickey
ATTORNEY.

United States Patent Office 2,893,721 Patented July 7, 1959

2,893,721

DASHPOT MECHANISM

Edward E. Hupp, South Bend, Ind., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application December 27, 1956, Serial No. 630,959

6 Claims. (Cl. 267—1)

The present invention relates to means for slowing motion in one direction; and more particularly to dashpot means particularly of the pneumatic type.

An object of the present invention is the provision of new and improved dashpot apparatus which is simple in design, efficient in its operation and inexpensive to manufacture.

Another object of the invention is the provision of new and improved motion dampening means for dashpot apparatus and the like wherein a groove is provided in one end face of a movable wall, the opposite ends of which groove communicate with opposite sides of said movable wall, and against which a membrane or cover member is biased to cause fluid flow between opposite sides of said movable wall to be throttled through the covered section of said groove.

A further object of the invention is the provision of a new and improved cylinder and piston device one end face of which piston is provided with a groove opposite ends of which extend between opposite sides of said piston and which end face is covered by a flexible membrane—the radially outer edges of which are in sliding sealing engagement with said cylinder and a radially inner portion of which overlies an intermediate portion of the groove, whereby flow in one direction across said piston is throttled through the intermediate section of said groove and flow in the opposite direction across said piston causes said membrane to be biased out of sealing engagement with said face of said piston.

The invention resides in certain constructions and combinations and arrangements of parts and further objects and advantages will become apparent to those skilled in the art to which the invention relates from the following description of the preferred embodiment described with reference to the accompanying drawing forming a part of this specification, and in which:

Figure 1 is a fragmentary side elevational view of a fluid pressure servo-motor embodying principles of the present invention and in which sections are broken away to better illustrate the features of the invention;

Figure 2 is an end view of a sealing membrane used in the structure shown in Figure 1; and

Figure 3 is an end view of the dashpot piston shown in Figure 1.

The fluid pressure servo-motor shown in Figure 1 is of the type shown and described in detail in the Earl R. Price application 411,386, and now Patent Number 2,818,710. The servo-motor generally comprises a cylinder or power chamber enclosure A which is divided into opposing fluid pressure chambers by means of a movable wall or piston B. The piston B is actuated by means of a control valve structure portions of which are shown at C adapted to provide differential pressure across the piston B; and which control valve is regulated by means of a push rod D adapted to be controlled manually by an operator. The piston B is shown in a position wherein it is spaced slightly inwardly (or to the right of) its retracted or left-hand limit of its travel. In the retracted

position of the piston, a nonmetallic washer 10 engages the flared portion 12 of the end cover plate 14 of the enclosure A.

The fluid pressure servo-motors shown in the drawing have been used for the power actuation of hydraulic braking systems in automobiles; and a troublesome clicking has been experienced when the brakes are quickly retracted to bring the disc 10 into sharp engagement with the end cover plate 14.

This clicking of the piston B has been overcome by the embodiment shown in the drawing by means of a dashpot arrangement E positioned on the end cover plate 14 of the servo-motor; and which dashpot is adapted to gradually absorb the kinetic energy of the turning piston. The dashpot E generally comprises a fluid pressure or cylinder housing 20 and a movable wall or piston 22 adapted to be moved into the cylinder 20 by the returning servo-motor piston B. The piston 22 is provided with a headed portion having oppositely facing generally radially extending end surfaces—the inner surface 24 of which is provided with an axially positioned cylindrical boss 26 which projects inwardly into the fluid pressure chamber 28 formed by the cylinder enclosure 20. The inner face 24 of the piston 22 is provided with a generally spirally shaped groove 30 one end of which proceeds axially along the side edge of the boss 26 and the other end of which proceeds outwardly along the radially outer edge of the piston 22 to provide flow communication between opposite sides of the piston. An annular cover member 32 is provided for the inner face 24 of the piston and is adapted to overlie an intermediate portion of the groove 30 such that flow communication between opposite sides of the piston will be throttled through the intermediate section of the groove 30. It will be seen that by this expedient throttling means of the conduit type is provided very inexpensively and effectively.

In the preferred embodiment shown in the drawing the cover member 32 is formed from a relatively thin flexible annular membrane the radially outer edges of which are biased into sliding sealing engagement with the side walls of the cylinder 20. Inasmuch as the piston 22 is forced inwardly into the chamber 20 to compress air therein, the resulting increase in pressure within the chamber 28 biases the membrane 32 into firm sliding sealing engagement with the side walls of the cylinder 20. Pressure within the chamber 28 also biases the membrane 32 up against the inner face 24 of the piston 22 to provide a seal therebetween and limit flow communication between opposite sides of the piston to the cross-sectional area of the groove 30. Rapid movement of the piston 22 outwardly of the chamber 20 (or to the right as shown in the drawing) will of course increase the pressure between the membrane 32 and the inner face 24 of the piston to force the membrane 32 out of sealing engagement with respect to both the inner face 24 of the piston and the side walls of the cylinder 20, thereby permitting substantially unrestricted flow communication across the piston in the reverse direction. The embodiment shown in the drawing further incorporates a coil spring 34 one end of which is centered on the closed end of the cylinder 20 and the opposite end of which abuts the membrane 32 adjacent its radially outer edge. Spring 34 therefore biases the membrane 32 in sealing engagement with the side walls of the cylinder 20 and with the inner face 24 of the piston 22; and at the same time urges the piston 22 into its outer position.

The device operates as follows: Any suitable means may be used to transfer movement of the servo-motor piston B to the piston 22 of the dashpot assembly E. The embodiment shown in the drawing utilizes an axially extending projection 36 on the piston 22 adapted to abut the piston B a predetermined distance ahead of its fully

retracted position during its retractile stroke. Engagement of the projection 36 with the piston B thereafter forces the piston 22 inwardly into the chamber 28. Pressure is thereupon built up in the chamber 28 causing the membrane 32 to be held in firm sliding sealing engagement with the side walls of the cylinder 20; and at the same time forcing the membrance 32 into firm engagement with the inner face 24 of the piston. Increased pressure within the chamber 28 causes air to flow into the groove 30 adjacent the inwardly projecting boss 26 and to thereafter proceed through the tortuous path provided by the spiral groove 32 to the radially outer edge of the piston 22 where the groove proceeds axially rearwardly into communication with the opposite side of the piston. The pressure within the chamber 28 will increase generally proportional to the speed at which the piston 22 is forced into the chamber 28 by the servo-motor piston B to provide an ideal condition for gradually slowing down the servo-motor piston until it comes into easy engagement with the end closure 14 of the servo-motor cylinder A. It will be seen that the coil spring 34 not only biases the piston 22 into its outer position but holds the membrane 32 into engagement with the piston 22; such that substantially no lost motion is involved in bringing the membrane 32 into firm sealing engagement with both the piston 22 and cylinder 20. It is a further very desirable feature of applicant's invention that the piston 22 is free to move outwardly of the chamber 28 quickly at all times. Movement of the piston 22 to the right as seen in Figure 1 permits air from the right-hand side of piston 22 to flow past its radial outer edges (inasmuch as considerable clearance may be provided between the piston and cylinder in this construction) causing the radially outer edges of the membrane 32 to be bent inwardly out of sealing engagement with the side walls of the cylinder 20. At the same time a pressure differential will be created across the membrane 32 causing it to move out of firm sealing engagement with the inner surface 24 of the piston. This permits air to flow radially inwardly between the membrane 32 and the face of the piston and thence past the boss 26 into the chamber 28. Fluid flow through this latter path will not be required to follow the convolution of the groove 30 thereby greatly reducing the pressure drop in this reverse flow direction.

While the invention has been shown and described as embodied in a device wherein a movable wall is moved into an enclosure to increase the fluid pressure therein it is not to be so limited. Presumably the same principles may be utilized in a device wherein the movable wall is moved outwardly of the enclosed chamber causing a decrease of pressure within the chamber and thereby a corresponding pressure drop across its piston. With such an arrangement the sealing membrane 32 and annular groove 30 could advantageously be placed on the opposite side of the piston from that shown in Figure 1.

While the invention has been described in considerable detail I do not wish to be limited to the particular construction shown and described; and it is my intention to cover hereby all adaptations, modifications, and uses thereof which come within the practice of those skilled in the art to which the invention relates.

I claim:

1. In a dashpot apparatus and the like: a housing having a variable volume fluid pressure chamber; a movable wall for said variable volume chamber, said movable wall having a normal position in said fluid pressure chamber from which it is moved in a first direction when retarding an externally applied force and during which movement a high fluid pressure is applied to a first face of the movable wall and a lower fluid pressure is applied to the opposite face of the movable wall; said movable wall having a flow restricting groove in its first face subjected to the higher pressure which groove starts at one point on said face and extends to a second point on said face which communicates with said opposing face of said movable wall; a cover member for said face in which said groove

is formed, said cover member overlying all but the beginning portion of said groove and being constructed and arranged to abut said first face when said movable wall is moved in said first direction and cause fluid to flow through said groove; and means for biasing said movable wall toward its normal position, said means being positioned against said cover member to bias it against said face of said movable wall.

2. In a dashpot apparatus and the like: a housing having a variable volume fluid pressure chamber; a movable wall for said variable volume chamber; said movable wall having a normal position in said fluid pressure chamber from which it is moved in a first direction when retarding an externally applied force and during which movement a high fluid pressure is applied to a first face of the movable wall and a lower fluid pressure is applied to the opposite face of the movable wall; said movable wall having a projection on said first face and a flow restricting groove which starts at one point on the side of said projection and continues across said first face to a second point on said face which communicates with said opposing face of said movable wall; a loose disk-shaped cover member for said face in which said groove is formed, said cover member being centered by said projection and overlying all but the beginning portion of said groove being constructed and arranged to abut said first face when said movable wall is moved in said first direction and cause fluid to flow through said groove; and means for biasing said movable wall toward its normal position, said means being positioned against said cover member to bias it against said face of said movable wall.

3. In a dashpot apparatus and the like: a housing having a variable volume chamber; a piston forming one end of said variable volume chamber, said piston having a normal position from which it is moved in a first direction when retarding an externally applied force and during which movement a high fluid pressure is applied to a first face of the piston and a lower pressure is applied to the opposite face of the piston; said piston having a flow restricting groove in its first face subjected to the higher pressure which groove starts at one point on said face and extends to a second point on said face which communicates with said opposing face of said piston; a disk-shaped cover member for said first face, said cover member being flexible with its outer periphery being in sliding sealing engagement with the side walls of said chamber, said cover member overlying all but the portion of said groove adjacent said one point and being constructed and arranged to abut said first face and thereby cause fluid to flow through said groove when said piston is moved in said direction, and said cover member being flexible enough to bend away from said side walls and permit fluid flow therepast when said piston is moved in the opposite direction.

4. In a dashpot apparatus and the like: a housing having a variable volume chamber; a piston forming one end wall of said variable volume chamber, said piston having a normal position from which it is moved in a direction decreasing the volume of said chamber when retarding an external force in said direction, said piston having a generally centrally located projection on its inside face exposed to said chamber and a flow restricting groove which extends along the side of said projection across the face of said piston to a point on said face which communicates with the opposite side of said piston; a loose disk-shaped cover member for said inside face which cover member surrounds and is centered by said projection, said cover member being shaped to overlie the portion extending across the face of said piston and not extend into the cross section of the groove in said projection; and a piston returned spring biasing said cover member against said one face of said piston; whereby said cover member abuts said piston and causes fluid to flow lengthwise through said groove during inward movement of said piston, and said cover member is loosely guided in

a manner preventing a complete closing off of said groove in said projection.

5. In a dashpot apparatus and the like, a housing having a variable volume chamber; a piston forming one end wall of said variable volume chamber, said piston having a normal position from which it is moved in a direction decreasing the volume of said chamber when retarding an external force in said direction, said piston having a generally centrally located projection on its inside face exposed to said chamber and a flow restricting groove which extends along the side of said projection across the face of said piston to a point on said face which communicates with the opposite side of said piston; a loose disk-shaped cover member for said inside face which cover member surrounds and is centered by said projection, said cover member being flexible with its outer periphery being in sliding sealing engagement with the sidewalls of said chamber, said cover member overlying all but the portion of said groove in said projection and being constructed and arranged to abut said inside face and thereby cause fluid to flow through said groove when said piston is moved in said direction and a piston return spring biasing said cover member against said inside face of said piston.

6. In a dashpot apparatus and the like, a housing having a variable volume chamber; a piston forming one end

wall of said variable volume chamber, said piston having a normal position from which it is moved in a first direction decreasing the volume of said chamber when retarding an external force in said direction, said piston having a generally centrally located projection on its inside face exposed to said chamber and a flow restricting groove which extends along the side of said projection across the face of said piston to a point on said face which communicates with the opposite side of said piston; a loose disk-shaped cover member for said inside face which cover member surrounds and is centered by said projection, said cover member being flexible with its outer periphery being in sliding sealing engagement with the sidewalls of said chamber; a piston return mechanism positioned against said cover member adjacent its outer periphery to bias it against said piston, said cover member being sufficiently stiff that its resistance to bending biases its outer periphery in engagement with said sidewalls when pressure forces are not acting thereon but will bend away from said sidewalls during piston movement in the opposite direction.

References Cited in the file of this patent

UNITED STATES PATENTS

374,080	Nickerson	Nov. 29, 1887
2,696,980	Goodwin	Dec. 14, 1954