Feb. 20, 1968 R. G. CARLE 3,369,674

HYDRAULIC CUSHIONING DEVICE FOR RAILWAY VEHICLES

Filed March 3, 1966

FIG. 1

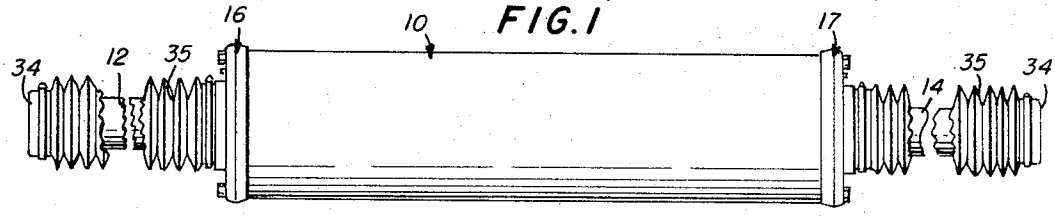
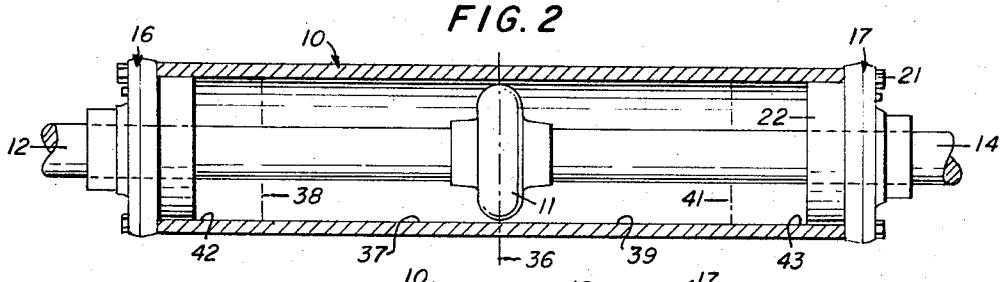


FIG. 2



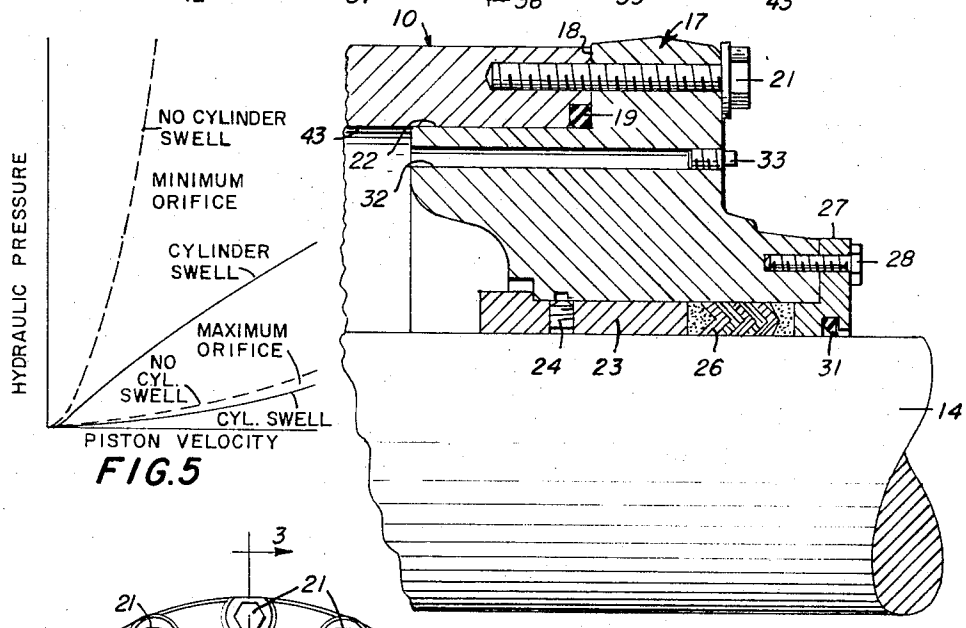


FIG. 5

FIG. 3

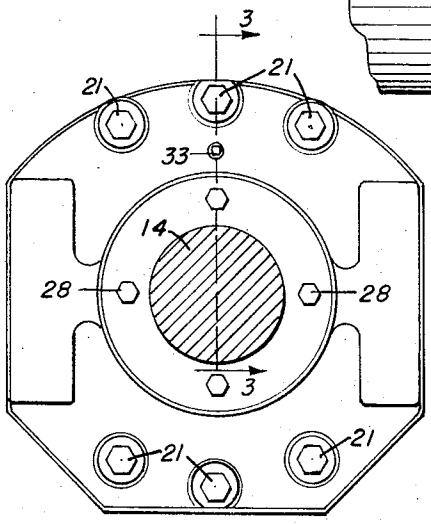


FIG. 4

INVENTOR
ROSS G. CARLE

BY Roger A. Brown
ATTORNEY

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HYDRAULIC CUSHIONING DEVICE FOR RAILWAY VEHICLES

Ross G. Carle, Columbus, Ohio, assignor to The Buckeye Steel Castings Company, Columbus, Ohio

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The present invention pertains to a hydraulic mechanism which includes a cylinder and piston assembly in which liquid is stored and a unit which includes an orifice area serving to meter movement of the liquid as it is displaced by the piston upon relative movement of the piston and cylinder. The invention more particularly relates to such a hydraulic unit wherein the orifice area is significantly enlarged upon the development of a high pressure acting on the interior of the cylinder wall in the vicinity of the orifice and the mechanism has particular utility in association with the underframe of a railway freight car to absorb the impact energy applied to a coupler of the vehicle.

Hydraulic cushioning devices have been in use by the railroads and serve to absorb the impact energy applied to the coupler of a railway car to reduce the kinetic energy being transferred to the car body. Such hydraulic mechanisms have served to effectively reduce damage to the lading and it is an object of the present invention to provide improvements in such a hydraulic mechanism.

A more specific object of the invention is to provide a hydraulic cushioning mechanism of the double acting type which functions to absorb impact energy applied to either end of the unit and to a piston and a cylinder assembly wherein the cylinder wall is such as to be sufficiently displaced radially during certain types of impacts to effectively enlarge the orifice and thus allow greater quantity of liquid to momentarily move to the low pressure side of the piston thus relieving abnormally high pressures which would otherwise damage the unit.

Another object of the invention is to provide such a hydraulic unit with a cylinder wall of limited resilient character so that it displaces radially outwardly within the elastic limit of the wall whereby the internal diameter of the cylinder is effectively enlarged to increase the orifice area as the pressure within the unit rises to a high level such as may occur upon certain impacts of high velocity with the wall contracting radially inwardly to restore the orifice area to its designed dimensions upon the relief of the excess pressure.

Another object of the invention is to provide a hydraulic unit wherein the cylinder wall may be deformed outwardly in response to pressure to alter the metering orifice to develop a significant reduction in pressure during certain severe impacts with the deformation predetermined by the design of the cylinder wall whereby the stresses induced during severe impacts are not sufficient to produce any permanent deformation of the cylinder wall.

Other objects and features of the invention will be appreciated and become apparent particularly to those acquainted with longitudinal cushioning mechanisms for railway vehicles as the present disclosure proceeds and upon consideration of the accompanying drawing taken in conjunction with the following detailed description wherein an embodiment of the invention is disclosed.

In the drawing:

FIG. 1 is an elevational view of a hydraulic device embodying the invention.

FIG. 2 is a longitudinal sectional view of the hydraulic unit.

FIG. 3 is an enlarged fragmentary sectional view taken on the line 3—3 of FIG. 4.

FIG. 4 is an end elevational view of the unit with one of the piston rods shown in section.

FIG. 5 is a diagrammatic view depicting the relationship of orifice areas to pressures that develop in the unit.

A hydraulic mechanism exhibiting the invention is shown in FIG. 1 and includes a tubular shaped wall member 10 which is formed as a rolled seamless tube. The tubular wall member 10 provides the principal element of the cylinder and the tube may be formed of suitable metal such as carbon steel. The tubular wall member 10 accommodates and houses a piston 11 as shown in FIG. 2 which is arranged intermediate the ends of the tubular member 10 in the inactive or neutral position. A piston rod 12 carried by the piston 11 extends beyond one end of the tubular member 10 and a piston rod 14 extends beyond the other end. The hydraulic unit comprises essentially the piston 11 and the tubular wall member 10 is for the purpose of serving as a cushion mechanism for absorbing the energy of impacts applied at either end of a railway vehicle and the hydraulic device is of the double ended double acting type.

A cylinder head member 16 surrounds the piston rod 12 and closes the end of the tubular wall member 10 as shown at the left in FIG. 2. A similar cylinder head member 17 is provided at the other end of the tubular wall member 10 and surrounds the piston rod 14 and closes the end of the cylinder shown at the right in FIG. 2. The cylinder head members 16 and 17 are of similar construction and the structural features of one will be appreciated upon consideration of FIGS. 3 and 4. The cylinder head member 17 is provided with an overall diameter greater than the exterior surface of the tubular wall member 10. A shoulder 18 on the cylinder head member 17 abuts against the end of the wall of the tubular member 10. A plurality of cap screws 21 extend through openings in the cylinder head member 17 and are threaded into suitable openings in the wall of the tubular member 10. A cylindrical surface 22 on the cylinder head member lies along the inner surface of the tubular wall member 10 as shown in FIG. 3. A resilient O-type gasket ring 19 accommodated in a recess in the end portion of the wall of the tubular member 10 as shown in FIG. 3 is displaced into sealed engagement with the tubular wall member 10 and the shoulder 18 and the surface 22 when the cap screws 21 are tightened.

A bushing 23 fits snugly about the periphery of the piston rod 14 and may be secured to the head member 17 by means of a set screw 24. A gasket assembly which includes a plurality of V-shaped packing rings 26 surrounds the piston rod 14 as shown in FIG. 4 and this assembly is held in place and urged into engagement with the perimeter of the piston rod 14 by means of a packing ring 27 which is L-shaped in section and secured to the cylinder head member 17 by a plurality of cap screws 28. A wiper ring 31 is accommodated in a recess in the packing ring 27 so as to engage and wipe the piston rod 14. An opening 32 is provided through the cylinder head member 17 for the purpose of supplying liquid into the interior of the tubular member 10. The opening 32 may be closed by a plug 33 which is threaded into the mouth of the fill opening 32.

The free end of each piston rod is provided with a cap member 34 which serves to prevent mushrooming of these ends as a result of impacts with lugs or stop members carried by one of the underframe members of a railway vehicle. A flexible bellows type boot 35 may be provided in surrounding relationship with each piston rod in a manner as illustrated in FIG. 1. These boots may be fastened to the piston rod cap members and to the cylinder head members in any suitable manner.

The interior of the tubular member 10 is substantially

cylindrically shaped but the maximum inner diameter is at a transverse plane 36 (FIG. 2) located substantially equal distances from the ends of the cylinder. An inner annular surface tapers inwardly in proceeding towards each end of the tubular member 10 from the plane 36. One of these conical surfaces 37 terminates adjacent the head member 16 and at a transverse plane 38. An inner conical surface 39 converges in proceeding towards the other end of the unit from the plane 36 and tapers inwardly at the same rate or at the same angle as that of the conical surface 37. The conical surface 39 terminates near the head member 17 and at a transverse plane 41. These conical surfaces 37 and 39 cooperate with the periphery of the piston 11 to form an orifice area which serves to meter movement of liquid from one side of the piston to the other side thereof during relative movements of the cylinder and the piston. The orifice area varies between a maximum at the plane 36 to a minimum at the planes 38 or 41. The inner annular surfaces 42 and 43 beyond the conical surfaces are desirably of cylindrical shape to facilitate mounting of the head members 16 and 17.

In operation and when there is movement of the piston 11 from its neutral position towards either end of the tubular member 10 and for example towards the cylinder head member 16 the liquid to the left of the piston escapes to the right through the orifice area provided between the periphery of the piston 11 and the conical surface 37. The radial outward displacement or swell of the tubular member 10 is proportional to the pressure therein. The pressure developed within the space between the piston 11 and the cylinder head 16 for an average velocity impact varies between fifteen hundred and forty-five hundred pounds per square inch, depending upon the conditions of impact. The area of the orifice defined by the perimeter of the piston 11 and the conical surface 37 is at a maximum when the piston is in the neutral position and during an average impact forward stroke, the pressure relief caused by the swell of the tubular wall is insignificant as shown by the curves in the lower portion of FIG. 5. The angle at which the surface 37 tapers in relation to the length of the stroke is such that a substantially flat closure curve is developed during an average impact applied to the coupler of a railway vehicle. The impact energy is absorbed by the time the piston 11 arrives in the vicinity of the plane 38. Such a relationship of the parts is developed at the conclusion of a forward impact stroke.

The present invention pertains to the structural characteristics of the wall of the tubular member 10 so that it serves to relieve pressure that may develop when a reverse or double impact is applied when the piston is near the transverse plane 38. The orifice area between the periphery of the piston 11 and the interior surface of the cylinder is then at a minimum. A reverse or double impact of average velocity serves to then develop pressures within the unit between the piston 11 and the cylinder head 17 in a range up to about nine thousand pounds per square inch. The metal forming the wall of the tubular member is designed to deform radially outwardly throughout the entire circumference when the pressure within the unit increases. As a consequence of both internal pressure and minimum orifice area, the amount of pressure relief is significant as indicated by the curves of the upper portion of FIG. 5. Such radial outward displacement of the wall of the tubular member 10 enlarges the orifice area between the perimeter of the piston 11 and the conical surface 37 and permits the liquid to move more freely to the low pressure side of the piston. Such structural characteristics serve to prevent unduly high pressures from being developed within the unit as a consequence of the small orifice area such as when the piston is near either end of the unit and a reverse impact is applied. The cylinder swell during forward impact strokes does not produce any significant pressure drop since the proportion of cylinder swell to the relatively large beginning orifice is small. This characteristic will be appreciated from a consideration of the lower curves of FIG. 5. The elasticity of the wall of the tubular member restores the inner surfaces to the designed meter orifice area when the pressure drops below the high valve.

It will be appreciated that the relief of pressure as a consequence of the radial outward displacement of the wall of the tubular member 10 momentarily enlarges the orifice area and that this phenomenon occurs during a portion of the piston stroke and when pressure relief would otherwise have to be achieved by some other means such as check valves.

While the invention has been described with reference to particular structural features it will be appreciated that changes may be made in the parts as well as the overall assembly and that the hydraulic device may be of the single acting type. Such modifications and others may be made without departing from the spirit and the scope of the invention as set forth in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. A hydraulic mechanism for cushioning impacts comprising, a tubular shaped wall, a head member closing each end of said tubular wall, a piston within said tubular wall, a piston rod carried by said piston extending through one of said head members, another piston rod carried by said piston extending through the other of said head members, said tubular wall having a diameter at its central portion greater than the diameter of said piston providing an orifice area between the perimeter of the piston and the inner surface of said tubular wall, inner surfaces on said tubular wall of conical shapes converging inwardly in proceeding from said central portion toward said head members, said tubular wall member being displaceable radially outwardly when the pressure between the piston and one of said head members rises above a predetermined value while the piston is displaced from said central portion and provides an enlarged orifice area sufficient to provide a significant pressure relief, and said tubular wall having an elastic limit above the pressure developed in service impacts.

2. A hydraulic mechanism for cushioning impacts according to claim 1 wherein the outward displacement of the tubular wall member when the piston is near one of the head members provides more relief than when the piston is in the central portion.

3. A hydraulic mechanism for cushioning impacts according to claim 1 wherein the tubular wall is a seamless metal tube.

References Cited

UNITED STATES PATENTS

2,833,535	5/1958	Blythe	267—63 X
3,163,301	12/1964	Settles	213—8
3,164,263	1/1965	Novickov	213—43 X
3,297,284	1/1967	Pellerin	188—88.506 X

ARTHUR L. LA POINT, *Primary Examiner.*

D. E. HOFFMAN, *Assistant Examiner.*