July 6, 1965 Z. O. KARAKASHJAN ETAL 3,193,112

HYDROPNEUMATIC ABSORBING DEVICE

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Fig. 1.

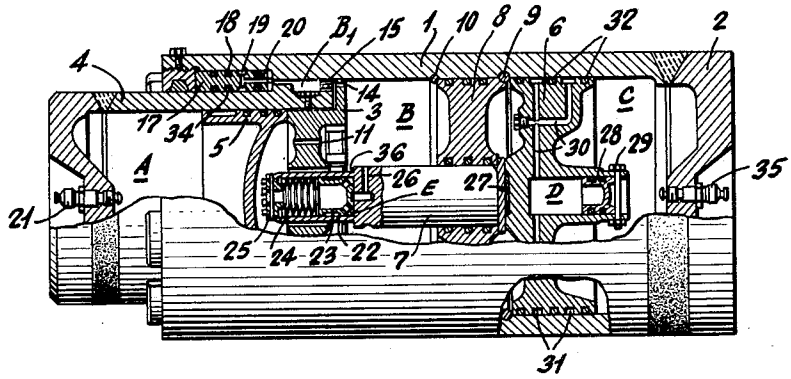
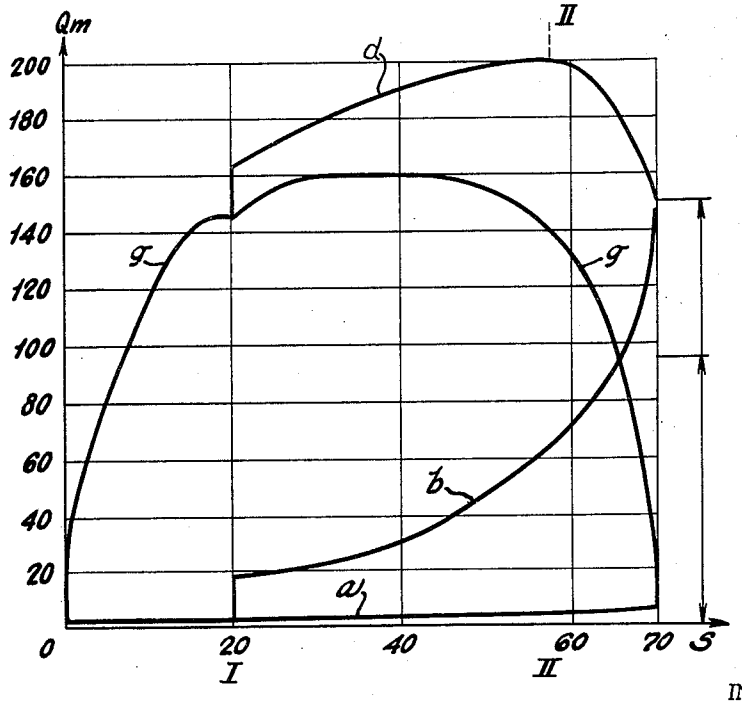


Fig. 2.



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Fig. 2.

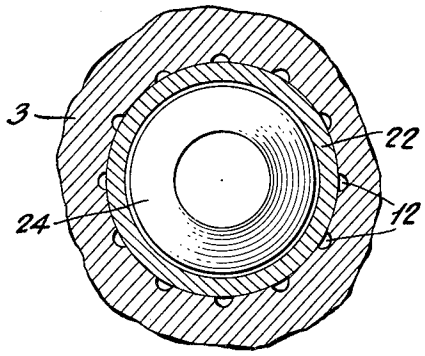


Fig. 3.

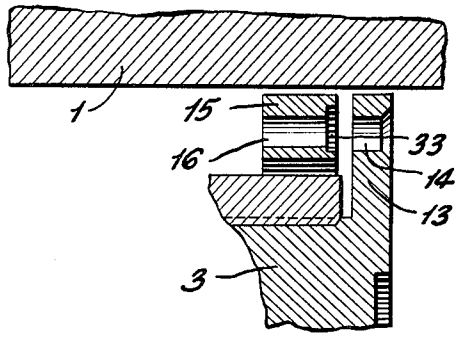


Fig. 4.

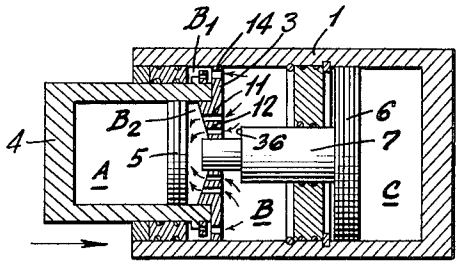


Fig. 5.

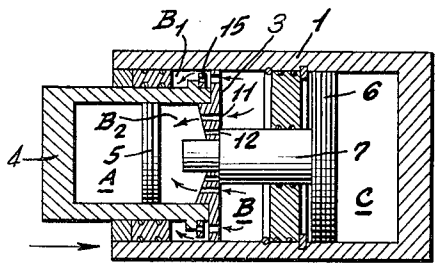
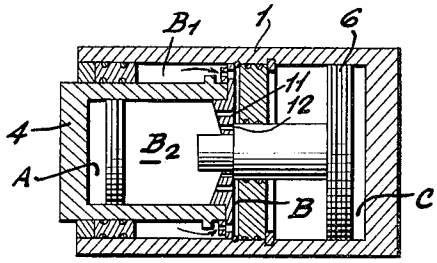


Fig. 6.



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HYDROPNEUMATIC ABSORBING DEVICE

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4 Claims. (Cl. 213—43)

This invention relates to absorbing devices for absorbing kinetic energy of relatively movable bodies and more particularly automatic couplers for railway rolling stock.

There exist hydropneumatic absorbing devices in which the absorption of the kinetic energy is effected due to the cooperation of the pneumatic resilient members, namely, the buffers and the hydraulic absorbers. In particular, in buffers of the railway rolling stock use is made of hydro-pneumatic devices comprising a hydraulic cylinder in which the piston is provided with a by-pass gauged opening, and the space above the piston is separated from the gas chamber of the buffer by a floating piston. The piston of the hydraulic cylinder is connected directly to the cylinder of the gas chamber.

All of the known absorbing devices are ineffective under slowly increasing load conditions, as when the piston moves slowly in the hydraulic cylinder which may take place during smooth starting of the rolling stock or with the rolling stock moving over a long gradient, the hydraulic resistance decreases in direct proportion to the square of the flow rate of the fluid. This arrangement renders ineffective the existing devices used for automatic couplers for railway rolling stock.

Attempts previously made to overcome these difficulties and shortcomings have proved to be inadequate.

The present invention provides an assemblage which eliminates the shortcomings of existing absorbing devices.

This invention is intended specially for automatic couplers for railway rolling stock.

An object of this invention is to provide means for dampening the shocks and impacts arising at relatively slow movement of the piston of the assembly, namely, at starting or the moving of the rolling stock over long gradients.

Another object of this invention is to provide means for preventing the too rapid return strokes of the moving parts of the absorbing device under the action of the compressed gas in the working chambers thereof after relieving the external load.

A further object of the invention is to provide reliable compression in the high pressure gas chamber.

Further objects and advantages of the invention will become more readily apparant to the one skilled in the art from the following detailed description and annexed drawings, in which drawings:

FIG. 1 is an elevational view partly in cross-section illustrating the present invention.

FIG. 2 is a fragmentary vertical cross-sectional view of FIG. 1 illustrating the piston.

FIG. 3 is a fragmentary view of the components of the throttling valve.

FIG. 4 is a vertical cross-sectional view partly in elevation showing the relationship of the components at the initiation of the power stroke.

FIG. 5 is a view generally similar to FIG. 4 showing

the relationship of the components at the intermediate stage of the power stroke.

FIG. 6 is a view similar to FIG. 4 showing the relationship of the components at the initial return stroke, and

FIG. 7 is a diagrammatic view of the performance of the absorbing device.

As shown in FIG. 1, the basic component of the absorbing device includes a cylindrical casing 1 having an open end and a base end 2. A piston 3 mounted within the casing is operably attached to an axially displaceable cylinder 4 extending into the casing from the open end. A floating piston 5 is located in the cylinder 4 and a second floating piston 6 is positioned within the casing 1 in proximity to the base end 2.

A washer or ring 8 is fixed to the interior of the casing 1 by gasket rings 9 and 10 and such washer limits the movement of the piston 3 towards the base end and of the floating piston 6 towards the open end.

It will be seen that the casing 1 is provided with three separate chambers A, B and C, respectively. The chamber A is filled with compressed gas, such as air, at an initial pressure of about 6 kg./cm.^{2}, chamber B with effective fluid, such as oil, and chamber C with a neutral gas, such as nitrogen, at an initial pressure of 60 kg./cm.^{2}.

The piston 3 is provided with by-pass gauged openings 11 and central by-pass slots 12, as best shown in FIG. 2. Flange 13 of the piston 3 (FIG. 3) includes openings 14 through which the fluid enters the chamber B_1. The return stroke throttling valve 15 is defined by a ring freely mounted within the casing and is provided with a plurality of axial openings 16 connected to circular groove 33. A packing for space B^1 includes a circular cage 17 having double sided grooves 34 fitted with gasket or sealing rings 18 and a hydraulic seal is achieved by two grooves 19 which communicate with space B_1, via longitudinal channel 20.

A valve 21 is built into the closed end of the cylinder 4 for feeding compressed air into the chamber A. A similar valve 35 is provided for the base end 2 of the casing 1 for feeding neutral gas into the chamber C. A rod 7 extends through the washer 8 and coacts at one end thereof with the floating piston 6 in chamber C. The rod 7 is formed with a hollow reduced extension 22 and on which the piston 3 is freely mounted. The length of the reduced extension 22 is such as to assure the possibility of preliminary movement of the piston 3 along the relatively immovable rod 7 at the initial power stroke of the assemblage. A safety valve defined by a valve body 23, a set of disc springs 24 and a stop nut 25 is mounted within the extension 22 and the interior of the extension is connected to the chamber B behind the piston 3 by channel 26 in the rod 7.

On the opposite end of the rod 7 is a stop head 27. The floating piston 6 has a central chamber D for additional small floating piston 28 and the extreme position of the latter piston is determined by a bolt 29. The chamber D forward of the small piston is filled with oil and is connected to peripheral grooves 31 by channels 30. The oil in the grooves 31 forms a hydraulic seal which in combination with rubber gasket or seal rings 32 eliminates the possibility of gas leakage from the chamber C.

The operation of the absorbing device is as follows: At the initial power stroke such as when the train starts

or at braking while moving, the cylinder 4 under the action of the movable members of the automatic coupler begins to move in the direction shown by the arrow in the FIG. 4. At the initial power stroke, the piston 3 moves freely along the immovable rod 7. At this time, the effective fluid flows from the chamber B behind the piston through the openings 11, slots 12 and openings 14 into the spaces B_1 and B_2, thus overcoming the resistance of the compressed air filling the chamber A. The effective fluid entering the space B_2 affects the floating piston 5 within the cylinder 4 (FIG. 5).

On further movement, the piston 3 reaches shoulder 36 of the extension 22 and the head 27 of the rod 7 starts to affect the floating piston 6 in the chamber C. The shoulder 36 covers the slots 12 (FIG. 5) and thus further increases the hydraulic resistance. To move the piston 6, it is necessary to overcome the considerable (compared with the resistance of the compressed air in the chamber A) resistance of the compressed gas in the chamber C due to which it is assured a substantial increase in the effort of the absorbing device. At the return stroke (FIG. 6) which is effected under the action of the elastic forces of the compressed gases in the chambers A and C, the piston 3 with the cylinder 4 and the piston 6 move in the direction opposite to that shown by the arrow (FIG. 6).

Under the influence of liquid contained within the space B_1, there is effected a pressing of the ring 15 against the flange 13 of the piston 3 (FIGURE 3). The effective fluid flows from the spaces B_1 and B_2 back into the chamber B through the openings 11, 16 and 14. Due to the fact that the fluid must overcome the resistance of the opening 16 in the ring 15, this significantly increases hydraulic resistance whereby an impact at the return stroke is eliminated.

At the moment when the piston 6 rests against the washer or ring 8, it stops and the piston 3 together with the cylinder 4 is separated from the shoulder 36 whereby the slots 12 are opened for fluid flow and the piston 3 continues its return movement to the initial position of the device.

In the case of slow starting, the flow rate of the fluid through the openings 11 and 14 and slots 12 may be so small that the hydraulic resistance of the device will be rather negligible. In this case, the chamber C prevents closing of the device thereby ensuring damping of the shocks occurring at starting.

In the case of applying heavy impact loads the pressure of the effective fluid in the chamber B may increase considerably. This is prevented by the safety valve in the hollow extension 22 of the rod 7. When the valve seats the fluid freely flows from the chamber B into the space B_2 thus preventing damage by excessive internal pressure.

The diagram shown in FIG. 7 illustrates the character of variation of the effort Q developed by the device during shunting and train operation, i.e. at car braking or at abrupt starting, depending upon the stroke S of the piston 3.

The line *a* shows variation of the effort developed by the compressed air in the chamber A and the line *g* the dynamic resistance of the effective fluid. Estimation of the axial clearance behind the stem of the rod 7 takes place on the section 0–I. At the point I, the chamber C comes into operation and variation of the effort developed by the latter is shown by the line *b*. The dynamic resistance increases only up to the point II, and then the rate of movement begins to drop considerably. However, the resistance of the gas compressed in the chamber C which varies in accordance with the adiabatic law, sharply increases at the end of the stroke compensating for the drop of the hydraulic resistance. This ensures effective operation of the absorbing device. The law of change of the total effort is represented by the curve *d*.

During the operation of the device a part of the kinetic energy transforms into heat energy as early as the power stroke (hydraulic losses and a part of work spent on heating the compressed gas, the pressure of which at the end of the power stroke increases 5–12 times in each chamber). A considerable part of the energy is absorbed during the return stroke, which is promoted by the return-stroke throttle valve, ensuring a considerable increase of hydraulic resistance.

It should be noted that the present invention ensures effective operation of the device under different operating conditions. Repeated impacts of comparatively low force arising during train movement are considerably damped by the low pressure gas chamber A long before the high gas pressure chamber C comes into operation. Most of the energy of the impacts both during the power strokes and the return strokes is dissipated due to the hydraulic resistance developed during the flow of the effective fluid through the by-pass openings and slots. Heavy loads, both impact and comparatively slowly increasing ones, are taken by the additional gas chamber.

This prevents the members of the automatic coupler as well as the frames of the rolling stock from failing because of fatigue due to the action of repeated alternating loads and the effect of loads causing stresses exceeding the resistance of the materials of these members.

This makes possible to prolong the operating life of the rolling stock and to increase its working weight as well as the speed of shunting operations without any strengthening of the frames of the cars and without any damage to the goods carried by the cars.

The invention is not to be confined to any strict conformity to the showing in the drawings, but changes or modifications may be made therein so long as such changes or modifications mark no material departure from the spirit and scope of the appended claims.

What we claim is:

1. A hydro-pneumatic absorbing device for absorbing kinetic energy of bodies being in relative motion and particularly for automatic couplers for railway rolling stock, comprising a casing having a closed end and an open end, a cylinder mounted for axial movement within the casing and having a closed end projecting beyond the open end of the casing, a washer secured within the casing, a piston rod extending through an opening in said washer, a piston mounted on said rod operably connected with the cylinder, a floating piston within said cylinder with the chamber provided between the floating piston and the closed end constituting a low pressure gas chamber, a second floating piston within said casing between the washer and the closed end coacting with said rod and the chamber provided between such piston and closed end constituting a high pressure gas chamber, the chamber between the piston mounted on said rod and the washer constituting a chamber for fluid, means providing an annular space between said cylinder and casing adjacent the open end of the cylinder and said last named piston having gauged openings therein for the flow of fluid from the fluid chamber into said cylinder and into said annular space.

2. The absorbing device as claimed in claim 1, including a return stroke throttling valve in said annular space and defined by a ring freely mounted in said space provided with a plurality of openings parallel to the longitudinal axis thereof and an end groove for the flow of fluid, and said piston having a flange in spaced relation to the ring serving as a stop on the return stroke of the piston.

3. The absorbing device as claimed in claim 1, in which the piston in said high pressure gas chamber is provided with an additional fluid chamber, a piston in such chamber and channels leading from said additional chamber to peripheral grooves in the floating piston for providing a fluid seal against gas leakage from the chamber.

4. The absorbing device as claimed in claim 1, in which said piston rod is provided with a hollow reduced exten-

sion on which said piston is mounted, port means in the rod providing communication between the reduced extension and the fluid chamber, and a safety valve within the hollow extension and in communication with a space between the floating piston in the low pressure gas chamber and the piston operative to admit fluid into such space in the event of excessive pressure being developed in the fluid chamber.

References Cited by the Examiner

UNITED STATES PATENTS

2,726,773	12/55	Fitz John	213—223 X
2,994,442	8/61	Frederick	213—43

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