

[54] CUSHION DEVICE
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 [73] Assignee: **International Harvester Company, Chicago, Ill.**
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Related U.S. Application Data

[63] Continuation of Ser. No. 80,366, Oct. 13, 1970, abandoned.

[52] U.S. Cl..... 91/409, 92/136, 92/181

[51] Int. Cl..... F15b 15/22

[58] Field of Search..... 91/409, 408, 407, 91/26, 25; 92/85, 181, 182

[56] **References Cited**

UNITED STATES PATENTS

3,296,942 1/1967 Nelson 91/409

[57] **ABSTRACT**

A cushion device for a contractible chamber formed by a housing and a piston movable therein with an exhaust port normally permitting fluid to exhaust from said chamber, said cushion device comprising a recess within a wall of the piston unit, a decelerating member movable within said recess and having a surface complementary to the wall of the housing adjacent to the exhaust port, with interruptions therein for metering fluid from the interior of the chamber as the piston approaches the end of its stroke.

5 Claims, 4 Drawing Figures

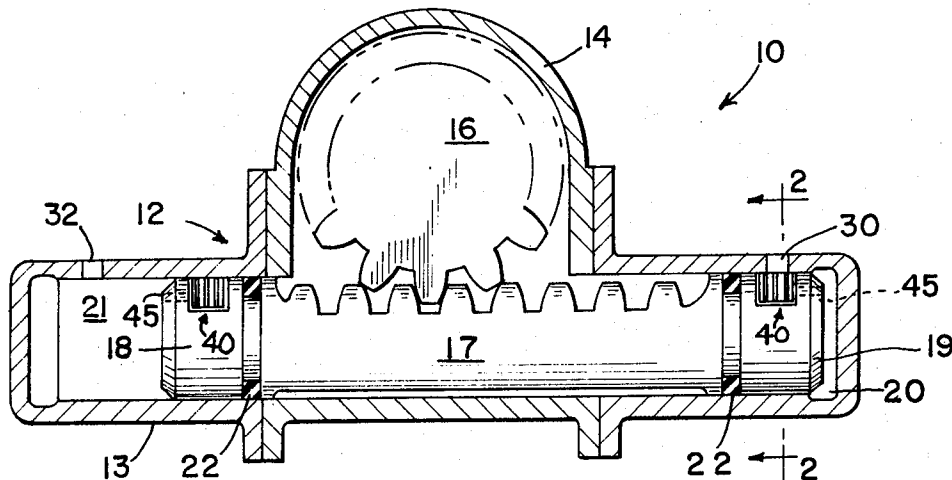


FIG. 1

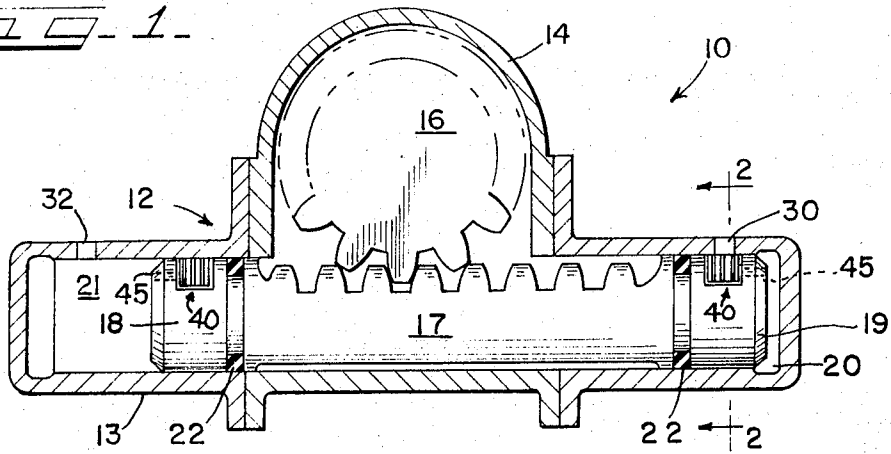


FIG. 2

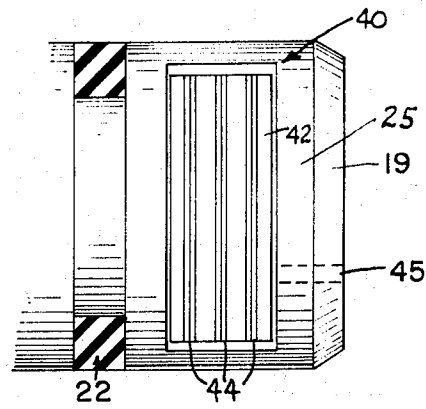
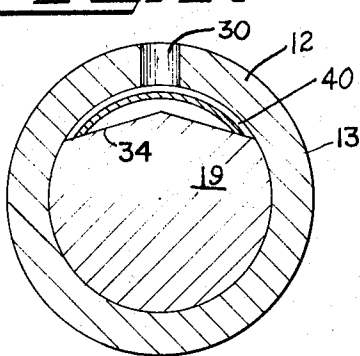


FIG. 3

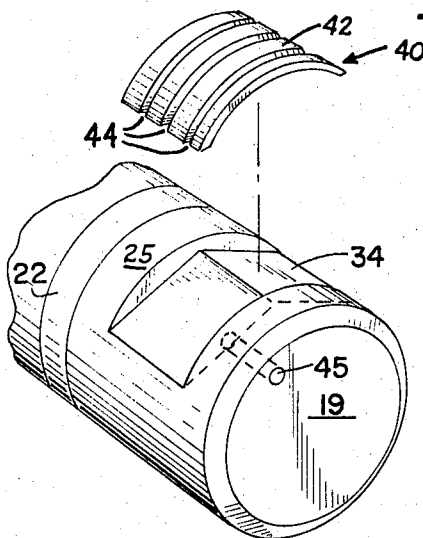


FIG. 4

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CUSHION DEVICE

This is a continuation, of application Ser. No. 80,366, filed Oct. 13, 1970, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a cushion device or a decelerator member for utilization with a fluid motor in which some means are provided for absorbing the kinetic energy of a moving mass as the piston approaches the end of its stroke, and for additionally absorbing continued fluid input energy as the piston approaches the end of its stroke.

Cushion devices operating upon generally the same principle as that herein disclosed have been proffered in the prior art as exemplified by U.S. Pat. No. 3,296,942, issuing to Vaughn A. Nelson and assigned to International Harvester Company, Inc. This patent relates to the utilization of an annular decelerator ring carried by the piston on one end surface thereof in such a manner as to have limited axial movement. Accordingly, as the piston approaches the end of its stroke, an efflux jet will draw the decelerator ring into contact with the decelerator wall, and such will substantially close off the exhaust of fluid from the contracting chamber so as to build up pressure in said chamber which is effective to absorb the kinetic energy of a load associated with the hydraulic motor. Simultaneously, interruptions provided in the decelerator rings will meter fluid out of said chamber at a reduced rate.

Although hydraulic cylinders manufactured according to the above identified patent are successful, certain operating disadvantages accrue therefrom. For example, the decelerator ring does not have the same concentricity as the interior wall of the hydraulic motor, and it is believed that this line contact rather than an area type contact with the interior cylinder wall leads to scoring thereof. Similarly, the disclosure of the above identified patent suggests the utilization of cup members on the pressure or exhaust sides of the piston, and thus additional length dimensions of the hydraulic cylinder may be required if the decelerating device is to be utilized. Finally, machining requirements and tolerance requirements for the metering grooves in that disclosure result in difficult manufacturing technique.

SUMMARY OF THE INVENTION

In order to provide a decelerator or cushion device for a hydraulic motor which provides advantages additional to those of the identified patent, the applicant proposes the utilization of a decelerator member which has an exterior surface substantially complementary to the interior wall of the motor and is carried within a recess in the side wall of the piston in a manner to permit limited axial movement. Accordingly, it is an object of the instant invention to provide a decelerator means for any expansible chamber device in which the decelerator surface is complementary to the interior wall of the housing, and is carried by the piston itself and thus reduces the possibility of scoring. Further, an additional object of the instant invention is to provide a decelerator member which may be carried by a piston within a hydraulic motor in such a manner as to reduce the longitudinal length of the hydraulic motor which might otherwise be required. Additionally, an object of the instant invention is to provide a decelerator mechanism for a hydraulic motor which is subject to side thrust,

and does not effect the bearing surface which is necessary to react against such side thrust.

DESCRIPTION OF THE DRAWINGS

The manner in which the objects of this invention are obtained will be made clear by consideration of the following specification and claims when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a top plan view partially in section of a hydraulic motor embodying my invention in which the piston rod has teeth thereon forming a rack for engagement with a pinion;

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

FIG. 3 is an elevational view of one piston of the hydraulic motor of FIG. 1; and

FIG. 4 is an orthographic projection of FIG. 3.

DETAIL DESCRIPTION

As depicted in FIG. 1, a preferred embodiment of my invention is associated with a hydraulically actuated rack and pinion assembly 10. This assembly comprises a pinion gear 16 which is formed as part of an elongated shaft having teeth thereon which mesh with gear teeth of a rack in the form of a piston rod 17. Such a rack and pinion assembly is often associated with devices in which rotational motion is desired. To effect such rotation a housing 12 is provided having chambers 20 and 21 at each end thereof with pistons 19 and 18 reciprocating therein. Ports 30 and 32 may selectively be connected to a source of fluid energy or a sump whereby fluid energy may be directed to one chamber while fluid is exhausted from the other chamber to the sump. A center section of the housing interconnects the two chamber portions 20 and 21 thereof and also provides a closure about the shaft 16 so as to prevent entry of dirt and other foreign articles into the rack and pinion assembly. Thus, it should be appreciated that if the shaft 16 were fixed to a backhoe support stand and constrained against rotation, fluid energy directed to chamber 20 will cause this chamber to expand while chamber 21 would contract with fluid being exhausted therefrom through port 32. Such expansion would cause counterclockwise motion of the housing 12 about the shaft 16 as the gear teeth on the piston rod 17 and the shaft 16 successively engage. It should also be appreciated that the housing 12 may be fixed to the backhoe support stand, with the shaft 16 being constrained for rotation with the mass of a rotatable backhoe boom.

Assuming that the boom of the backhoe or another mass is being carried by the housing 12 as it rotates about the fixed shaft 16, it should be apparent that the kinetic energy due to the moving mass must be absorbed as the piston unit (18 or 19) approaches the end of its stroke, or the end wall of the chamber 21. Additionally, in order to complete the rotational movement of the system, input energy is continuously being directed to the expanding chamber, and until the end of the stroke is reached, such input energy is also acting in conjunction with the kinetic energy, and the sum of these two energies must be absorbed.

In order to absorb such kinetic energy and continued fluid input energy, a cushion device is herein proffered in which a groove or recess 34 is formed in the piston 18 and 19 as more clearly depicted in FIG. 2 and within this groove is placed a decelerating member 40 having

an exterior surface configuration 42 generally complementary to the interior surface configuration of chamber 20 or 21 in the area adjacent to ports 30 and 32. The decelerating member 40 represents a sector of a cylinder having an exterior cylindrical surface 42 with interruptions 44 thereon in the form of grooves. According to the instant invention, as a piston of the contracting chamber begins to pass over an associated port (30 or 32), the cross sectional area of the port is gradually diminished so as to limit the exhaust of fluid therefrom. Before the port can be completely closed by the piston's external surface 25, the decelerator or cushion member 40 will be in juxtaposition with the associated port and dynamic fluid forces arising from the exhaust of fluid will cause the external surface 42 of the decelerating member to mate with the interior surface of the housing 12 in the area of port. Fluid may then exhaust from the contracting chamber only through the interruptions or grooves 44. Fluid in the extreme end of chamber may pass through the aperture 45 in piston end wall, and enter into the recess 34. From this recess fluid may then enter the grooves and will be metered out of the recess into the exhaust port through the interruptions 44. Due to this restriction which is now placed in the path of exhaust fluid, pressure must increase within the chamber 21 and such back pressure will act to absorb the kinetic energy of the moving mass as well as to absorb the continued fluid input energy, and accordingly the moving mass may be decelerated in a gradual manner.

With respect to the decelerating member itself, the external surface configuration thereof is complementary to the internal surface configuration of the housing 12. In its preferred form the decelerating member 40 has a minimum dimension and does not extend the entire circumference of the piston 18. Thus, by limiting the circumferential dimension of the member 40, the opposite side of the piston does not have a recess therein, and accordingly a maximum area of the piston 18 is in contact with the interior wall of the housing 12. It is believed that this maximum surface area exposure is necessary in order to provide sufficient strength to resist the separating forces between the gear teeth on the shaft 16 and the piston rod 17.

MODE OF OPERATION

Assuming that it is desired to rotate the housing counterclockwise about shaft 16, fluid energy may be directed to port 30 so as to expand chamber 20. Such fluid will initially act on member 40 to move same away from the port 30 and fluid may flow around the member, through aperture 45 and into this chamber, seals 22 precluding any loss of fluid therefrom. As rotation is effected, chamber 21 contracts and fluid exhausts from port 32, until piston 18 approaches the end of its stroke. As piston 18 traverses port 32, member 40 moves into juxtaposition with the port and dynamic fluid forces act on member 40 to cause its external surface 42 to mate with the internal surface of housing 12, at which time fluid may be exhausted from the chamber 21 via aperture 45, recess 34, grooves 44 and out the port. Actuation in the opposite direction is accomplished in the same manner. Should the external radius of member 40 be substantially the same as the internal diameter of housing 12, an area type contact between the members should be effected, and scoring problems associated with the prior art will be eliminated.

Thus it should be appreciated that applicant, by a single one-piece element has provided a decelerator mechanism for a hydraulic motor or any expansible chamber device. It is believed that such a cushion device will find application in any fluid motor, although such is most beneficial in such motors which have a minimum amount of working space, and in which bearing surfaces on the sides of the piston are important. It is conceivable that minor modifications may fall within the spirit and scope of this invention, and such might appropriately include resilient means behind the decelerator device urging same outwardly. Additionally, applicant contemplates the manufacture of the instant decelerator member from powered metal.

I claim:

1. A hydraulic motor for effecting rotational movement comprising:

- a. a housing,
- b. a pinion shaft therethrough,
- c. piston means within said housing defining fluid chambers at either end thereof, said piston means having teeth thereon, adapted to be engaged with teeth upon said shaft whereby reciprocable motion of said piston means within said housing will effect rotational motion of one of said housing and shaft,
- d. a fluid port connected to each chamber,
- e. decelerator means associated with at least one end of said piston means, said decelerator means comprising a non-continuous groove within said piston means, a thin arcuate member having limited motion within said groove and an external surface adapted to overlie one of said ports associated with said chambers, said surface having interruptions thereon to permit metered flow of fluid from the associated chamber as the piston approaches the end of its stroke.

2. A hydraulic motor for effecting rotational movement comprising:

- a. a housing,
- b. a pinion shaft therethrough,
- c. piston means within said housing defining fluid chambers at each end thereof, said piston means having teeth thereon, adapted to be engaged with teeth upon said shaft whereby reciprocable motion of said piston means within said housing will effect rotational motion of one of said housing and shaft,
- d. a fluid port connected to each chamber,
- e. decelerator means associated with an least one end of said piston means, said decelerator means comprising a non-continuous groove within said piston means, a thin arcuate member loosely mounted and having limited motion within said groove and an external surface adapted to overlie one of said fluid ports associated with said chambers, said surface being complementary to the wall surface of said housing.

3. In an expansible chamber device having a housing, a fluid port, a piston means movable within said housing and having a surface in sealing engagement with the interior of the housing so as to form a chamber and a reacting surface for permitting expansion of said chamber, the improvement comprising:

- a. a recess in the sealing surface of said piston means and extending no more than half way therearound,
- b. a decelerator member consisting of a hollow cylindrical sector loosely mounted in said recess having a surface for covering said fluid port when said

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chamber is contracted for limiting the exhaust of fluid from said chamber, said surface having an external radius substantially the same as the internal diameter of said chamber, thereby resulting in area type contact therebetween with the elimination of scoring.

4. In an expansible chamber device having a housing, piston means movable therein and having a surface in sealing engagement with the interior of the housing so as to form a chamber on each side of said piston means and reacting surfaces for causing expansion and contraction of said chambers, fluid ports for directing and exhausting fluid from each of said chambers, an improved decelerating means comprising:

- a. a non-continuous recess in the sealing surface of said piston means,
- b. a thin arcuate decelerating member loosely mounted in said recess having a surface for covering an appropriate port as the piston means approaches the end of its stroke, said surface being complementary to the wall surface of said housing,
- c. interruptions in the surface of said decelerator member for metering flow from said contracting

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chamber when the piston has reached the end of its stroke.

5. In an expansible diameter device having a housing with an internal bore, a piston means with a peripheral surface movable within said bore and forming therewith a chamber, a fluid port communicating with said chamber, the improvement comprising:

a non-continuous groove in the peripheral surface of the piston means;

a decelerator member consisting of a hollow cylindrical sector loosely carried in said groove and having a metering surface for covering said fluid port when said chamber is contracted for limiting the exhaust of fluid from said chamber;

said decelerator member being forced into engagement with the said bore by the pressure exerted thereon by fluid escaping from the chamber through said port and capable of conforming to the radius of said bore, whereby scoring of the internal bore by the decelerator member during contraction of the chamber is minimized.

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