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HYDRO-PNEUMATIC OR HYDRAULIC JACK DEVICES

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Fig. 1

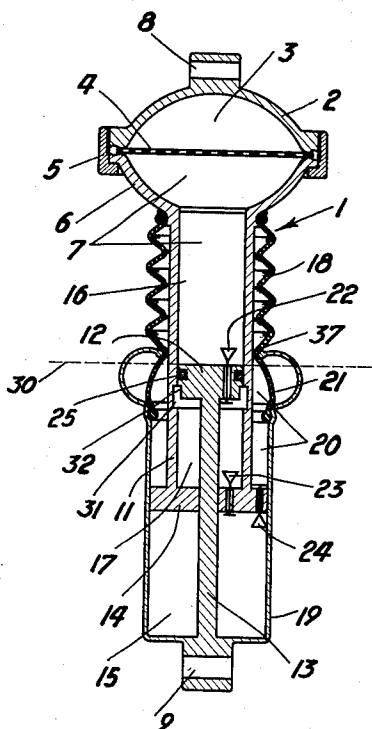


Fig. 2

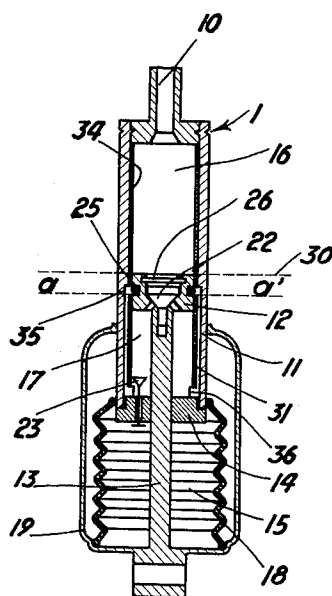


Fig. 3

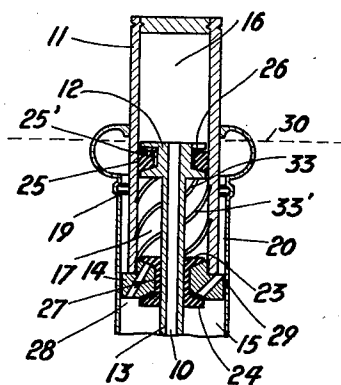
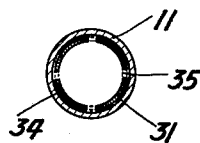


Fig. 4



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HYDRO-PNEUMATIC OR HYDRAULIC JACK DEVICES

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Hydropneumatic or hydraulic jack devices are presently used, as is well known, in various industrial applications, and particularly for the suspension and shock-absorption or damping of vehicles. In addition to the fact that liquid leakages from such jacks are not generally recovered, nor recoverable, the deflection of such jacks under a permanent load varies definitely as a function of such load. The effective damping of such presently known jacks, generally accomplished by other resilient means, is hardly adapted to the variations of this permanent load.

The present invention has for its object the provision of improved jacks of this type, enabling the recovery and the restoration of any leakage of useful liquid to the inside of the jack, the correction to a constant level of their deflection characteristics and of their damping when the permanent overload varies, all or part of these functions being automatically secured by using only the liquid inside the jack under the effect of the movements thereof, and more particularly under the effect of the movements caused by the wheels on passing over the inequalities and obstacles of the road, without resorting to auxiliary loading and reloading means (pumps), nor to any external control (trimming correction) of the fluid level within the jack, or to a stability correction (anti-rolling bar members).

The invention is wholly described in the following specification referring to the appended drawings, wherein:

FIGURES 1, 2 and 3 are cross-sectional views through the axis of three alternative embodiments, respectively, of jacks according to the invention, FIGURE 3 being a fragmentary view.

FIGURE 4 is a cross-sectional view, perpendicular to said axis, along the line *a-a'* of FIGURE 2.

A hydraulic jack according to the invention, as illustrated in FIGURE 1, indicated by the general reference number 1, comprises a cup-shaped member 2 including a gas chamber 3 and a diaphragm 4, secured in position on a cup-shaped member 6 of the jack body by means of locking ring 5, said diaphragm separating the gas contained in chamber 3 from the connecting fluid 7 in a chamber 16. The device is generally connected by means of two lugs such as 8 and 9, at the two opposite ends thereof, between the mobile parts of the system, and specifically between the wheel and the frame of the vehicle to which it is adapted. However, said jack may also be of the hydraulic type, as shown in FIGURES 2 and 3, and in this case it will be connected as at 10 to any auxiliary resilient system.

As is known in prior art jacks, harmful fluid leakages usually occur outside the chamber 16, particularly at the joint between piston 12 and the body 11 thereof, or between the piston-rod 13 and the guiding support or bearing guide 14 thereof, and flow towards chambers 17 and 15, wherefrom they are, in exceptional cases, recovered by an auxiliary arrangement, but are more often lost.

In the arrangements according to the present invention, these leakages are automatically recovered in the chamber 15 closed on purpose, and reincorporated in chamber 17 (below piston 12), then in the already mentioned upper chamber 16 above said piston, this being effected by the sole reciprocating motion of the various elements of the jack, in such a manner that, initially, while piston 12 is overloaded, the preliminary filling of

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chamber 17 below piston 12 should be compulsory, and that, on the other hand, the subsequent discharge from chamber 17 towards chamber 16 takes place during the opposite stroke during which piston 12 is discharging and that, finally, any overflow may be automatically discharged from chamber 16 to chamber 17.

Thus, referring more particularly to FIGURES 1 through 4, it will be noted that chamber 15, below the guiding support 14, may be placed either directly under the resiliently deformable bellows-shaped cap 18, as shown in FIGURE 2, secured at both its ends to said support 14 and, at the lower portion of the figure, to the bell-shaped member 19, or, as illustrated in FIGURE 1, below the bell-shaped portion 19, extended by an expansion chamber 20, and below a diaphragm 21 and cap 18 (top of FIGURE 1).

Piston 12 carries a control valve member 22, adapted to cause the fluid discharge to pass from chamber 17 to chamber 16, but not in the opposite direction. Bearing guide 14 carries a similar first control valve member 23 opposing, totally or partially, the liquid flow from chamber 17 to chamber 15, but may open a free passage to the liquid in the opposite direction, and a second similar control valve member 24 (FIGURES 1 and 3), opposing partially the flow of liquid from chamber 15 towards space 20, but leaving a free passage in the opposite direction, from space 20 towards chamber 15.

The control members 22, 23 and 24 may be of any desired type and member 22 may be located anywhere else than in the support 14, for instance, above support 14 (FIGURE 1) and inside the bell-shaped member 19; members 23 and 24 are however complementary to one another, one thereof being closed, while the other is open, and vice versa.

In FIGURES 1 and 3, the upstroke of piston 12 increases the volume of chamber 17, while shrinking that of chamber 15, the incompressible liquid of which tends to leak into the spaces 17 and 20, but closes member 24, thus resulting, through a viscous braking on space 20 towards chamber 15, in the compulsory filling of chamber 17 through the correlatively open member 23; in FIGURE 2, the filling of chamber 17 is urged by the tension of cap 18.

The subsequent downstroke of piston 12, in the case of FIGURE 1, in the body 11, increases the volume of chamber 15, while decreasing that of chamber 17, the liquid of which, being incompressible, closes member 23 and opens member 22, i.e. opens therethrough the liquid re-incorporation of chamber 17 in space 16, whereas the valve member 24 (FIGURE 3), opened subsequently to the closing of member 23, causes the liquid from space 20 to enter chamber 15, under stress due to diaphragm 21; in FIGURE 2, this liquid will remain constant under the stress of cap 18.

The overflow from chamber 16 is conducted below piston 12 in body 11, by a particular liquid flow arrangement leaking towards chamber 17 and automatically fed therein.

Various alternative embodiments of the above valves, gates and arrangements are illustrated in FIGURES 1 through 4.

Thus, as shown in FIGURES 1 and 2, in the piston, valves are used for the control member 22 for the passage from chamber 16 to chamber 17, whereas in FIGURE 3, the seal element 25 of piston 12 is itself used to this end, carrying at its center circumferential grooves 25' and being formed at the lower side with a tapered cross-section, adapted to stop the flow (position as shown in the figure), whereas, when driven upwards by a slight downward shift of piston 12, it may release said tapered portion and open the flow from chamber 16 to chamber

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17. Seal 25 abuts at the top on a rim or ring 26 (FIGURES 1 and 3), and FIGURE 2, respectively.

In FIGURE 3, a guide bearing plug 14 inserted at the lower end of body 11, carries valves 23 and 24 interlocked by piece 27, adapted to slide on rod 13 by slight axial shifts. These opposed heads 23 and 24 may thus either screen flow channels 28 of chamber 17 towards chamber 15 (half view from the left) and expose then passage or channel 29 of chamber 15 towards member 20 (half-view from the right), or inversely, member 24 screening the latter on behalf of the first.

When closed, member 24 leaves a passage for restrained flow liquid open, whereas when valve 23 is closed, said member may block any passage from chamber 17 to chamber 15.

Also shown in the drawings are various arrangements incorporating self-controlled liquid overflow or circulation channels from chamber 16 to chamber 17, at the level 30 of piston 12 in body 11.

At said level, a recess 31 (FIGURE 1) is provided in body 11 which may correspond to a clearance 32 outside piston 12, so that said recess and said clearance overlap when there is an excess of liquid in chamber 16 and when piston 12 lowers, the usual seal 25 in piston 12 is thus facing recess 31 and ceases to function.

In FIGURE 3, a recess inside body 11 corresponding to the recess 31 is provided by a plurality of helically shaped channels such as 33, 33' (which may also be longitudinally shaped), the upper ends of which are generally at level 30. When piston 12 is lowered in body 11, chambers 16 and 17 are in communication through said channels.

In FIGURES 2 and 4, the recess 31 of body 11 is extended up from its base on bearing 14 and is covered by an inner sheath or jacket 34 formed with calibrated openings 35 exposed by piston 12 below level 30 and which allow the flow outside cap 18, and with windows 36, adjacent bearing 14, and the passage to chamber 17. In FIGURE 3, clearance 29 provides for restricted fluid flow between chamber 15 and space 20.

In this type of jacks, the damping according to the invention remains conventional as a function of the speed of piston 12 in body 11.

When piston 12 is overloaded, the flow of liquid from chamber 15 towards space 20 is throttled at the laminar passage or clearance between said head or bearing 14 and the inside diameter of the bell-shaped piece 19, or by any other known means provided in said bearing 14.

When piston 12 relieved, the discharge of the liquid from chamber 17 towards chamber 16, due to the expansion of the gas in chamber 3, or to the resilient element, is controlled and restricted by the maximum energy thereof, the value of which remains an instant function of the preliminary shift of piston 12. The energies at work are identically opposed and, when valve 23 is hermetically closed, they mutually cancel whatever the residual energetic value possessed at that instant by said elastic element, so that said damping, complementary to the previous one, may be complete.

In these examples of the jacks as described and illustrated according to the invention, it is seen that any liquid leakage outside the members thereof is recovered in a chamber adjacent to the body of these jacks and taken up again below the piston, then re-incorporated into the initial chamber above the piston, at a constant level, without resorting to any auxiliary means, external to said jacks.

What I claim is:

1. A hydraulic jack for a vehicle having a frame and wheels, said jack comprising a first hollow body having a bottom portion, an open upper end and a first cup-shaped member at said open upper end and communi-

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cating with said first body, said first cup-shaped member being open at its top; a second cup-shaped member, open at its bottom, attached to the open top of said first cup-shaped member; a deformable diaphragm fixed between and extending through said first and second cup-shaped members and providing therewith two substantially equal chambers respectively below and above said diaphragm; means on said second cup-shaped members for attaching the latter and said first body to one part of the vehicle frame and wheels; a second hollow body closed at its bottom and being coaxial with said first body and surrounding and slidably engaging at least a portion thereof; a piston slidably engaging and being mounted coaxially within said first body; a piston rod fast with said piston; a guide bearing for said piston rod in the bottom portion of said first body; a rigid connection between said piston rod and the bottom end of said second body; means for connecting said piston rod and with it said second body to that part of the frame and wheels which is not connected to said first body; a fluid under pressure in the upper of said two chambers; a fluid in said first body and in the lower of said two chambers; a passageway in said piston for the passage of fluid through said piston from one face thereof to the other within said first body; valve means for closing and opening said passageway; means in said piston for permitting passage of fluid between said piston and said first body from one face of said piston to the other; a first fluid passage extending through said guide bearing and located between said piston rod and the wall of said first body; a second fluid passage extending through said guide bearing and being located between said wall of said first body and the surrounding said second body; valve means for opening and closing said first and second fluid passages; a deformable convolute diaphragm having two open ends and being concentric with both said first and said second bodies; a fluid tight connection between one of said ends of said tubular diaphragm and said first body; and a fluid tight connection between the other of said ends of said tubular diaphragm and said second body.

2. A jack device according to claim 1, wherein a recess is formed in said first body and a corresponding clearance is formed in said piston.

3. A jack device according to claim 1, wherein circulation channels are provided between the two portions of said first body on opposite sides of said piston.

4. A jack device according to claim 1, wherein the portion of said first body on one side of said piston extends to said bearing guide.

5. A jack device according to claim 1, wherein said tubular diaphragm is extensible radially outwardly with respect to said first and second bodies.

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