

Aug. 25, 1970

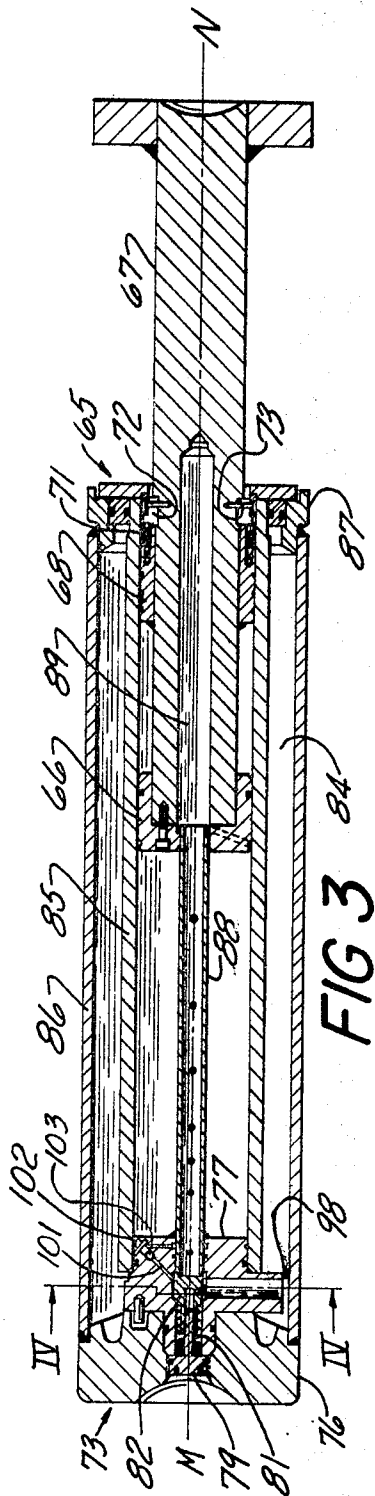
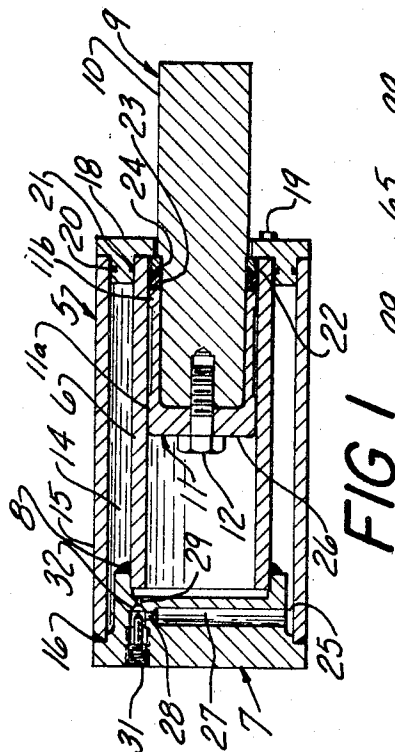
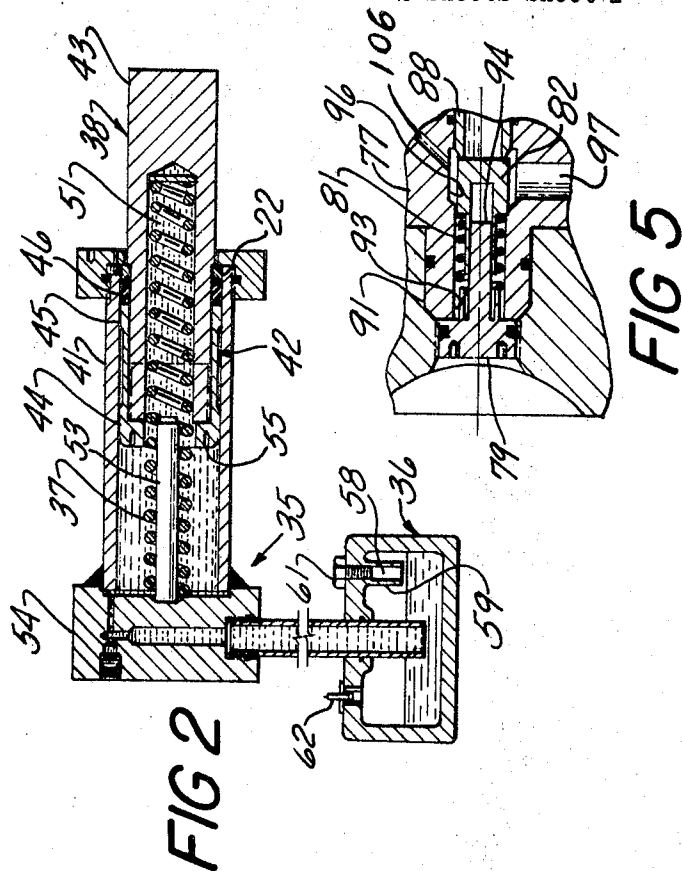
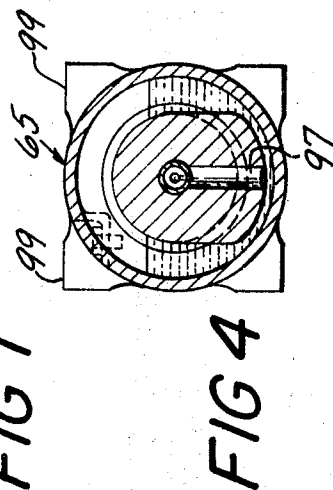
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3,525,449

HORIZONTALLY ACTING HYDROPNEUMATIC BUFFER

Filed Feb. 15, 1968

2 Sheets-Sheet 1



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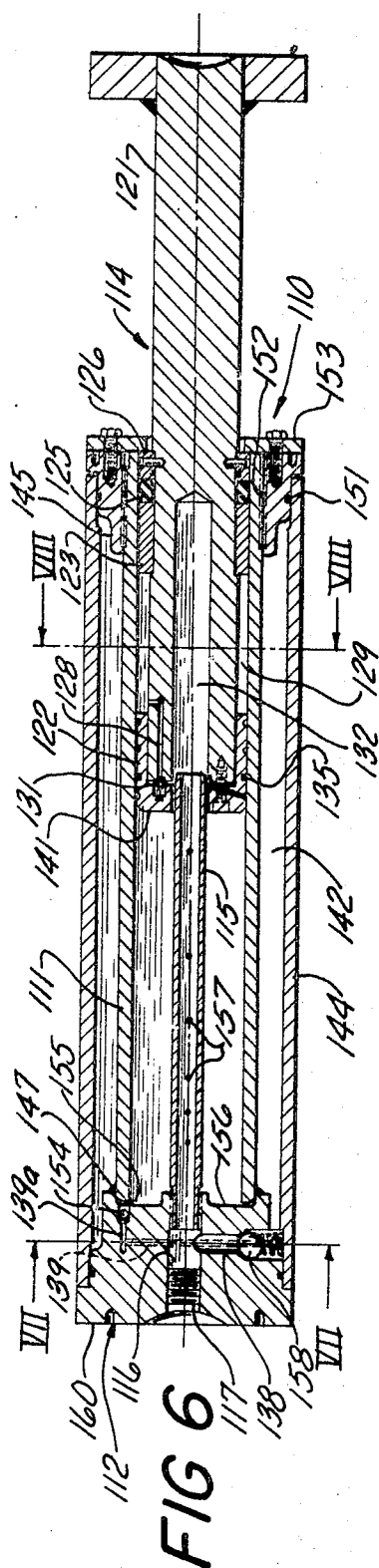
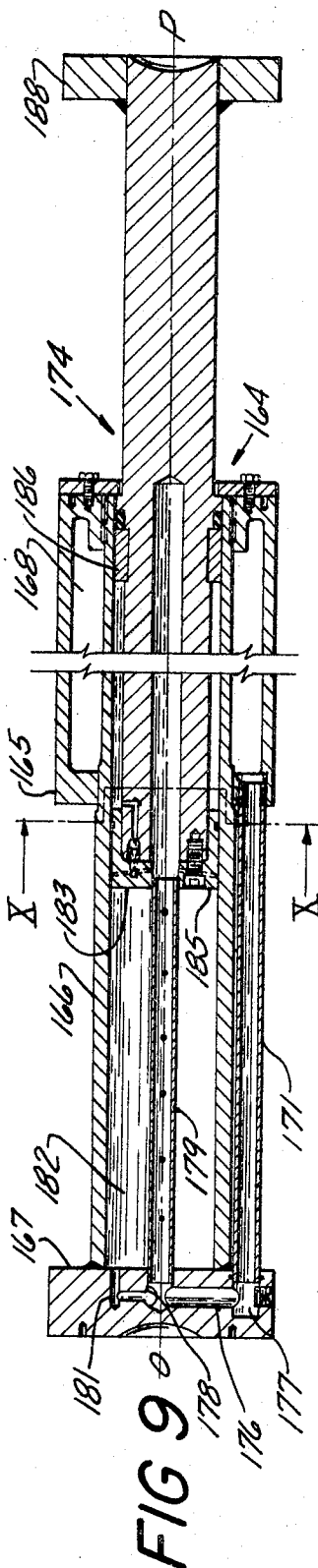
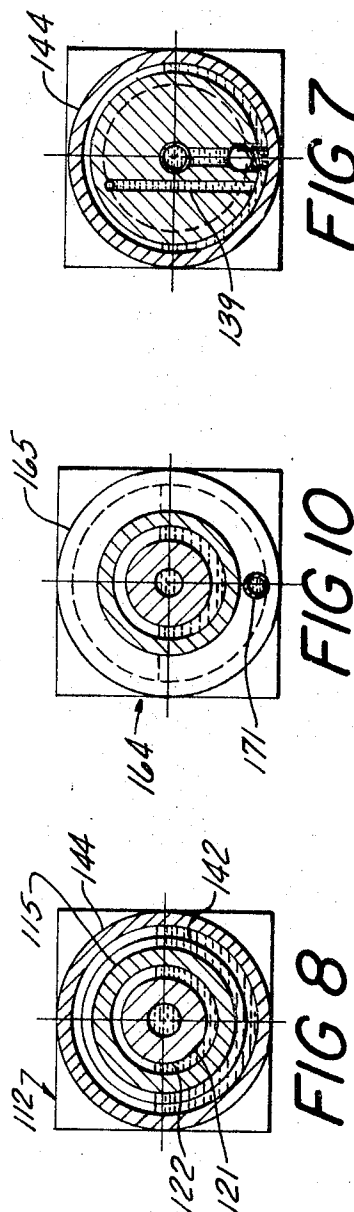
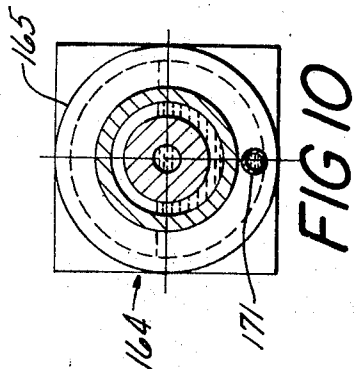
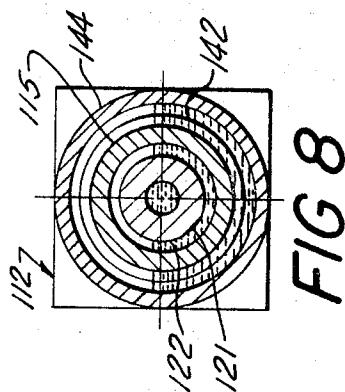
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2 Sheets-Sheet 2



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HORIZONTALLY ACTING HYDROPNEUMATIC BUFFER

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4 Claims

ABSTRACT OF THE DISCLOSURE

A single-action hydraulically-cushioned snubbed-return buffer utilizing but not restricted to a compressed gas to cause the buffer to execute a return stroke. The buffer is especially constructed with respect to a reservoir for storing the compressed gas and a reserve quantity of oil to avoid passage of gas from the reservoir to the working cylinder during a return stroke, to purge any gas from the cylinder during a working stroke, and to render the buffer self-priming.

DESCRIPTION OF THE INVENTION

The present invention is concerned in particular with heavy-duty buffers which may be placed in the underframe of a railway car to absorb forces imposed on the couplers of the car as the result of coupling or over-the-track train operations. While buffers of the type herein described may be used in the manner of conventional draft gears functioning within a fixed pocket within the center sill of the car, they are adapted especially for use in cars of the "sliding sill" type wherein the buffer is used to connect the elogate "sliding sill" which extends through the car from coupler to coupler in resilient relation with the car body.

An important object of the invention is to provide buffers capable of high energy dissipation for use, e.g., on railway cars, and especially buffers which yield high capacities in relation to the space in a railway car underframe which may be allotted to the buffer.

Another object is to utilize hydropneumatic principles in achieving the foregoing object and to provide a hydropneumatic buffer in which a hydraulic cylinder is automatically purged of gas during reciprocation of a piston assembly thereof.

A further object is to provide a hydropneumatic buffer based upon a design wherein two pistons or the equivalent thereof, arranged in relatively fixed, spaced, tandem relationship, traverse the main working cylinder.

These and other objects are achieved in a single-acting hydraulic buffer having a cylinder enclosed at one end by a head and an opening at the other end traversed by an assembly including a piston rod and a pair of pistons or equivalent members fixed to the rod in axially spaced, tandem relationship. The buffer also includes a reservoir of sufficient capacity to contain all fluid removed from the cylinder by the piston and piston rod assembly in addition to space for the storage of air placed under compression by liquid forced into the reservoir from the cylinder, and to provide space for spare liquid.

The present invention is concerned particularly with duct means at least partially contained within the head with one terminus in communication with the region swept by the inner piston and having its other terminus in an extreme lower part of the reservoir. The latter terminus is arranged relative to other parts of the buffer to assure that all liquid returning to the cylinder from the reservoir passes through such lower terminus of the duct. In a preferred embodiment, the duct means within the

head has the first named terminus opening into an extreme upper part of the region swept by the inner piston adjacent the junction of the cylinder and the head.

In the drawing with respect to which the invention is described:

FIG. 1 is a cross sectional view taken along the longitudinal axis of a buffer of relatively simple construction;

FIG. 2 is a cross sectional view taken along a longitudinal axis of a buffer having a liquid-gas reservoir in separated but fluid communicating relation with a cylinder and piston assembly of the buffer;

FIG. 3 is a cross sectional view taken along a longitudinal axis of a buffer which includes a metering tube for controlling passage of liquid from the cylinder into the reservoir thereof and another duct system for passing of liquid from the reservoir into the cylinder;

FIG. 4 is a cross sectional view along line IV—IV of FIG. 3 taken transversely of the longitudinal axis;

FIG. 5 is an enlarged view in cross section of a portion of FIG. 1 relating to valve mechanism in the cylinder head;

FIG. 6 is a cross sectional view taken along the longitudinal axis of another modified buffer;

FIG. 7 is a transverse cross sectional view of the buffer of FIG. 6 taken along line VII—VII;

FIG. 8 is a transverse cross sectional view of the buffer of FIG. 6 taken along line VIII—VIII;

FIG. 9 is a cross sectional view taken along the longitudinal axis of still another modified buffer having a reservoir which surrounds merely a part of the length of the cylinder and communicates with the cylinder partly through the cylinder head and partly through a tube; and

FIG. 10 is a transverse cross sectional view of the buffer of FIG. 8 taken along line X—X of that figure.

Of the various embodiments herein disclosed, FIG. 1 illustrates the simplest form of the invention in which a relatively short-bodied buffer 5 comprises a cylinder formed by a tubular wall 6 and a head 7 attached to the wall 6 by means, such as welding at 8. The buffer further comprises an assembly 9 which includes a piston rod 10 and a cylindrical member 11 secured thereto by a bolt 12 forming the equivalent of two pistons in axially-spaced, tandem, fixed relationship. The member 11 comprises axially-spaced enlarged piston portions 11a and 11b which function as two pistons in tandem relation to provide bearing areas on the inner surface of the wall 6 assuring the alignment of the piston and piston rod assembly 9 with the cylinder in the presence of substantially misaligning forces which are possible in railway car use.

As the buffer of FIG. 1 embodies an integral reservoir, a storage region 14 for liquid and gas is enclosed by the wall 6, another cylindrical wall 15 shown welded at 16 to an annular shoulder of the head 7, and a flange member 18 secured adjacent the open end of the cylinder wall 6 by means such as bolts 19 as shown. The flange 18 is grooved at 20 and 21 to accommodate sealing material in engagement with surfaces of the walls 6 and 15 in forming the reservoir region 14. The piston rod has an annular shoulder 22 formed by a difference in diameters of the rod which cooperates with an outward end surface of the member 11 to confine a resilient sealing ring 23 and a rigid, nonresilient support ring 24 in fixed relationship with the piston rod assembly 9, and the ring 23, and in frictional sealing relation with both the assembly 9 and cylinder wall 6.

As an essential feature of the invention, the head 7 provides duct means between a lower extremity of the reservoir at 25 and the region within the cylinder swept by the inner surface 26 of the piston and piston rod assembly 9. In the embodiment of FIG. 1, such duct means connects

3

the extreme lower portion of the reservoir and extreme upper portion of the swept cylinder region. As shown, the duct means consists of a vertical bore 27 terminating in a smaller diameter section 28, and an intersecting horizontal bore 29 connecting the swept cylinder region and the bore section 28. An adjustable plug 31 is provided along a threaded portion of the bore 29 which may be adjusted with reference to a seat 32 formed by head structure within the bore 29 to obtain different liquid pressure ranges resisting the closure of the buffer. The duct means just described functions in controlling the rate of passage of liquid between the reservoir and the cylinder in both closing and return strokes of the piston assembly since this is the only passageway through which fluid exchange is effected between the cylinder and the reservoir.

In the embodiment of FIG. 1, as in the other embodiments to be described herein below, the buffer is oriented with its longitudinal axis aligned horizontally or within normal practical tilting ranges of such buffers in railway use. Such buffers, in order to practice the invention, must be oriented with junction of the reservoir with the duct means for returning liquid from the reservoir to the cylinder at approximately the lowest portion of the reservoir.

FIG. 2 illustrates a buffer 35 having a piston, cylinder, and head arrangement similar to that of FIG. 1. It differs essentially in the location of the reservoir 36, and structure for accommodating a spring 37 which assists a gas under compression in the upper portion of storage space of the reservoir 36 in returning the piston and piston rod assembly 38 to its most outward position relative to a cylindrical wall 41. Similarly to the earlier described embodiment of FIG. 1, the buffer 35 has a cylindrically shaped member 42 fitting over the inner end of the piston rod 43 comprising spaced tandem piston portions 44 and 45. A moving seal fixed to the piston rod at 46 is provided on the assembly 38 as in the manner described with respect to the buffer 5. The member 42 and the piston rod are open along the axis of the cylinder to provide a chamber 51 for accommodating the return spring 37. A guide rod 53 fixed to the head 54 of the cylinder in concentric relation with the cylinder axis maintains the spring in proper registry with the region 51 during compression strokes of the buffer.

The important significance of FIG. 2 is that it illustrates that the reservoir 36 may be separately located from the cylinder and assembly 38 as effective storage for the oil or other liquid which passes to and from the portion of the cylinder swept by the innermost surface 55 of the piston and piston rod assembly. As shown, the reservoir is provided with a fill opening 58 defined in part by tubular boss 59 threaded along the upper portion thereof for receiving a threaded plug 61. Boss 59 terminates at a desired level for liquid at the most outward position of the assembly 38. That is to say, when a liquid is poured into the reservoir through the exposed opening 58, air is trapped above the lower extremity of the boss 59 and no more liquid can be poured into the reservoir. Additional air or other gas may be forced into the reservoir through a valve 62 of the type such as that commonly used on automotive tires.

FIGS. 3 and 4 illustrate a buffer 65 of relatively long-travel capacity adapting it for use in car underframe structure commonly known as a "sliding-sill" rigging. In this embodiment, the basic arrangement of reservoir, cylinder, and piston and piston rod assembly is maintained with, however, material modification in the mode of securing buffer components together, and in duct structure for passing liquid between the reservoir and the cylinder during compression and expansion strokes of the buffer. The tandem arranged piston means characteristic of the invention comprises, in this instance, a cup shaped piston 66 secured to the end of the piston rod 67 and a sleeve 68 secured to an intermediate portion of the piston rod. The outer diameter of the sleeve 68 is annularly recessed

4

for a sealing material 71 held in place by rigid ring structure 72 seated against a shoulder of the piston rod created by differences in diameter of the rod.

The essential feature of the buffer 65 illustrated by FIGS. 3, 4, and 5 is in the construction of the two-piece head 75 comprising an annular block 76, a cylinder insert 77, and elements of valve mechanism including a plug 79, the spring 81, and a cartridge 82. The buffer 65 differs from the others primarily in the structure for passing liquid between that portion of the cylinder swept by the piston 66 and the fluid storage space 84 of the reservoir as formed by the cylinder wall 85, the cylindrical outer reservoir wall 86, the head 75, and a collar 87 shown welded to the wall 86.

Attached to the insert 77 of the head is a metering tube 88 accommodated by a suitable bore 89 extending through a substantial inward portion of the piston rod 67 and necessarily through the piston 66. The tube 88 is secured as by welding to the insert and extends into a complementary bore of the insert in concentric coaxial relation with the buffer axis MN. The insert 77 forms an annular coaxially extending boss 91 extending into a complementary recess of the block 76. This recess terminates in an axially-outward threaded bore for receiving the plug 79. The central bore of the insert 77 has an axially outward portion 93 complementary to the outer surface of the cartridge 82 along which the cartridge may move away from the end of the metering tube 88 in response to an increase in pressure caused by inward movement of the piston and piston rod assembly. Such movement of the cartridge is resisted only slightly by the spring 81 since the function of the latter is to return the cartridge to a position against the end of the tube 88 as soon as the piston rod assembly ceases to move in a direction toward the head and there is a consequent drop in the internal pressure of the cylinder to equilibrium with that of the reservoir. As shown, the plug 79 provides a seat for the spring 81 and a central pin-like portion 94 functioning as a guide as it moves into telescopic relation with the cartridge 82 along its central bore.

Movement of the cartridge away from the end surface of the tube 88 permits liquid to escape into the open space provided around the head of the cartridge by an intermediate portion 96 of the insert bore. The hollow region thus provided is contiguous with a duct 97 which extends downwardly within insert 77 and terminates at 98 adjacent to, but in clearance with, the outer wall 86 of the reservoir. As shown in FIG. 4 the buffer 65 has means, such as four lugs 99 adapting it to fit a compartment of square cross section in which it is prevented from rotating about its axis. The buffer is thus fixed in a position in which the lower terminus of the duct 97 is maintained at approximately the lowest point in the reservoir.

At the fully shortened or "buffed" condition of the buffer 65, the oil level in the reservoir space 84 will be at its highest and the air above the oil will be at a maximum pressure. Hence, with cessation of buffing force acting on the buffer, compressed air or other gas in the reservoir space 84 forces liquid back in to the working cylinder through the duct 97, bore portion 96, and a passageway having a lower section 101 of small diameter for metering the rate of oil returning to cylinder as the piston 66 moves outwardly. The passageway has an upper section 102 in which is received a ball 103. This ball seats at a junction of the sections 101, 102 to function as a check valve, mildly preloaded as by gravity, preventing passage through the passageway during shortening of the buffer but unseating during expansion of the buffer to permit passage of liquid into the cylinder. The seat for the ball 103 may be formed as disclosed below with respect to the embodiment of FIG. 6 to permit slight leakage during an inward stroke to enable purging of air from the space swept by the piston 66. The cartridge 82 seats against the end of the tube 88 and thus prevents passage of liquid into the cylinder by way of the tube 88.

The buffer is initially loaded with sufficient liquid to maintain the level thereof within reservoir at a discrete level above the lower entrance to the duct 97 to avoid the possible entrance of air thereinto.

FIG. 6 illustrates a type of hydropneumatic buffer adapted for mounting within a sliding sill and cushioning it with respect to fixed car underframe structure, such as a center sill. As basic features found in earlier described embodiments, the buffer 110 has a cylindrical wall 111 and a head 112 defining a cylinder in which a piston assembly 114 is reciprocable in telescoping relationship with a metering tube 115 fixed to the head 112 in coaxial relation therewith. As shown, the metering tube extends within a coaxial bore 116 of the head stoppered at its outer end by a plug 117.

The assembly 114 comprises a piston rod 121 and pistons 122 and 123 attached thereto in spaced tandem relationship. To prevent leakage from the working cylinder, an annular resilient seal 125 is secured between the piston 123 and a supporting ring 126. The piston rod is shown drilled with a passageway 128 which relieves any pressure within the cylinder in the annular region 129 formed by spacing of pistons 122 and 123. The duct 128 has a check valve 131 which allows relief of pressure in the region 129 higher than that in a bore 132 of the piston rod for accommodating the tube 115. The check valve 131 is oriented to prevent equalization of pressure when the pressure in bore 132 is higher than in the region 129. Another passageway 134 from the perimeter of the piston 122 to the bore 132 drains off high pressure liquid around the piston to the bore to prevent transmission of excessive liquid and pressure to a resilient seal ring 135 in the periphery of the piston 122 and passage to the region 129.

The embodiment of FIGS. 6, 7, and 8 is especially notable for a duct 138 for completing the communication channel between the region within the working cylinder swept by the front face 141 of the piston 122 and the generally annular reservoir 142 through the tube 115 and the bore 116 contiguous therewith. The reservoir is bounded and defined by the head 112, an outer cylindrical wall 144, the cylinder wall 111, and the sleeve 145 fitting between walls 111 and 144 adjacent to the open end of the working cylinder.

As shown, the wall 111 is secured to the head 112 by welding at 147. The sleeve 145 is secured to the outer surface of the wall 111 and in turn holds the wall 144 in its proper position. Any leakage from the reservoir is prevented by resilient seals 151 and 152. A flange ring 153 bolted to the sleeve 145 functions as a stop for the assembly 114 in outward or return movements.

It will be noted that the wall 111 is secured to the head so as to leave a slight clearance 155 between the end of the wall 111 and the inner head surface 156. A passageway 139 extends in a right angle path from the surface 156 at a point in longitudinal alignment with the end surface of the wall 111. The clearance 155 functions as a duct for the passage of fluid from the cylinder into duct 139. This duct has a short horizontal counter-bored leg 139a which together with a ball 154 forms a check valve preventing the passage of liquid through the duct 139 during a closing stroke, i.e., a stroke in which the assembly 114 moves toward the head 112. However, at this time, liquid moves from the cylinder primarily through apertures 157 in the metering tube and through the duct 138 past the ball check valve 158 and into the region 142 of the reservoir. At cessation of buffer-shortening force, the air compressed within the upper part of the region 142 causes the buffer to expand in the longitudinal direction, i.e., to drive the assembly 114 outward or away from the head 112. When such movement of the assembly occurs, the check valve in the passageway 139a opens and liquid is forced through the duct 139 from approximately the lowest portion of the region 142 and into the extreme upper portion of the cylinder. The relative sizes of the duct portions 138 and 139 indicate that liquid is permitted

to return to the cylinder in a relatively small stream which results in a slow and controlled rate of longitudinal expansion of the buffer.

As shown in FIG. 8, various elements of the buffer are of circular relatively-concentric contour but the portion of the head adjacent its end surface 116 may be of rectangular or square contour, or other contours to fit a buffer-receiving compartment so that the buffer may be supported against rotation about its longitudinal axis. Preferably, the check valve seat for the ball 154 is arranged to allow slight leakage during a closing stroke of the buffer in order that any air or other gas collected in the top of the cylinder will have an opportunity to be discharged into the reservoir.

FIGS. 9 and 10 depict a long-stroke buffer of the type suitable for use in sliding-still type cars. An essential feature of this embodiment is the provision of a casing 165 which encloses only a portion of the cylindrical wall 166 in spaced remote relation with a head 167 of the buffer, i.e., a portion of the wall 166 adjacent its open end. The reservoir region 168 formed by the casing 165 and the cylindrical wall is connected by a duct, such as a tube 171. Such an arrangement is practical in constructing buffers of extra length since it is generally expensive and unnecessary to make the reservoir coextensive with the full length of the cylinder. For example, the cylindrical wall 166 is connected to the head 167 by a simple weld and the casing 165 is supported along machined outer surfaces of the cylinder without any great need for perfect concentricity of a casing with the axis OP of the piston and piston-rod assembly 174. In a buffer designed according to FIGS. 9 and 10, the head 167 provides a passageway or duct 176 which extends from a lower horizontal bore 177 in the extreme lower portion of the head complementary to the outer surface of the tube 177, to a bore 178 in coaxial relation with a metering tube 179 or axis OP. The duct 176 extends upwardly from the axis OP in smaller cross section and then horizontally as a section 181 into the extreme upper portion of the region 182 swept by the inner surface 183 of the piston and piston-rod assembly 174. In common with other above described embodiments, the assembly 174 includes two axially-spaced pistons 185 and 186.

In closing strokes, liquid is forced from the region 182 into the reservoir simultaneously through both duct sections 178 and 181 to the duct 176 and thence through the tube 171 into the main storage region 168. The tube 171 may be considered in a minor degree as reservoir space for liquid transferred into and out of the cylinder region 182.

As any air present in the cylinder tends to collect in the upper portion thereof, a closing stroke of the buffer purges air from the cylinder outwardly through the duct section 181 and ultimately to the upper portion of the reservoir region 168. During a return stroke, i.e., when the assembly 174 moves outwardly of the working cylinder under propulsion of, e.g., a spring (not shown) acting between the casing 165 and a bearing block 188, and/or compressed air stored within the region 168, liquid moves through the duct 176 and through both the duct section 181 and the metering tube 179. In manner consistent with earlier described embodiments, liquid free from any entrapped air is forced from the extreme lower portion of the reservoir into the cylinder.

However, it is to be observed that all buffers are self-priming. That is to say, even if, e.g., the working chamber formed by elements 85, 66 and 77 is left purposely void of liquid at an expanded condition, then upon a single, or, at the most, only a few shortenings and re-expansions of the buffer, the air will be purged from the chamber and, because of the features of the passageways described, replaced by liquid. This holds true for all embodiments described herein unless the reserve oil supply has been depleted, i.e., it has nearly reached the level of the lower terminus of e.g., the duct 97. Further-

more, the pressure required to pump the liquid into the chamber defined, e.g., by elements 85, 66, 77, depends upon the specific weight of the fluid, and is normally small, except for the case of embodiment shown in FIG. 2 wherein the reservoir 33 is located very much below the buffer, requiring a proportional rise of pressure. A higher pressure is desirable only to obtain expansion of the buffer.

While the buffers described are ordinarily operated with sealed reservoirs, the reservoirs may be connected with an air supply (not shown) regulated to a constant supply pressure at which air passes into the reservoir, if it drops below a desired minimum.

What is claimed is:

1. A hydropneumatic buffer having a longitudinal axis along which the buffer contracts and expands, and a bottom portion in radial relation with said axis, said buffer intended for use with said axis aligned generally horizontally with said bottom portion directly under said axis, said buffer comprising:
 - a cylinder concentric to said axis and having a central opening at an outer end thereof;
 - a cylinder head enclosing the inner end of the cylinder; an assembly adapted to reciprocate within the cylinder as a unit comprising a piston rod extending outwardly through said opening and piston means in fixed relation to said rod conforming to the inner cylindrical surface of the cylinder in sealed slidable relation therewith;
 - a reservoir providing storage space for liquid and gas substantially exceeding the volume of said cylinder swept by the inward face of the piston means, and an additional predetermined volume for the storage of gas above the liquid received from the cylinder when said piston means occupies its inwardmost position;
 - stop means for limiting travel of said assembly to an operative ambit retaining the piston means within the cylinder;
 - first duct means in said head communicating with said swept region and extending to the lowest extremity of said reservoir space;
 - second duct means in said head in communication with said swept region and connecting with said reservoir space; and
 - check valve means for controlling passage of fluid through said second duct means arranged to open during an inward stroke of said assembly;
 - said first duct means being separate from said second duct means and connecting with an upper extremity of said swept region.
2. The buffer of claim 1 comprising:
 - check valve means in said first duct means oriented for opening during an outward stroke and constructed

for a slight leakage of fluid therethrough during an inward stroke.

3. A hydropneumatic buffer having a longitudinal axis along which the buffer contracts and expands, and a bottom portion in radial relation with said axis, said buffer intended for use with said axis aligned generally horizontally with said bottom portion directly under said axis, said buffer comprising:

a cylinder concentric to said axis and having a central opening at an outer end thereof;

a cylinder head enclosing the inner end of the cylinder; an assembly adapted to reciprocate within the cylinder as a unit comprising a piston rod extending outwardly through said opening and piston means in fixed relation to said rod conforming to the inner cylindrical surface of the cylinder in sealed slidable relation therewith;

a reservoir providing storage space for liquid and gas substantially exceeding the volume of said cylinder swept by the inward face of the piston means, and an additional predetermined volume for the storage of gas above the liquid received from the cylinder when said piston means occupies its inwardmost position; stop means for limiting travel of said assembly to an operative ambit retaining the piston means within the cylinder;

duct means in said head communicating with said swept region and extending to the lowest extremity of said reservoir space, said duct means having one portion opening into an extreme upper portion of said swept region and a second portion opening into said region at a lower level;

check valve means in said one portion oriented to close during the passage of liquid from said region to the reservoir through said second portion; and

check valve means in said second portion oriented for closing during passage of liquid from the reservoir to said region through said one portion.

4. The buffer of claim 3 wherein said check valve means of said one portion is constructed for slight leakage through said check valve means during inward strokes.

References Cited

UNITED STATES PATENTS

1,855,064	4/1932	Messier.	
2,726,773	12/1955	Fitzjohn	213—43
3,147,826	9/1964	McHenry	188—88
3,252,587	5/1966	Scales	213—43
3,341,189	9/1967	Rumsey	213—43 X

DRAYTON E. HOFFMAN, Primary Examiner

U.S. Cl. X.R.

188—88, 100; 267—64