# United States Patent

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[73] Assignee **Evans Products Company**


[54] **DIRECT-ACTING HYDRAULIC PNEUMATIC DEVICE**
**8 Claims, 11 Drawing Figs.**


[52] **U.S. Cl.** ..... **213/8,** 188/88, 188/100, 213/43, 267/64 R
[51] **Int. Cl.** ..... **B61g 9/08,** B71g 9/12, B61g 11/12
[50] **Field of Search** ..... 213/8, 43, 223; 188/88.509, 88.53, 100 P; 251/215, 216; 267/64, 64 A



[56] **References Cited**

UNITED STATES PATENTS

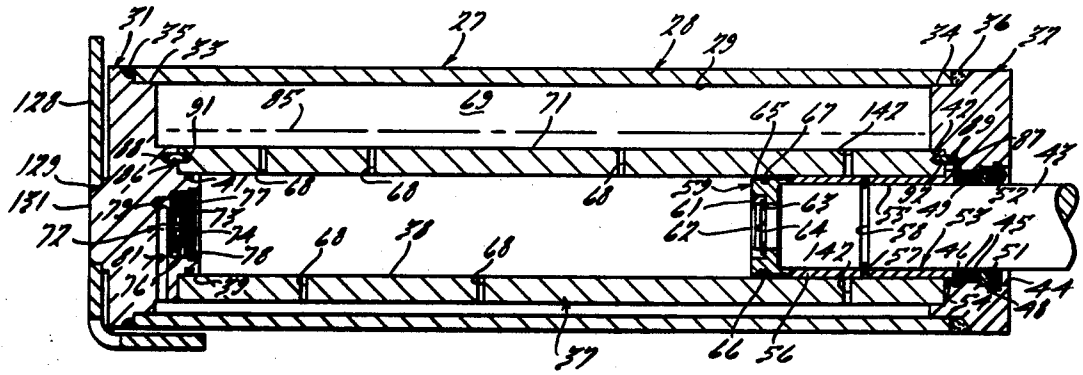
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|---|---|---|---|
| 987,447 | 3/1911 | Dwyer | 251/216 |
| 1,099,592 | 6/1914 | Dornin | 251/216 |
| 2,964,288 | 12/1960 | Holmes et al. | 251/216 |
| 3,176,856 | 4/1965 | Smith | 213/43 |
| 3,190,458 | 6/1965 | Zanow | 213/43 |
| 3,252,587 | 5/1966 | Scales | 213/43 |
| 3,341,189 | 9/1967 | Rumsey | 213/43 |



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**ABSTRACT:** A railway-car-cushioning arrangement embodying a hydraulic pneumatic cushioning device interposed between the car underframe and couplers. The cushioning unit includes a hydraulic dashpot from which fluid is displaced under shock loadings, the loads being transmitted to the cushioning unit from draft lugs interposed between the underframe and a sliding sill of the car that carries the couplers. The fluid is displaced into a reservoir in which a high-pressure gas is contained which gas is in direct contact with the fluid. The gas is at a sufficiently high pressure so as to act as a fluid when compressed and which exerts a restoring force on the cushioning unit when the loads are relieved.

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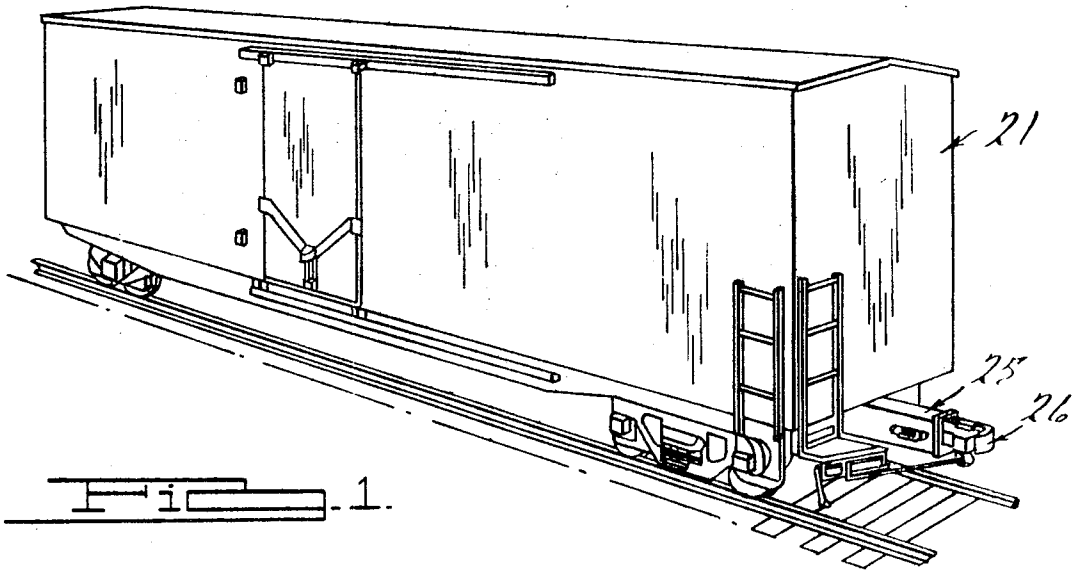



Fig. 1.

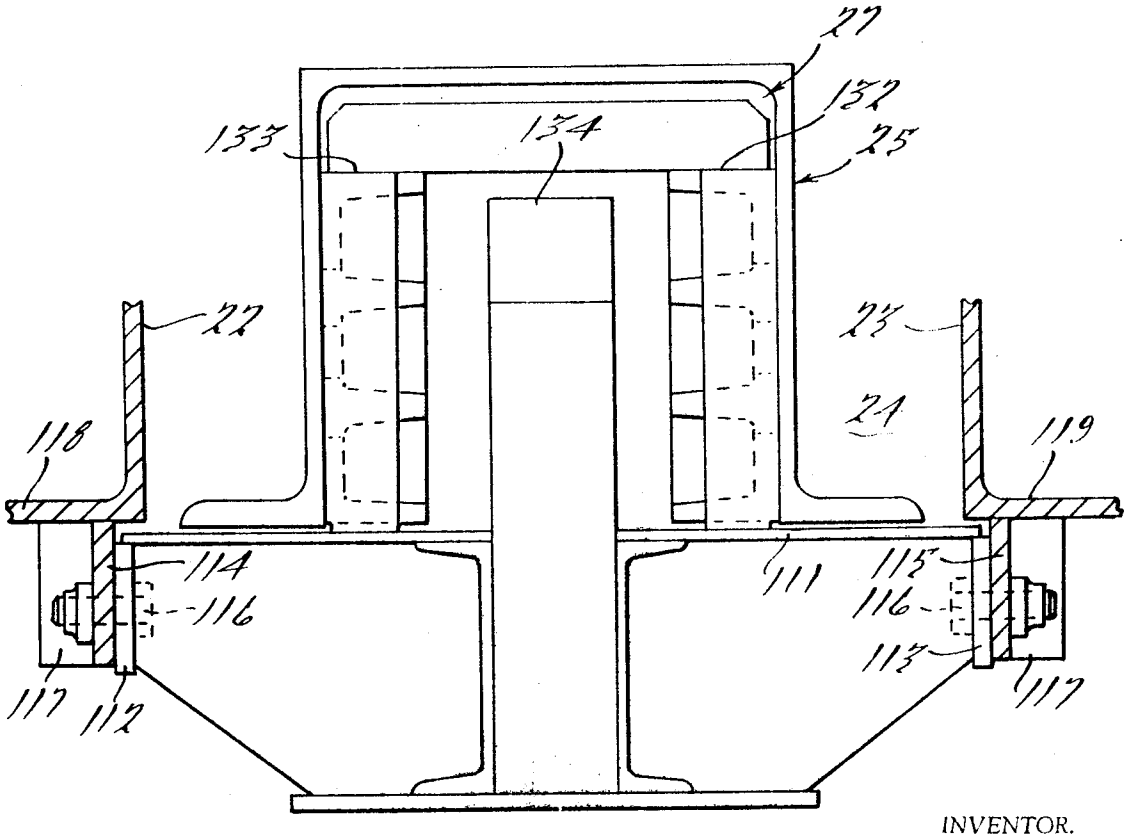



Fig. 4.

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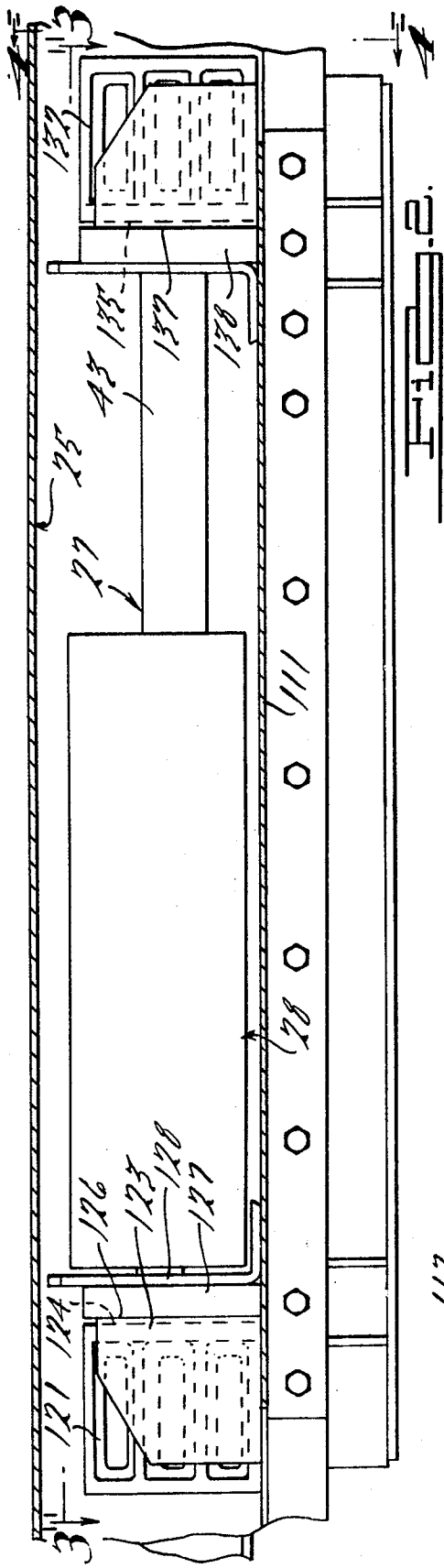


FIG. 2.

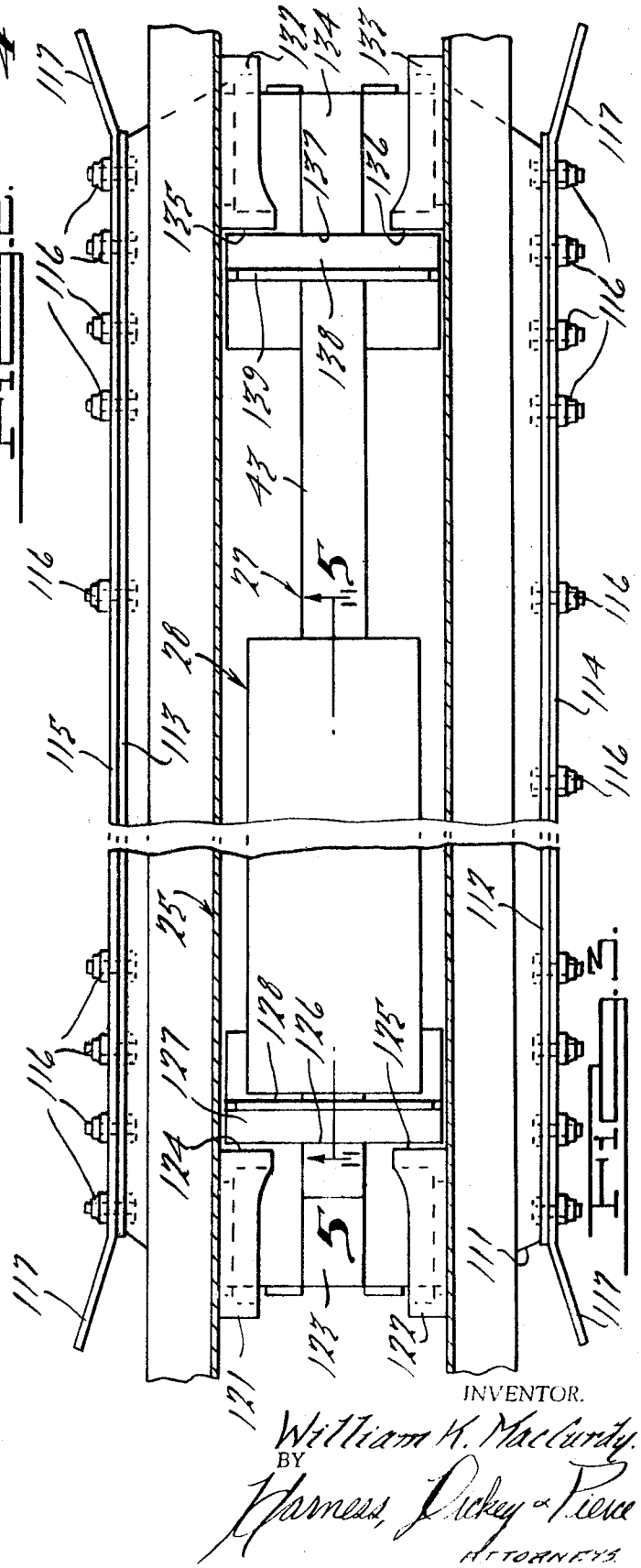
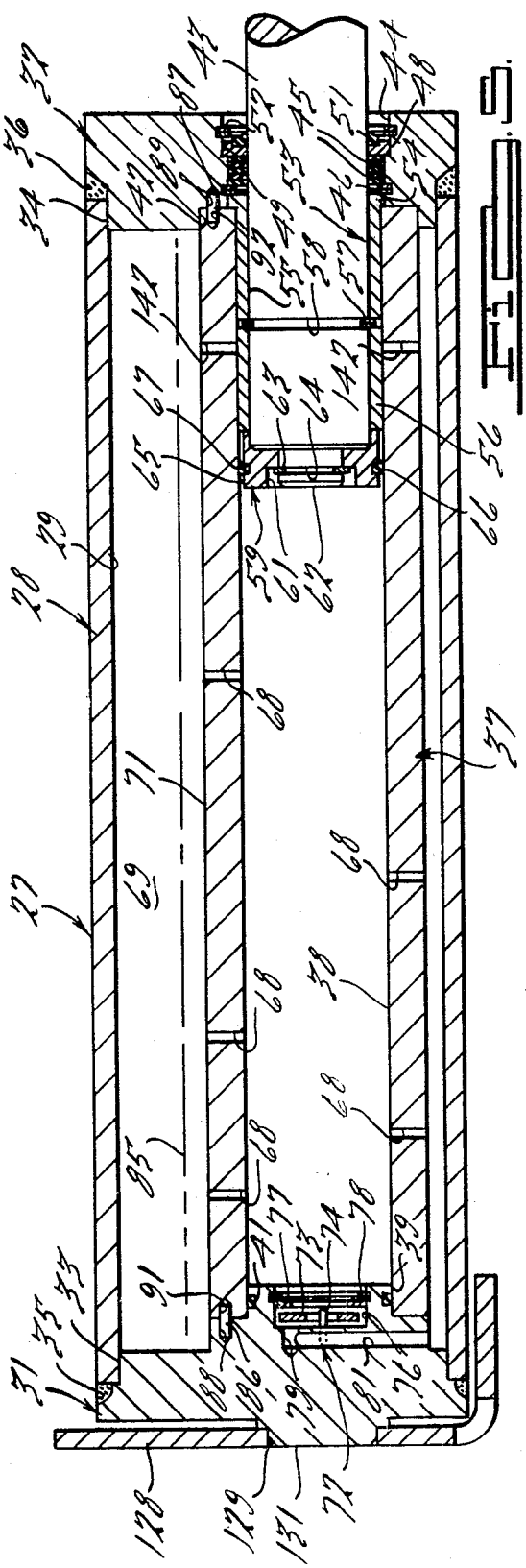
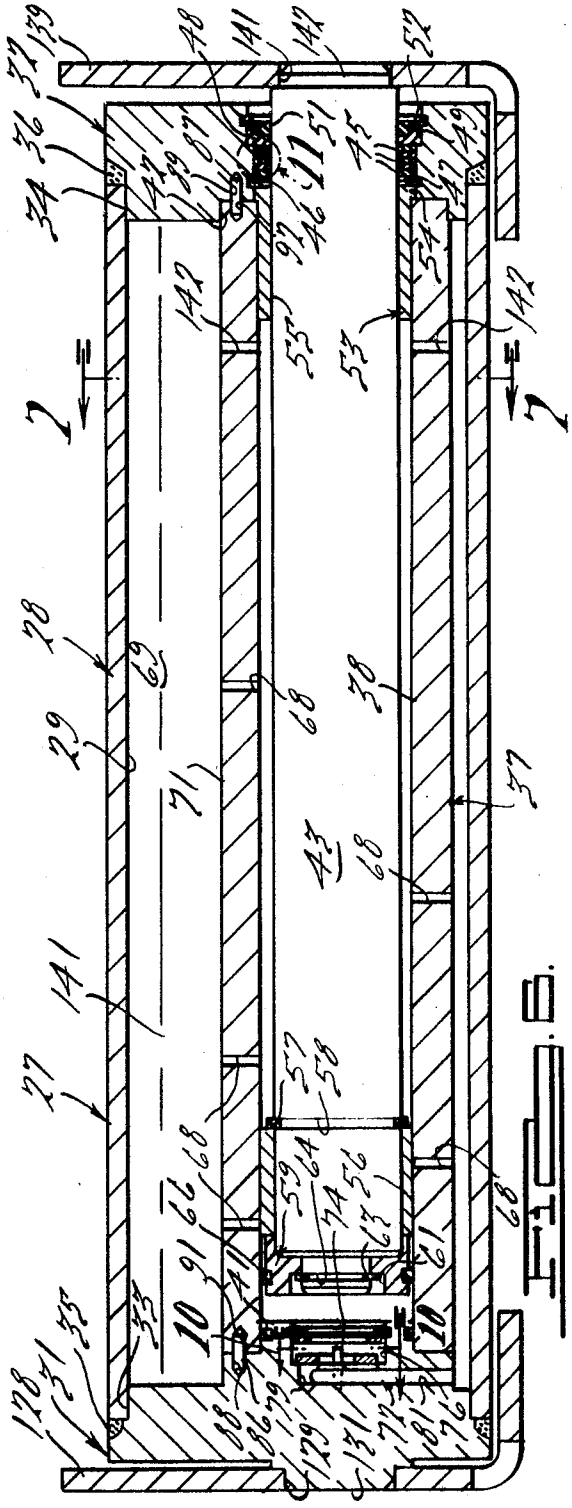


FIG. 4.

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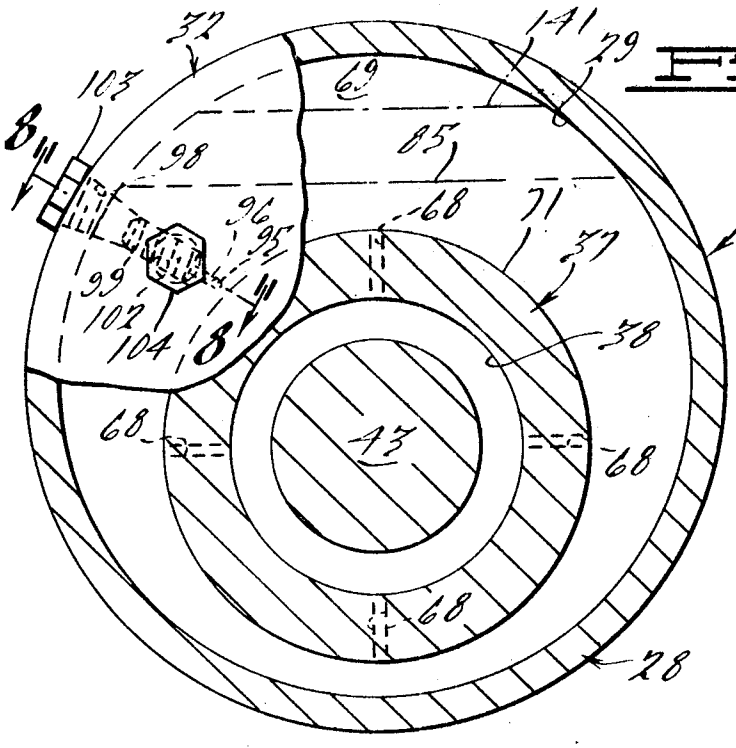



FIG. 7.

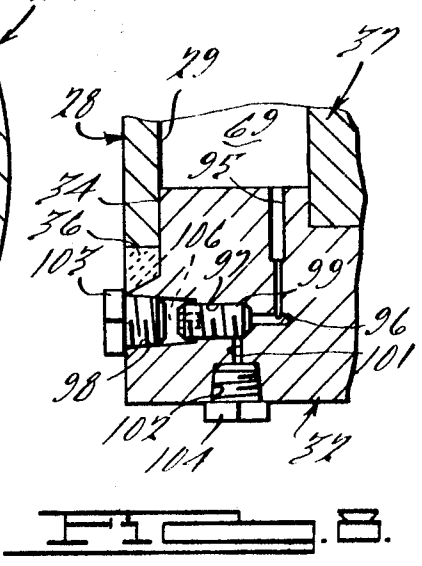



FIG. 8.

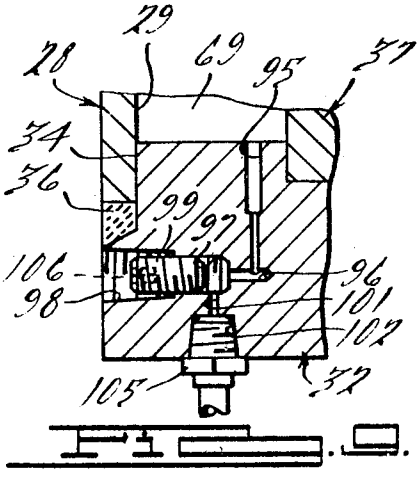



FIG. 9.

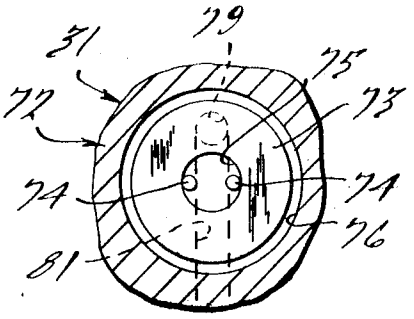



FIG. 10.

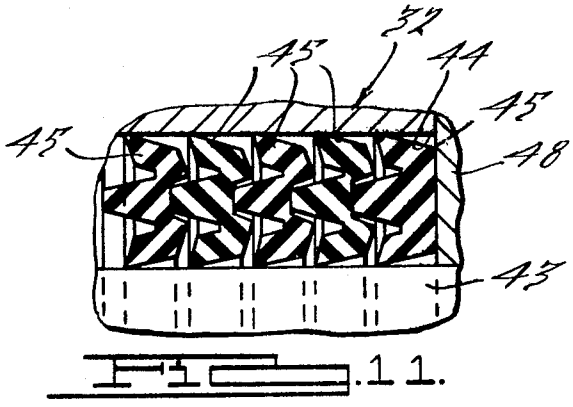



FIG. 11.

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# DIRECT-ACTING HYDRAULIC PNEUMATIC DEVICE

## BACKGROUND OF THE INVENTION

This invention relates to a direct-acting hydraulic pneumatic device and more particularly to a hydraulic pneumatic cushioning arrangement for use in railway cars.

The importance of cushioning between the couplers and the railway car to prevent damage to the lading carried by the car has received considerable attention recently. The use of larger and larger cars capable of carrying high loads as well as increased transit and switching speeds has created further demands on the cushioning units employed in the cars. These factors have created further demand for cars having cushioned underframes and for improved cushioning units. Hydraulic cushioning devices are particularly adapted for absorbing the high-impact loading and have the advantage of being capable of being designed to accommodate predetermined loading conditions. Such hydraulic cushioning units, however, must be constructed to take the severe abuse encountered in the railway field and should be trouble free for extended periods of operation. In addition to cushioning the loadings, the cushioning unit should employ some arrangement for returning the collapsed cushioning unit to its extended position so that it is ready to absorb the next shock loading. Conventional springs have normally been used for this purpose although it has been proposed to use a compressed gas for providing the return force. Where compressed gases are used, however, it has previously been thought necessary to prevent the gas from becoming mixed with the fluid used in the cushioning unit. This has necessitated the use of flexible seals or diaphragms thus adding considerably to the cost of the unit.

It is, therefore, a principal object of this invention to provide an improved railway-cushioning device using a compressed gas as a restoring force.

It is another object of the invention to provide a hydraulic pneumatic railway-cushioning device wherein the hydraulic and pneumatic fluids are in direct contact with each other.

It is a further object to provide an improved simplified hydraulic pneumatic cushioning device suitable for use in the railway art.

When a compressed gas is used in a cushioning device and particularly when such a gas is used to provide a restoring force, it is essential that some structure be provided for permitting charging of the device. The charging structure should be relatively simple but should ensure against leakage of the compressed gas and the attendant loss of restoring force.

It is, therefore, another object of the invention to provide an improved device for charging a hydraulic pneumatic cushioning unit with a high-pressure gas.

## SUMMARY OF THE INVENTION

This invention is particularly adapted for use in a cushioning arrangement for a railway car having an underframe, a sliding sill movably carried by the underframe and adapted to carry a coupler at at least one of its ends and is embodied in a hydraulic cushioning arrangement interposed between the sliding sill and the underframe. The hydraulic cushioning arrangement is comprised of a first cylinder having a longitudinally extending axis and a second cylinder also having a longitudinally extending axis. The axis of the second cylinder is offset from but parallel to the axis of the first cylinder. The second cylinder has a smaller diameter than the first cylinder and is disposed at the lower periphery of the first cylinder for forming a reservoir at least in part by the volume between the cylinders with the larger portion of the reservoir volume being formed above a plane containing the axis of the second cylinder. Head means form closures for the opposite end of the cylinders. A piston is supported for reciprocation in the second cylinder. Means are provided for reciprocating the piston relative to the second cylinder upon relative movement between the sliding sill and the underframe. Means restrict the flow of a fluid contained within the second cylinder from out of this cylinder upon the aforenoted relative movement. At least a portion of this fluid is displaced into the reservoir and further compresses an already compressed gas contained in this reservoir.

A charging arrangement embodying this invention is particularly adapted to charge a hydraulic cushioning unit of the type described in the immediately preceding paragraph. Such a charging device includes a first fluid passage extending from the reservoir and a second fluid passage that opens to the atmosphere and which is offset from the first fluid passage. A third passage intersects the first and second passages and is internally threaded for at least a portion of its length. An externally threaded closure member is threadably received in the internally threaded portion of the third passage and is movable from a first, closed position wherein flow between the first and second passages is precluded to a second, opened position wherein flow from the first passage to the second passage is permitted through the third passage.



## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a railway boxcar embodying this invention.

FIG. 2 is a side elevational view, with portions broken away, showing the cushioning unit associated with the car in FIG. 1.

FIG. 3 is a cross-sectional view taken along the line 3–3 of FIG. 2 with the underframe of the car removed to more clearly show the construction.

FIG. 4 is an enlarged cross-sectional view taken along the line 4–4 of FIG. 2.

FIG. 5 is an enlarged cross-sectional view of the cushioning unit taken along the line 5–5 of FIG. 3.

FIG. 6 is a cross-sectional view, in part similar to FIG. 5, showing the cushioning unit at the extreme end of its cushioning stroke.

FIG. 7 is an enlarged cross-sectional view taken generally along the line 7–7 of FIG. 6.

FIG. 8 is a cross-sectional view taken along the line 8–8 of FIG. 7 showing the structure for charging the cushioning unit.

FIG. 9 is a cross-sectional view, in part similar to FIG. 8, showing the charging device in its charging position.

FIG. 10 is an enlarged cross-sectional view taken along the line 10–10 of FIG. 6 and shows the check valve of the cushioning unit.

FIG. 11 is an enlarged view of the area encompassed by the circle 11 in FIG. 6 and shows the piston rod seal.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A railway boxcar embodying a cushioning arrangement constructed in accordance with this invention is identified generally by the reference numeral 21. Although the cushioning unit is described in connection with such a boxcar, it is to be understood that it may be used in connection with other types of railcars or, for that matter, in other applications where shock absorbers are used. The cushioning unit to be described, however, has particular utility in cushioning railway cars due to its construction.

The car 21 has an underframe construction of any known type and which includes a fixed center sill that is shown only partially in the drawings. This fixed center sill includes a pair of generally Z-shaped members 22 and 23 that are closed at their upper ends by a plate (not shown) to define a longitudinally extending opening 24 in which a sliding sill, indicated generally by the reference numeral 25, is supported for longitudinal movement. The sliding sill 25 has a generally inverted channel shape and carries couplers 26 (only one of which appears in FIG. 1) at its opposite ends. A hydraulic cushioning unit, indicated generally by the reference numeral 27, is interposed between the fixed and sliding sills for cushioning loads on the lading carried within the car 21 and loads upon the car 21 transmitted to or from the car by means of the couplers 26.

Referring now specifically to FIGS. 5 through 11, the cushioning unit 27 includes an outer cylinder 28 having an internal bore 29. The outer cylinder 28 is closed at its opposite ends by means of cylinder heads 31 and 32. The cylinder heads 31 and 32 have respective pilot portions 33 and 34 that are received in the cylinder bore 29 and these heads are affixed to the outer cylinder 28, as by circumferential welds 35 and 36, to provide a fluidtight seal. A second cylinder 37 is disposed within the cylinder 28 and has an internal cylinder bore 38 that is disposed with its axis parallel to the axis of the cylinder bore 29 but offset from it. One end of the cylinder bore 38 receives a second pilot portion 39 of the cylinder head 31 and an O-ring seal or the like 41 is positioned between the bore 38 and pilot portion 39 to effectively seal this end of the cylinder bore 38. The opposite end of the cylinder 37 is received in a counterbore 42 formed in the piston head 32 for accurately locating and supporting this end of the cylinder 37.

A piston rod 43 passes through a bore 44 formed in the cylinder head 32 and into the cylinder bore 38. A plurality of formed labyrinth-type seals 45 having a shape shown specifically in FIG. 11 encircle and engage the piston rod 43 and the surface of the bore 44. The seals 45 are held in place at one end by means of a retaining ring 46 of the snap type that is received in a circumferential groove 47 formed at the end of the bore 44 adjacent the counterbore 42. A second retaining ring 48 engages the opposite ends of the seals 45 and is received in a circumferential groove 49 formed in the cylinder head 32 adjacent this end of the seals 45. A piston rod wiper 51 is held adjacent the ring 48 by means of a snapring 52 to complete the sealing of the piston rod 43 and prevent the ingress of dirt into the cylinder bore 38.

An antifriction bushing 53 has an enlarged headed portion 54 that is compressed between the snaprings 46 and the adjacent end of the cylinder 37. The bushing 53 defines a bore 55 that slidably supports the piston rod 43 adjacent the cylinder head 32. A second bushing 56 encircles the inner extremity of the piston rod 43 and is held axially in place by means of snaprings 57 that are received in a circumferential groove 58 of the piston rod 43 and by means of a piston 59. The piston 59 has a counterbore 61 that receives a smaller end portion 62 of the piston rod 43. A snapring 63 is received in a circumferential groove 64 in the piston rod portion 62 to axially affix the piston 59 relative to the piston rod 43. The piston 59 has an exterior surface 65 that is spaced slightly inwardly from the cylinder bore 38 to define a clearance that has been exaggerated in the drawings. A piston ring 66 is received in a piston ring groove 67 in the periphery of the piston surface 65 and sealingly engages the cylinder bore 38.

A number of restricted orifices 68 extend radially through the cylinder 37 from the cylinder bore 38 into a volume 69 defined between the bore 29 of the outer cylinder and the outer periphery 71 of the inner cylinder 37. The volume 69 forms a reservoir and compressed gas chamber, as will become more apparent as this description proceeds, the greater portion of which is disposed above a plane containing the axis of the cylinder bore 38 due to the offset between the axes of the cylinder bores 38 and 29. It should be readily apparent that the axis of the cylinder bore 38 is disposed on the lower side of a horizontal plane containing the axis of the cylinder bore 29 from an inspection of FIGS. 5 through 7.

A check valve assembly, indicated generally by the reference numeral 72, is disposed at the inner end of the cylinder bore 38 and is carried by the cylinder head 31. The check valve 72 is comprised of a floating, generally annular valve member 73 that is supported upon a pair of spaced pins 74 that are affixed to the cylinder head 31 and which extend into an inner bore 75 of the valve member 73. The valve member 73 is disposed in a bore 76 formed in the pistonhead pilot portion 39 and is prevented from axial displacement by means of a valve retainer 77 and snapring 78. At the base of the bore 76 an axially extending passage 79 is formed that is intersected by a radially extending passage 81. The radially extending passage 81 extends in a generally downwardly direction from the passage 79 and intersects the reservoir 69 at its lower end. Movement of the valve member 73 to the left as viewed in FIGS. 5 and 6 causes it to mask the passage 79 and preclude flow through the passages 79 and 81.

The cushioning unit 27 is normally filled with a suitable hydraulic fluid of the type normally used in such cushioning units to a level indicated by the fluid line 85 when the piston 59 is at the extreme outward limit of its stroke as viewed in FIG. 5. The area in the reservoir 69 above the fluid level 85 is charged with a gas under a relatively high pressure. Preferably, nitrogen gas at a pressure of at least 1,000 pounds per square inch is charged into this reservoir. In the event any of this high-pressure gas should enter the cylinder bore 38, it is desirable to provide means for its return to the reservoir 69. For this reason, a number of the orifices 68 are disposed in a vertical relationship so that the gas may thus escape. In order to assure that certain of the orifices 68 will be disposed in such a vertical relationship, dowel pins 86 and 87 are received in bores 88 and 89 formed in the cylinder heads 31 and 32, respectively. The opposite ends of the dowel pins 86 and 87 are received in complementary bores 91 and 92 formed in the cylinder 37 in alignment with a series of the orifices 68.

The gas is charged into the reservoir 69 through a valve arrangement as best shown in FIGS. 7 through 9. This valve arrangement is comprised of a stepped passage 95 that extends axially through the cylinder head 32 from the reservoir 69. The stepped passage 95 is intersected by a radially extending passage 96 formed at one end of a female-threaded opening 97. The threaded opening 97 is formed adjacent a larger female-threaded opening 98 and receives a male-threaded closure plug 99. The female-threaded opening 97 is intersected by an axially extending passage 101 that is formed at the base of a female-threaded passage 102. Suitable closure plugs 103 and 104 are normally received in the threaded openings 98 and 102, respectively, to close these passages. In addition, the closure plug 99 is normally abutted against the base of the threaded opening 97 as shown in FIG. 8 to close off the passages 101 and 96.

If it is desired to charge the reservoir 69, the closure plug 104 is removed and a fitting 105 of a compressed gas source (not shown) is threaded into the opening 102 (FIG. 9). The closure plug 103 is then removed and a suitable tool is inserted into a socket opening 106 formed at the outer end of the closure plug 99 and this plug is retracted so that the passages 101 and 96 will be in communication with each other. The compressed gas is then discharged from the fitting 105 through the passages 101, 96 and 95 into the reservoir 69. After the reservoir has been charged to the desired pressure, the closure plug 99 is again moved to its closed position from the position shown in FIG. 9 to the position shown in FIG. 8 and the closure plugs 103 and 104 are reinserted.

Referring now again to FIGS. 2 through 4, the cushioning unit 27 is mounted on a platform comprised of a bottom plate 111 that has a pair of longitudinally extending plates 112 and 113 affixed, as by welding, to its lower surface. The plates 112 and 113 are affixed to the plates 114 and 115, as by bolt and nut assemblies 116. The plates 114 and 115 are offset at their ends, as at 117. The offsets 117 are adapted to engage the undersides of horizontally extending flanges 118 and 119 of the center sill Z-shaped members 22 and 23. In assembly, the offset portions 117 are abutted against the flanges 118 and 119 with the cushioning unit 27 in place and are then welded to the flanges 118 and 119. The cushioning unit 27 is thus accurately aligned within the sliding sill 25 and fixed sill. The unit 27 and its supporting platform assembly may, however, be readily removed for servicing by removal of the bolts 116. Upon reassembly, the unit again will be accurately aligned.

Draft lugs 121 and 122 are affixed to the interior of the sliding sill 25 adjacent the cylinder head 31. The draft lugs 121 and 122 are disposed on opposite sides of a draft lug 123 that is affixed to the platform plate 111 of the cushioning unit 27. Each of the draft lugs 121, 122 and 123 has a respective inner surface 124, 125 and 126 that is disposed adjacent the contact

plate 127. The contact plate 127 is normally engaged with the draft lug surface 126 and spaced from the draft lug surfaces 124 and 125. The contact plate 127 engages a generally L-shaped member 128 that is formed with a bore 129 which receives a projection 131 of the cylinder head 31 and which is affixed, as by welding, to this cylinder head.

At the opposite end of the cushioning unit 27, a pair of draft lugs 132 and 133 are affixed to the side of the sliding sill 25 on opposite sides of a draft lug 134 that is affixed to the platform plate 111. The draft lugs 132, 133 and 134 have respective inwardly facing surfaces 135, 136 and 137 that face a contact plate 138. The surface 137 normally engages the plate 138 while the draft lug surfaces 135 and 136 are normally spaced from this plate. The plate 138 is in contact with an L-shaped plate 139 that is apertured, as at 141 (FIG. '), to receive an extension 142 of the piston rod 43. The extension 142 is welded to the plate 139.

## OPERATION

The cushioning unit 27 is normally held in an expanded position as shown in FIG. 5 by the pressure of the compressed gas within the reservoir 69. Assuming a draft load is applied to the coupler 25 at the right-hand end of the car, the sliding sill 25 will tend to move to the right, as viewed in FIGS. 2, 3, 5 and 6, relative to the fixed sill. Under this condition, the surface 126 of the draft lug 123 will engage the contact plate 127 and bear against the cushioning unit 27 through the pistonhead 31. The surface 137 of the draft lug 134 will move away from the plate 138 and this plate will move slightly until it engages the draft lug surfaces 135 and 136. Hence, the cushioning unit 27 will be compressed between the draft lugs 132 and 133 and the draft lug 123. When this occurs, the cylinder 37 will move to the right relative to the piston 59 and fluid will be displaced from the cylinder bore 38 into the reservoir 69 through the orifices 68. The size and spacing of the orifices 68 will determine the rate of closure of the cushioning unit, and as is well known in this art, the size and location of the orifices 68 may be chosen so as to determine the desired rate of cushioning. At this time, the fluid in the cylinder bore 38 will be pressurized and will act on the valve member 73 of the check valve assembly 72 to urge it into contact with the cylinder head 31 and close the port 69. The closure will continue at a magnitude depending upon the degree of load and assuming the load is sufficient, the piston 59 will eventually close all of the orifices 68 and establish a hydraulic lock in the cylinder bore 38 thus limiting further closure of the cylinder 37 with respect to the piston 59.

It has been previously noted that the vertical orientation of certain of the orifices 68 permits the gas which may have been trapped in the fluid to escape from the cylinder bore 38. If any of this gas has not escaped, however, the operation of the cushioning unit 27 will not be adversely affected due to the high pressure that the gas is under. At such high pressures the gas acts almost as a liquid and thus will have little adverse affect on the operation of the unit 27.

As the draft force is reduced, the gas which has been further compressed in the reservoir 69 due to the rise in the level of the fluid, as seen in FIGS. 4 and 6 by the new liquid level line 141, will exert a restoring force on the cushioning unit causing it again to expand to the position shown in FIG. 5. Initially the fluid will reenter the cylinder bore 38 through the check valve 72 since the pressure of the fluid on the valve member 73 through the passages 81 and 79 causes this valve member to open. Upon further movement of the piston 59 additional fluid will flow into the cylinder bore 38 through the respective orifices 68 as they become unmasked. If any fluid has leaked past the piston ring 66, this fluid will be driven out of the area between the bushings 53 and 56 through the orifices 68. A row of orifices 142 is also provided at the extreme inner end of the cylinder 37 so that the return stroke may be completed without significant interference by this fluid.

Considering now the application of a buff force to the right-hand coupler 26, the sliding sill 25 will move to the left as shown in FIGS. 2, 3, 5 and 6. Under this condition, the draft lug 134 will act on the plate 138 through its surface 137 to drive the piston rod 43 to the left. The cylinder 37 will be held against movement by the draft lugs 121 and 122 when the surfaces 124 and 125 engage the plate 127. The cushioning unit 27 will then act to absorb these forces in the manner previously described since the piston 59 will again move relative to the cylinder 37. In this case, however, it is the piston 59 which moves rather than the cylinder 37.

It should be readily apparent that forces applied to the coupler at the opposite end of the car will also be absorbed in the same manner described. However, draft forces exerted upon this coupler will cause the piston 59 to move and buff forces will cause the cylinder 37 to move. Thus, in all events relative movement between the sliding sill 25 and the underframe of the car 21 will be resisted by the flow of the fluid through the orifices 68 in the cylinder 37.

What I claim is:

1. A cushioning arrangement for a railway car having an underframe, a sliding sill movably carried by said underframe and adapted to carry a coupler at at least one of its ends, and a hydraulic cushioning unit interposed between said sliding sill and said underframe, said cushioning arrangement comprising a first cylinder having a longitudinally extending axis, a second cylinder having a longitudinally extending axis offset from but parallel to the axis of said first cylinder, said second cylinder having a smaller diameter than said first cylinder and being disposed at the lower periphery of said first cylinder for forming a reservoir at least in part by the volume between the outer periphery of said second cylinder and the inner periphery of said first cylinder, the larger portion of said reservoir volume being formed above a plane containing the axis of said second cylinder, head means forming closures for the opposite ends of said cylinders, said cushioning unit having a stepped opening formed at one end thereof in alignment with said second cylinder, said stepped opening being comprised of a larger diameter portion extending through said one end of said cushioning unit and a smaller diameter portion with a shoulder defined therebetween, a bushing inserted into said opening and removable therefrom, said bushing having an enlarged head engaged with said shoulder and a reduced portion extending into the bore of said second cylinder, removable restraining means cooperable with said bushing head for retaining said bushing within said opening, said bushing being removable from within said opening upon removal of said removable restraining means, a piston rod slidably supported by said bushing and extending into said second cylinder, a piston affixed to said piston rod and supported for reciprocation in said second cylinder, means for reciprocating said piston and said cylinders relative to each other upon relative sliding movement between said sliding sill and said underframe, and means for restricting the flow of fluid from said second cylinder upon said relative movement between said piston and said second cylinder, at least a portion of the fluid so displaced being delivered to said reservoir, the fluid displaced into said reservoir leaving a volume in said reservoir which volume is filled with a high-pressure compressed gas for exerting a restoring force upon said hydraulic cushioning arrangement, the gas being in direct contact with the fluid in the reservoir.

2. A cushioning arrangement as set forth in claim 1 wherein the means for restricting the fluid flow from the second cylinder comprises a plurality of orifices formed in said second cylinder and extending from said second cylinder into the reservoir.

3. A cushioning arrangement as set forth in claim 2 wherein at least certain of the restricted orifices extend in a substantially vertical direction for return of entrained gases from the fluid in the second cylinder to the reservoir.

4. A cushioning arrangement as set forth in claim 3 further including dowel pin means for aligning the second cylinder

with respect to the cylinder head means for fixing the vertical orientation of the orifices.

5. A cushioning arrangement as set forth in claim 1 further including means for charging the reservoir with a compressed gas comprising first fluid passage means extending through one of the cylinder heads from the reservoir, second fluid passage means extending through said one cylinder head from the atmosphere and adapted to receive a fitting, a third passage intersecting said first and said second passages and having at least a portion of its length threaded, and a closure plug received in said threaded portion of said third passage and adapted to prevent fluid flow between said first and said second passages when said closure means is in one position and for permitting flow between said first and said second passages when said closure means is in a second position.

6. A cushioning arrangement as set forth in claim 1 wherein the larger diameter portion of the opening in the one end of the cushioning unit is formed in the respective cylinder head, the smaller diameter portion of the opening comprising the bore of the second cylinder, the shoulder being defined by the respective end of the second cylinder.

7. A cushioning arrangement as set forth in claim 6 further including a second bushing fixed to the piston rod and received within the bore of the second cylinder for supporting said piston rod as the piston traverses the bore of the second cylinder.

8. A cushioning unit comprising a first cylinder defining an internal cylinder bore, a second cylinder having an outer periphery of smaller diameter than the cylinder bore of said first cylinder and having a cylinder bore, said second cylinder being received within said first cylinder with the axes of the cylinder bores of said cylinders being disposed in parallel but offset relationship, the axis of said second cylinder bore being offset downwardly from the axis of said first cylinder bore, a first cylinder head having a first pilot portion received within and supporting one end of said first cylinder and a second pilot portion received within and supporting said second cylinder, a second cylinder head having a pilot portion received within and supporting the other end of said first cylinder, said second cylinder head being formed with a first bore receiving and supporting the other end of said second cylinder, said second cylinder head being formed with a second bore concentric to said first bore and larger in diameter than said first bore a piston rod extending into said cylinder bore of said second cylinder through said bores of said second cylinder head, a first bushing extending into said second cylinder bore and slidably supporting said piston rod, said first bushing having an enlarged headed portion received within the second bore of said second cylinder head, a seal received within said second bore of said second cylinder head and juxtaposed to said headed portion of said first bushing, a snapring received within said second bore of said second cylinder head for affixing said seal and said bushing axially relative to said cushioning unit, a piston carried by said piston rod within said second cylinder bore, a second bushing supported upon said piston rod adjacent said piston and slidably engaging said second cylinder bore for supporting the inner end of said piston rod, piston ring means carried by said and slidably engaging said second cylinder bore, a plurality of axially spaced orifices extending through said second cylinder from its cylinder bore to its outer periphery and opening into a reservoir volume formed between the outer surface of said second cylinder and said first cylinder bore, said second cylinder bore and at least a portion of said reservoir being adapted to contain a fluid which fluid is forced through said orifices upon relative movement of said piston rod and said cylinders, the remaining volume of said reservoir being adapted to contain a high-pressure gas, a return passage formed in said first cylinder head and extending from said reservoir to said second cylinder bore, and check valve means in said return passage for permitting return flow of fluid from said reservoir to said second cylinder bore while precluding flow from said second cylinder bore to said reservoir.

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,596,774 Dated August 3, 1971

Inventor(s) William K. MacCurdy

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 16, "(FIG. )" should read -- (FIG. 6) --.
Column 8, line 21, after "said", first occurrence, insert -- piston --.

Signed and sealed this 18th day of January 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents

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