Nov. 4, 1958 J. A. JOHNSON 2,859,032

SHOCK ABSORBING DEVICE

Filed May 10, 1956 2 Sheets-Sheet 1

FIG. 1

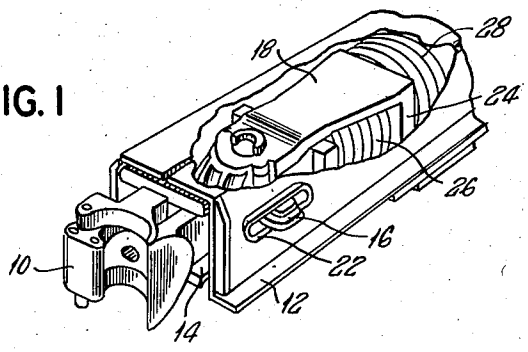



FIG. 2

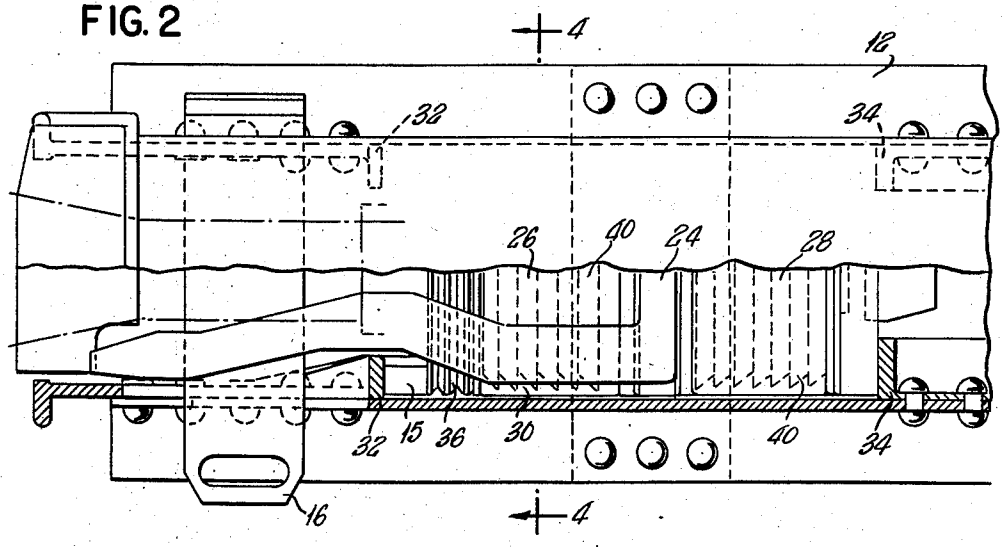
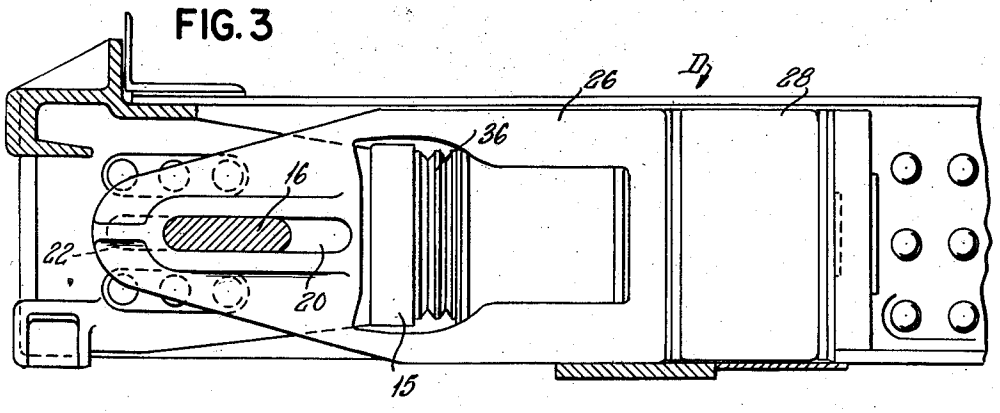



FIG. 3




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FIG. 4

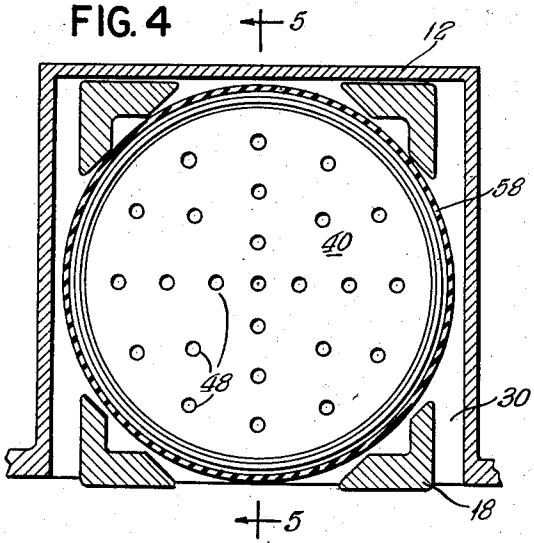



FIG. 5

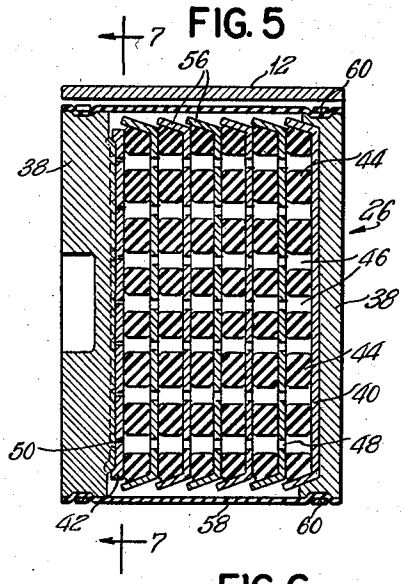



FIG. 9

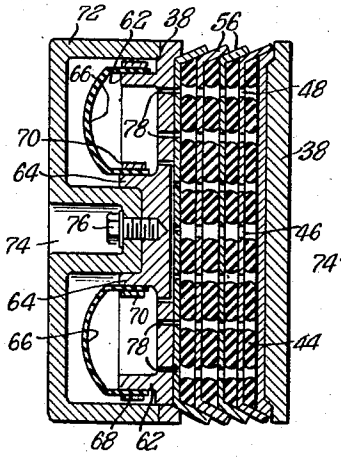



FIG. 8

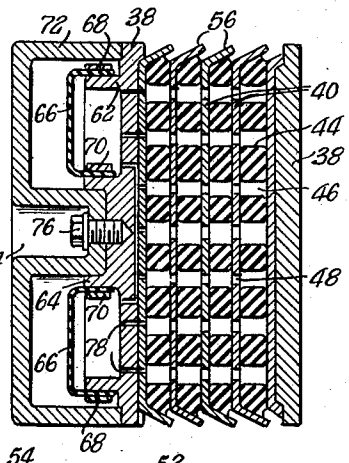
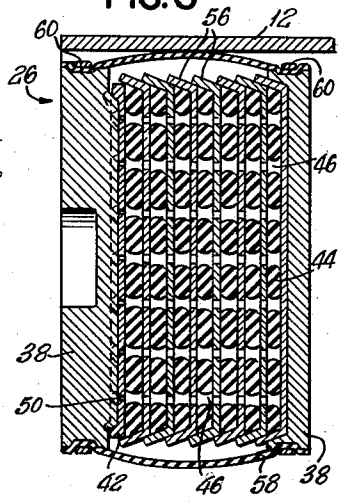



FIG. 6



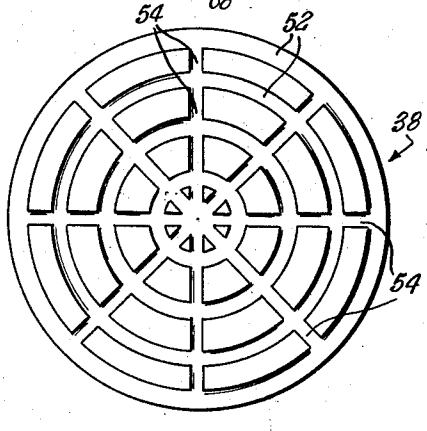




FIG. 7

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2,859,032

# SHOCK ABSORBING DEVICE

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Application May 10, 1956, Serial No. 583,973

13 Claims. (Cl. 267—1)

This invention relates to impact or shock absorbing devices and particularly to a hydraulic rubber cushioning device for railway car draft gear. The invention also has other applications such as in railway car floating center sill structure and hold-down mechanism for highway trailers on railway cars, but is generally shown and described in connection with railway draft gear.

Standard friction and rubber spring types of draft gear have certain advantages and disadvantages. The friction type of gear employs spring-loaded friction elements and provides greater initial impact resistance, but tends to alternately bind and slide during operation and closes positively or abruptly solid upon reaching its maximum energy absorbing capacity. The rubber spring type gear utilizes rubber pads or mats interposed between and bonded to metal spacer plates and while inherently less resistant to initial impact than the friction type, does not tend to go abruptly solid when closed and is satisfactory for slightly higher impact velocities. In addition, the standard types of gear have an undesirable sharp recoil characteristic, the greater the impact absorbing capacity the shorter the draft gear travel. Increasing the length of draft gear travel would provide greater and more gradual energy absorption, but limitations are imposed by the size of the draft gear pocket. Neither type of standard gear is satisfactory for present-day high impact velocities, where the energy in excess of absorption capacity of the gear must be absorbed by the car structure and lading, frequently resulting in damage thereto.

It is an object of the present invention to provide a shock absorbing cushioning device for railway car draft gear which eliminates the disadvantages of the standard friction and rubber spring types of gear while retaining the advantages.

Another object of the invention is to provide a device as above described adapted to absorb the high velocity impacts of present-day railroad practice.

Still another object of the invention is to provide a hydraulic cushioning device of the character described in which a viscous fluid is pumped under pressure from chambers therein by compression on impact to increase the energy absorbing capacity of the draft gear.

These and other objects of the invention will be apparent to those skilled in the art from a study of the following description taken with the accompanying drawings, in which:

Figure 1 is a perspective, partially broken-away view showing the cushioning device of the present invention embodied in a railway car draft gear;

Fig. 2 is a plan view of the draft gear assembly, certain parts being broken away to better disclose other parts;

Fig. 3 is a side elevational view of the draft gear assembly with a flange of the center sill removed;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 2;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 4 showing one unit of the device in normal position;

Fig. 6 is a sectional view similar to Fig. 5, but showing the unit in "solid" or compressed position;



Fig. 7 is a sectional view taken on line 7—7 of Fig. 5 showing the grooved end plate of the cushioning units;

Fig. 8 is a sectional view similar to Fig. 5 showing a modified form of hydraulic cushioning unit in normal position, and

Fig. 9 is a sectional view similar to Fig. 8, but showing the modified form of cushioning unit in "solid" or compressed position.

Referring now more in detail to the drawings, the shock absorbing device is shown in Fig. 1 as applied to a railway car draft gear having a coupler 10 extending from center sill 12 with its shank 14 connected by key 16 to a yoke 18. The key is arranged in slot 20 of the yoke and projects through slot 22 in the draft or center sill 12, as is standard practice. The draft gear arrangement may be of any suitable type, such as shown in Figs. 2 and 3, wherein the back face 24 of the yoke 18 is interposed between the forward and rear cushioning units 26, 28, respectively, of the shock absorbing device generally designated D. The device is shown as installed in the standard draft gear pocket 30 of center sill 12 between front and rear draft lugs 32, 34, respectively, and due to its high energy absorbing capacity the units may be sufficiently smaller than usual to permit inclusion of a standard rubber cushion unit 36 in advance of the forward unit 26. The forces in buff are transmitted through the butt of coupler shank 14 and a front follower 15 to each of the cushioning units 36, 26, 28, respectively, in series, while the draft forces are absorbed through yoke back face 24 only by the forward unit 26 of the device D and standard unit 36. However, this is merely by way of illustration, since either or both units 26, 28, of the device may be used with various other arrangements of transmitting forces to be absorbed according to conditions and requirements.

One form of hydraulic cushioning unit or device 26 is shown in Figs. 4–7, and since it is essentially the same as unit 28, the description of it and reference numerals apply to both. The device comprises end plates 38 between which are arranged a series of vertically disposed longitudinally spaced pan-shaped metal plates 40 and an orifice disk or plate 42 adjacent one of the end plates. Interposed or sandwiched between and bonded to these plates are perforated circular resilient mats or pads 44, of rubber or other elastic material, forming with the plates a plurality of contractable circumferentially spaced concentrically arranged chambers 46 containing a suitable viscous hydraulic fluid. The rubber elements 44 may be in the form of concentrically arranged rings, forming therebetween concentric annular chambers 46. The plates 40 between rubber elements 44 are provided with circumferentially spaced passageways 48 extending therethrough properly located to connect the chambers 46 which are axially adjacent to each other. The disk 42 adjacent end plate 38 is formed with orifices 50 somewhat smaller than and located to communicate with the passages 48. The orifices 50 in disk 42 are also in communication with circumferential grooves 52 in end plate 38 which are in turn connected by radially extending channels 54 leading to the periphery of the end plate exteriorly of the series of plates 40. The plates 40 are arranged in what may be termed partially nested relation with their diagonal rim or flange portions 56 extending in the same direction and normally slightly overlapping each other and overlying the outer edges of the rubber mats or rings 44. An expansible fluid accumulator 58 of reinforced sheet rubber or similar elastic material completely surrounds the series of sandwiches formed by the plates and rubber elements 40, 44, respectively, and is sealingly secured to the periphery of end plates 38 by clamps or bands 60.

In operation, when the cushioning units 26, 28 are com-

pressed in resisting the impact of either buff or draft forces, as shown in Fig. 6, the plates 40 are moved closer together and the rubber elements 44 compressed or distorted, contracting the size of chambers 46. The contraction of chambers 46 acts to pump hydraulic fluid therefrom under pressure through passages 48 in plates 40 and orifices 50 in disk 42 to circumferential grooves 52 and radial channels 54 in the end plate 38. The fluid then finally enters the accumulator 58, which is slightly distended or expanded in accommodating to the fluid pressure, as also indicated in Fig. 6. It will be seen that in effect the sandwiches formed by the plates 40, rubber elements 44 and the pumping of fluid under pressure from the intercommunicating contracting chambers 46 arranged axially to each other act in series, while deformation of the rubber elements 44 radially into chambers 46 act in parallel, to absorb the energy of the impact. In other words, compression of the units 26 or 28 contracts the size of fluid containing chambers 46 both axially and radially, compression of plates 40, rubber rings 44 and contraction of chambers 46 axially acting in series, while distortion of rings 44 and contraction of chambers 46 radially acts in parallel. The frictional engagement of adjacent diagonal rim portions 56 of plates 40 aid further in absorbing the shock as well as acting to limit compression of the cushioning units. These rim or flange portions 56 also serve to limit distortion or spreading of the outer edges of the outermost rubber rings 44, thus further increasing contraction of the chambers 46 and the energy absorbing capacity of the units. Upon decompression of the units to normal position as shown in Fig. 5, the elastic fluid accumulator 58 contracts and the fluid is returned to chambers 46.

The cushioning unit per se of the modification shown in Figs. 8, 9 is similar to that in Figs. 4–7 and the same reference numerals have been applied thereto, but a different type accumulator is used. In Figs. 8, 9 the orifice plate 42 and the grooves and channels 52, 54 in the end plate 38 are omitted and instead one of the end plates is provided with projecting outer and inner annular ribs 62, 64, respectively. The fluid accumulator 66, of rubber or similar elastic material, is sealingly secured to the ribs 62, 64 by any suitable means, such as outer and inner clamps or bands 68, 70, respectively. The elastic accumulator is enclosed by an annular housing 72 secured at its hub portion 74 to the end plate 38 by a bolt 76. The end plate is provided with circumferentially spaced orifices 78 extending therethrough and properly located to connect the passages 48 in plates 40 with the annular or doughnut-shaped accumulator 66. Operation of the modified form of device is basically the same as described for Figs. 4–7, except that when compressed, as shown in Fig. 9, the fluid is pumped directly through the orifices 78 in end plate 38 into an interior housed accumulator instead of by way of an orifice disk to a grooved and channeled end plate into an exterior accumulator surrounding plates 40, as shown in Figs. 4–7. When decompressed to normal position, as shown in Fig. 8, the accumulator deflates and fluid returns to chambers 46, the same as described for Figs. 4–7.

From the foregoing description it is believed clear that a shock absorbing device has been provided having the necessary increased energy absorbing capacity to withstand present-day high velocity impacts. The pumping of hydraulic fluid under pressure, together with the advantages of the rubber cushioning elements, increases especially the initial impact absorbing capacity of the device while reducing to a minimum the tendency in standard devices to close positively solid. In addition, the recoil of the present device is more gradual or less abrupt than in the standard friction type device.

The invention may be modified in various respects as will occur to those skilled in the art, and the exclusive use of all such modifications that come within the scope of the appended claims is contemplated.

What is claimed is:

1. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced metal plates between said end plates, resilient mats interposed between and bonded to said spaced plates, a plurality of contractable hydraulic fluid containing chambers within said device, an expansible accumulator associated with said device, and passageways connecting said chambers to permit pumping of fluid under pressure therefrom during compression of said device, at least one of said end plates being formed with means connecting said passageways with said accumulator for passage of fluid pumped from said chambers into said accumulator.

2. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced circular metal plates between said end plates, resilient mats interposed between and bonded to said spaced plates, said mats being formed to provide a plurality of axially spaced contractable hydraulic fluid containing chambers within said device, an expansible accumulator associated with said device, and passageways extending through said spaced plates connecting said axially spaced chambers to permit pumping of fluid under pressure therefrom during compression of said device, at least one of said end plates being provided with means connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

3. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced circular metal plates between said end plates, resilient mats interposed between and bonded to said spaced plates, said mats being formed to provide a plurality of contractable hydraulic fluid containing chambers within said device radially and axially spaced from each other, an expansible accumulator associated with said device, and passageways extending through said spaced plates connecting the axially spaced chambers to permit pumping of fluid under pressure therefrom during compression of said device, at least one of said end plates being formed with means connecting said passageways with said accumulator for passage of fluid pumped from said chambers into said accumulator.

4. In a hydraulic shock absorbing cushioning device, end plates a series of vertically arranged longitudinally spaced circular metal plates between said end plates, resilient concentric rings interposed between and bonded to said spaced plates, said concentric rings forming with said plates a plurality of contractable hydraulic fluid containing chambers therebetween, an expansible accumulator associated with said device, and passageways extending through said spaced plates connecting said chambers to permit pumping of fluid under pressure therefrom during compression of said device, at least one of said end plates being formed with means connecting said passageways with said accumulator for passage of fluid pumped from said chambers into said accumulator.

5. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced pan-shaped metal plates between said end plates, resilient mats sandwiched between and bonded to said spaced plates, said mats being formed to provide a plurality of contractable hydraulic fluid containing chambers within said device, an expansible accumulator associated with said device, and passageways extending through said spaced plates connecting said chambers to permit pumping of fluid under pressure therefrom during compression of said device, said pan-shaped plates being forced toward nested position whereby the rim portions thereof interengage to limit compression of said device, at least one of said end plates being formed with means connecting said passageways with said accumulator for passage of fluid pumped from said chambers into said accumulator.

6. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally

spaced pan-shaped metal plates between said end plates, resilient concentric rings sandwiched between and bonded to said spaced plates, said concentric rings forming with said plates a plurality of contractable hydraulic fluid containing chambers therebetween, passageways extending through said spaced plates connecting said chambers to permit pumping of fluid under pressure therefrom during compression of said device, said pan-shaped plates being forced toward nested position whereby the rim portions thereof interengage to limit spreading of the outer edges of the outermost concentric rings, and an expansible accumulator associated with said device, one of said end plates being formed with means connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

7. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced plates between said end plates, resilient mats interposed between and bonded to said spaced plates, said mats being formed to provide a plurality of contractable hydraulic fluid containing chambers within said device, an expansible accumulator surrounding said series of spaced plates and sealingly secured to said end plates, and passageways extending through said spaced plates connecting said chambers to permit pumping of fluid under pressure therefrom during compression of said device, at least one of said end plates being provided with means connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

8. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced plates between said end plates, resilient mats sandwiched between and bonded to said spaced plates, said mats being formed to provide a plurality of contractable fluid containing chambers within said device, passageways extending through said spaced plates connecting said chambers to permit pumping of fluid under pressure therefrom during compression of said device, and an expansible accumulator surrounding said series of spaced plates and sealingly secured to said end plates, one of said end plates having channels therein connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

9. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced plates between said end plates, resilient mats interposed between and bonded to said spaced plates, said mats being formed to provide a plurality of contractable fluid containing chambers within said device, passageways extending through said spaced plates connecting said chambers to permit pumping of fluid under pressure therefrom during compression of said device, a housing secured to one of said end plates, and an expansible accumulator within said housing sealingly secured to said end plate, said end plate having orifices therethrough connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

10. In a hydraulic shock absorbing cushioning device, end plates, a series of vertically arranged longitudinally spaced plates between said end plates, resilient concentric rings interposed between and bonded to said spaced plates, said concentric rings forming with said plates a plurality of contractable hydraulic fluid containing chambers therebetween, an expansible accumulator surrounding said series of spaced plates and sealingly secured to said end plates, and passageways extending through said spaced plates connecting said chambers, said spaced plates and resilient rings acting in series and the latter also in parallel to pump fluid from said chambers during compression of said device, one of said end plates being formed with means connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

11. A hydraulic shock absorbing cushioning device comprising, end plates, a series of vertically arranged longitudinally spaced circular metal plates between said end plates, concentric rings of rubber sandwiched between and bonded to said spaced plates, said rubber rings forming with said spaced plates a plurality of concentric chambers therebetween contractable in size when said device is compressed by imposition of impact thereon, a viscous fluid in said chambers, circumferentially spaced passageways extending through said spaced plates connecting said chambers, said spaced plates and rubber rings acting in series and said rubber rings also in parallel upon compression of said device to pump fluid from said chambers, and an elastic accumulator casing enclosing said series of plates and sealingly secured to said end plates, at least one of said end plates being provided with circumferential and radial channels connecting said passageways and accumulator for passage of fluid pumped from said chambers into said accumulator.

12. A hydraulic shock absorbing cushioning device including end plates and a series of vertically arranged longitudinally spaced circular metal plates having diagonal peripheral flanges between said end plates, rubber pads sandwiched between and bonded to said spaced plates, said rubber pads being formed to provide a plurality of contractable hydraulic fluid containing chambers within said device, passageways extending through said spaced plates connecting said chambers whereby fluid is pumped therefrom under pressure during compression of said device to absorb the energy of impact imposed thereon, said plate flanges being forced into frictional engagement to increase said energy absorption, and an elastic accumulator surrounding said series of spaced plates and sealingly secured to said end plates, one of said end plates being formed with means connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

13. A hydraulic shock absorbing cushioning device including end plates and a series of vertically arranged longitudinally spaced circular metal plates between said end plates, circular rubber mats sandwiched between and bonded to said spaced plates, said rubber mats being perforated to form with said plates a plurality of contractable circumferentially spaced concentrically arranged hydraulic fluid containing chamber within said device, passageways extending through said spaced plates connecting said chambers whereby fluid is pumped therefrom under pressure during compression of said device to absorb the energy of impact imposed thereon, and an expansible accumulator associated with said device, one of said end plates being formed with means connecting said passageways with said accumulator whereby fluid pumped from said chambers is received in said accumulator.

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