# United States Patent [19]

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[11] **3,779,396**

[45] **Dec. 18, 1973**


[54] **HYDRAULIC BUFFERS**


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[22] Filed: **Mar. 30, 1972**

[21] Appl. No.: **239,668**

[30] **Foreign Application Priority Data**

Apr. 17, 1971 Germany ..... P 21 18 655.0

[52] **U.S. Cl.** ..... **213/43,** 213/223, 267/65 R

[51] **Int. Cl.** ..... **B61g 9/08**

[58] **Field of Search** ..... 213/8, 43, 223; 188/289; 267/8 A, 65 R



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[57] **ABSTRACT**

A hydraulic buffer device of the type in which a piston is slidable in a cylinder and has a throttle aperture which is controlled by a regulating pin whose cross section varies along its length. The throttle aperture is closable by a valve member which is spring loaded into the closing position. On rapid entry of the piston into the cylinder the valve member is unsealed and a relatively low resistance to piston travel is afforded. On slow entry of the piston into the cylinder the valve member remains seated and a relatively high resistance to travel of the piston is afforded.


**2 Claims, 5 Drawing Figures**

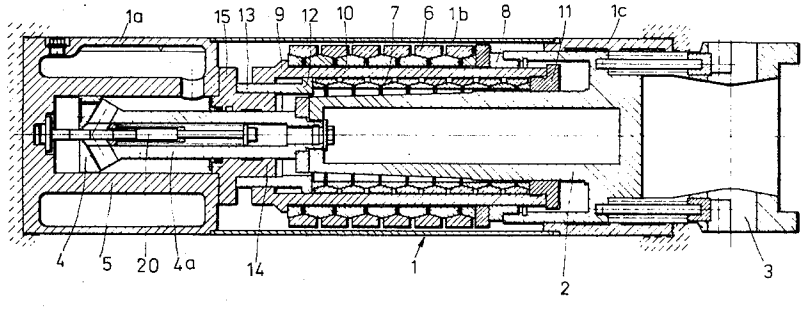


Fig. 1

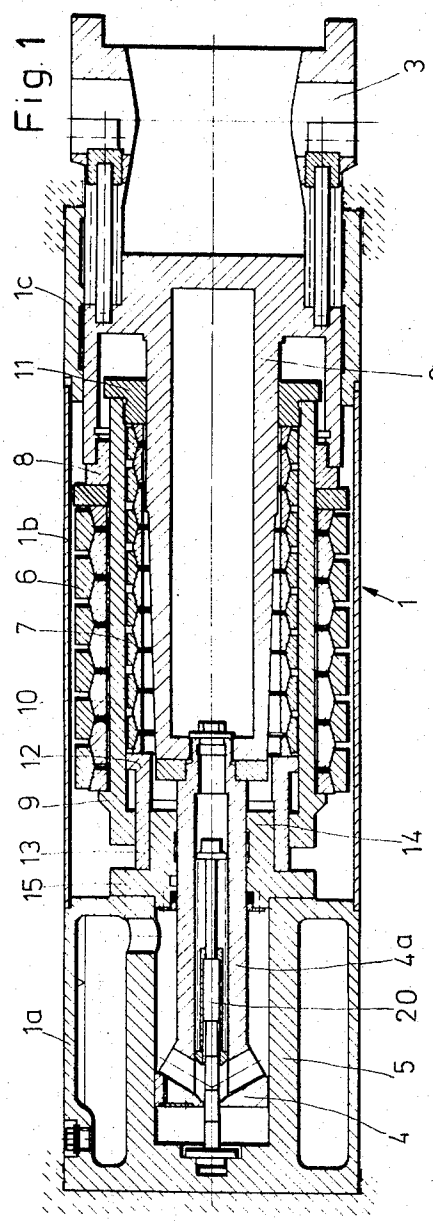
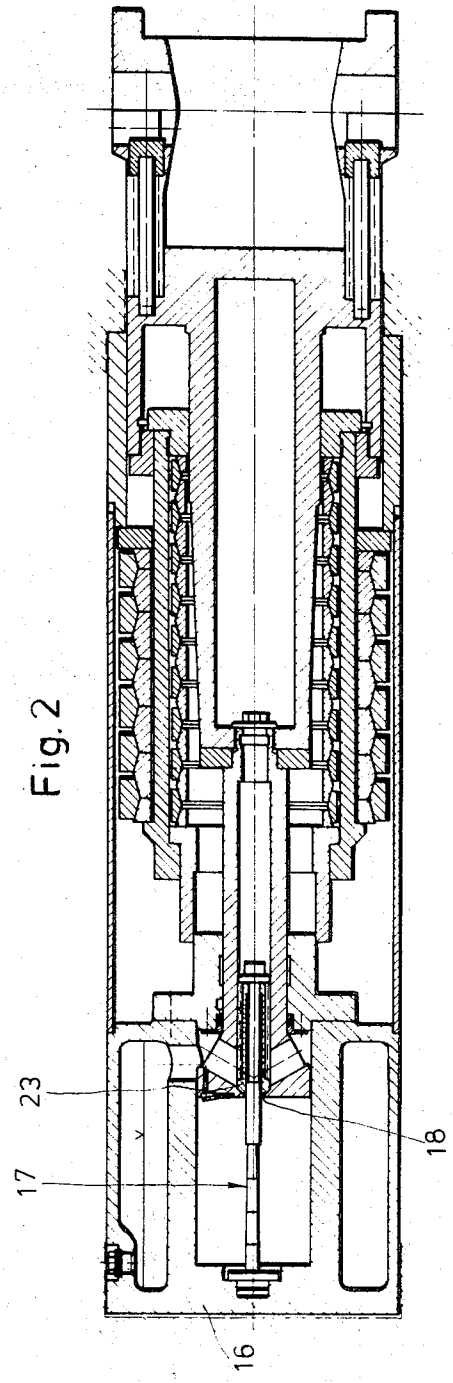



Fig. 2



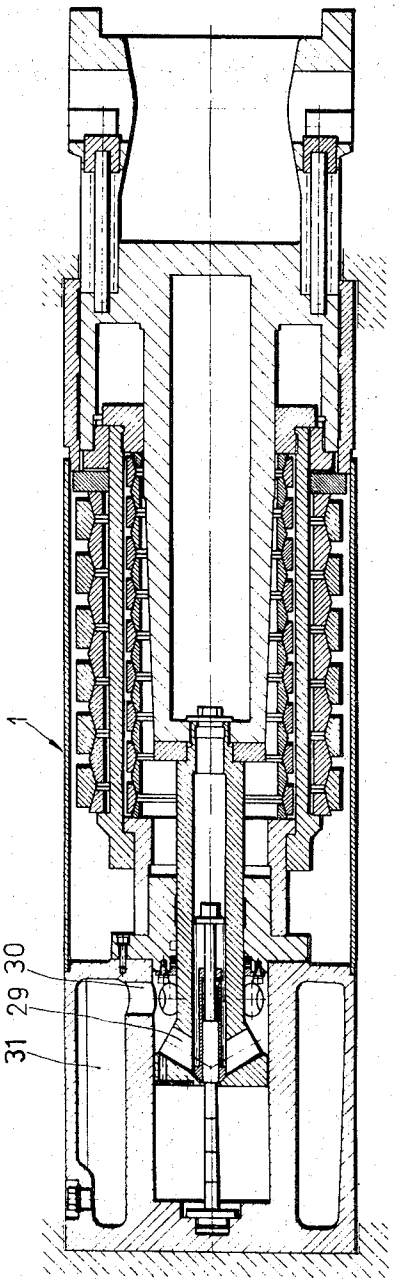



Fig. 3

Fig. 4

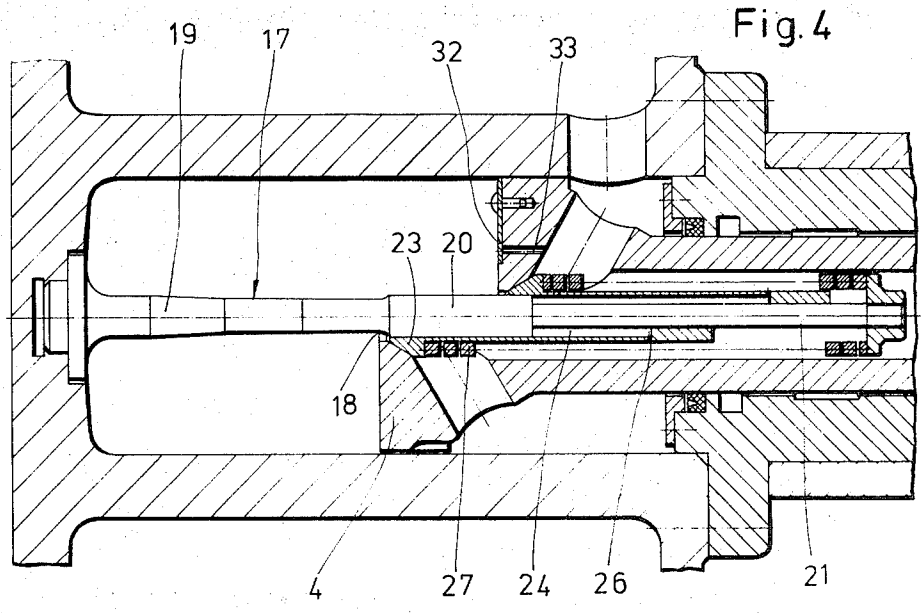
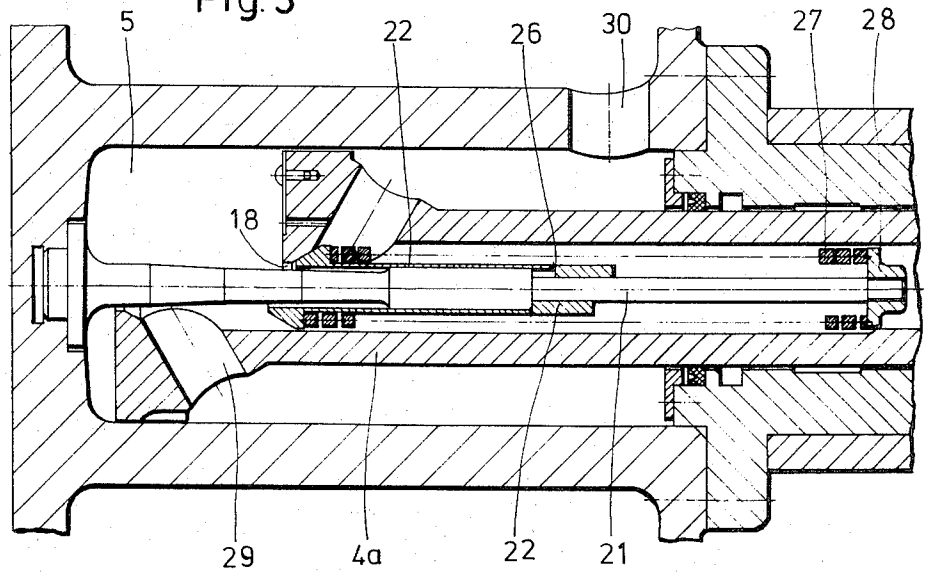



Fig. 5



# HYDRAULIC BUFFERS

This invention relates to hydraulic buffers of the type in which a braking force is produced by fluid enclosed in a cylinder being forced out through a throttle aperture as a piston enters. The cross sectional area of the throttle aperture can be varied depending on the buffer stroke by a regulating pin projecting into the throttle aperture, so that certain variations of the buffer force along the buffer stroke can be achieved.

In railway buffers, this type of hydraulic buffer action is suitable for withstanding impacts during shunting operations. In this case the piston has a relatively high entry speed and it is necessary to absorb these impacts so that the energy is dissipated, in order to avoid high decelerations or accelerations of the carriages and goods.

However, during the travel of a railway train, as well as during braking, only slight differences in speed occur between the individual carriages so that the buffer piston enters the cylinder at a relatively low speed.

With the known hydraulic buffers of the type described above this would have the result that on braking the train the coupling would be severely compressed, due to which when the train moves off again or when the brakes are released, undesirable, alternating pulling and pushing movements between the carriages and in particular during rapid braking of long trains high longitudinal forces occur. Therefore, for travelling, a coupling which is as rigid as possible is desired, which with low entry speeds of the buffer piston produces a considerable buffer force.

It is an object of the invention to provide a hydraulic buffer device for vehicles, in particular rail vehicles, which with low piston entry speeds — as they occur between the individual carriages when braking a train — has a high resistance and in the case of impacts causing higher piston entry speeds has a comparatively low resistance, the hydraulic buffer force being determined solely by the piston entry speed and the colliding masses.

In a hydraulic buffer device of the afore-described type, this object is fulfilled according to the invention in that an annular valve cone slidably guided on the regulating pin and supported on the latter against a closing spring is associated with the throttle aperture provided concentrically in the piston, as a pressure limiting valve.

When the train is standing still, and with low piston entry speeds, such as occur at the buffer when slowing down the train, the throttle aperture remains closed due to the valve cone, which thus forms a locking device and produces a comparatively rigid coupling of the train. Only when a pressure corresponding to the initial stressing force has built up in the cylinder in front of the piston is the valve cone pushed back against the force of its closing spring and the throttle aperture cleared. Thus in the case of low piston entry speeds the valve cone closing the throttle aperture determines the buffer force. In the case of high entry speeds, such as occur during forceful impacts, the valve cone is not able to follow the leading piston at the same speed, so that the annular throttle opening is cleared.

In a preferred embodiment of the invention the valve cone is located at one end of a sleeve guided on a cylindrical section of the regulating pin, the other end of which sleeve forms an annular cylinder chamber with a section of lesser diameter adjoining the cylindrical section, the wall of which chamber has a throttle bore.



The closing speed of the valve cone is determined according to the dimensions of the throttle bore, in that the pressure fluid located in the cylinder chamber has to be pushed through the throttle bore by the force of the valve spring.

The load characteristic of the closing spring of the valve cone is in this case appropriately arranged so that in the case of low entry speeds depending on the buffer stroke an approximately constant buffer force results. In co-operation with the mechanical spring of a mechanical/hydraulic buffer and draw gear device a force pattern of this type results in the buffer force of the mechanical spring increasing as the piston enters the buffer, whereas the spring force of the closing spring of the pressure limiting valve is reduced and thus due to the opening of the valve the fluid pressure in the buffer cylinder is reduced.

The invention will now be further described with reference to the accompanying drawings, in which:

FIGS. 1–3 show a buffer and draw gear device for central buffer couplings with one embodiment of hydraulic buffer device according to the invention shown in longitudinal section, in various positions.

FIGS. 4 and 5 show the hydraulic buffer device in various positions of the buffer piston in longitudinal section as a partial section of FIG. 1 on an enlarged scale.

Whereas FIG. 3 shows a mechanical / hydraulic buffer and draw gear device in the starting position, FIG. 1 shows the device in the pushing position in the case of impact and FIG. 2 shows it in the pulling position. The reference numeral 1 indicates the housing of the buffer and draw gear device forming a closed unit. The housing consists of the cup-shaped part 1*a* receiving the hydraulic part, an adjoining sleeve 1*b* and a support sleeve 1*c* serving for supporting the mechanical spring. The unit is rigidly secured to a carriage on the longitudinal central axis thereof. A moving part 2 of the device is located in the housing. The device has, at its end projecting from the housing, a coupling part 3 for the flexible attachment of the central buffer coupling and, at its other end, a piston rod 4*a* with a buffer piston 4, which projects into a hydraulic cylinder 5 formed in the cup-shaped part 1*a*.

The mechanical spring mechanism comprises two annular spring columns 6 and 7 arranged concentrically around the moving part 2. The outer annular spring column 6 is fixed between an annular flange 8 secured to the movable part 2 of the device and a shoulder 9 of a sleeve 10 movable relative to the movable part 2. The inner annular spring column 7 is fixed between an annular flange 11 secured to the sleeve 10 and a collar 12 of a sleeve 13, which is slidably guided on a boss 14, which is located on a removable end wall 15 of the cylinder.

A regulating pin 17 is secured in an end wall 16 of the cylinder opposite the piston 4 and extends through a central throttle aperture 18 in the piston into a hollow piston rod 4*a*. Starting from the end wall 16 of the cylinder the regulating pin has, firstly, a section 19 of tapering diameter, a cylindrical section 20 of greater diameter and a cylindrical section 21 of lesser diameter. The diameter of the throttle aperture 18 is such that a narrow annular clearance remains between it and the periphery of the cylindrical section 20 (FIGS. 4 and 5).

A sleeve 22 of substantially greater length than that of the section 20 is guided on the cylindrical section 20, which sleeve has at one end a valve cone 23 and at its other end a shoulder 25 guided on the section 21 of lesser diameter forming an annular cylinder chamber 24. A throttle bore 26 is provided in the wall of the cylinder chamber. The sleeve 22 with the valve cone 23 is supported against a spring washer 28 by a coil spring 27 acting as a closing spring, which spring washer 28 is attached to the end of the cylindrical section 21 of the regulating pin. The closing speed of the valve 23 depends on the load characteristic of the closing spring and the cross section of the throttle bore 26 in the wall of the cylinder chamber 24. In this way, the valve cone 23 forms a pressure limiting valve for the pressure fluid located in the hydraulic cylinder 5, which can pass when the valve is open through the throttle aperture 18 and through bores 29 located in the piston 4 to the other side of the piston, the cylinder space being connected by way of apertures 30 to a compensating chamber 31 surrounding the cylinder. A bore 33 closed by a resilient valve plate 32 is also provided in the front end of the piston.

The compensating chamber 31 does not work as a hydropneumatic pressure reservoir, its function is solely to receive the fluid displaced by the piston rod at the time of the pushing stroke or to supply the additional amount of fluid required at the time of the pulling stroke and to compensate for changes in volume caused by heating.

The method of operation of the mechanical/hydraulic buffer and draw gear device is as follows:

FIG. 3 shows the device in the starting position. This position corresponds to the position of the buffer piston illustrated on a larger scale in the lower half of FIG. 4.

The pressure limiting valve is closed and, apart from their prestress, the annular spring columns are unloaded. Under tensile load (FIG. 2) the outer annular spring column 6 is compressed, it being supported against the carriage construction by means of the support sleeve 1c, whereas the inner spring column 7 is only displaced by the same amount. The piston 4 also moves by the same amount (FIG. 5 at the top), the valve 23 remaining closed and the valve plate 32 lifting so that the pressure fluid is able to pass through the bore 33 into the space in front of the piston 4. Simultaneously, the cylinder chamber 24 formed between the wall of the sleeve 22 and the section 21 of the regulating pin is filled through the throttle bore 26. FIG. 2 shows the extreme position at the time of the greatest tensile load. During the travel of a railway train the device will adopt a position corresponding approximately to FIG. 3 and FIG. 5 at the bottom.

At the time of braking the train only slight differences in speed occur between the individual carriages and thus the entry speed of the buffer piston is low. In this case the spring mechanism assumes the position shown in FIG. 1 and in FIG. 5 at the top. Since, in this case, the buffer piston 4 enters the cylinder at a comparatively low speed, sufficient time remains for the pressure fluid located in the cylinder chamber 24 to be displaced through the throttle bore 26 under the action of the force of the closing spring 27, so that the throttle opening 18 remains closed by the valve cone 23. In this way the mechanical spring mechanism is, as it were, locked during travel and at the time of braking the train, so that during these operating conditions the buffer and draw gear device has a high initial stressing force.

In the case of greater dynamic loads, as they occur with impacts, the buffer piston is inserted into the cylinder at a comparatively greater speed (FIG. 1). The valve cone 23 actuated by its closing spring 27 is not able to follow the rapid movement of the piston, since for this the fluid located in the cylinder chamber 24 must be pushed out through the throttle bore 26. In consequence and aided by the pressure build-up in front of the piston 4, the valve opens, so that the fluid can pass unhindered through the throttle aperture 18 to the other side of the piston. Thus, in the case of dynamic loading with a certain range of piston speeds, the hydraulic buffer device has a lower resistance so that even with impacts between lighter carriages no greater acceleration or deceleration values occur.

What is claimed is:

1. Hydraulic buffer device comprising: a cylinder, a piston slidable in said cylinder, a throttle aperture provided in said piston, a regulating pin for varying the available cross-section of said throttle aperture, said regulating pin being provided with a cross-section which varies in the longitudinal direction of said cylinder, a sleeve guided on a cylindrical section of said regulating pin, a slidably guided annular valve member disposed on one end of said sleeve, an annular cylinder chamber formed by the other end of said sleeve, said annular cylinder chamber being provided with a section of a lesser diameter adjoining the guide end of said sleeve, spring means for biasing said annular member to close said throttle aperture in said piston, and a throttle bore provided in a wall of said annular cylinder chamber for determining the closing speed of said annular valve member.

2. Hydraulic buffer device according to claim 1 further comprising: a mechanical buffer and draw gear device, wherein the load characteristics of said spring means and said mechanical buffer are selected to achieve an approximately constant buffer force.

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