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Schwam

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[45] **Apr. 1, 1975**

[54] **HYDRAULIC BOLSTER DAMPENING DEVICE**

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[73] Assignee: **Railroad Dynamics Inc.,** Newtown Square, Pa.

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[21] Appl. No.: **410,191**

[52] **U.S. Cl.** ..... **105/197 DH,** 267/4, 267/8 R

[51] **Int. Cl.** **B61f 5/06,** B61f 5/12, B61h 11/00

[58] **Field of Search** ..... 105/197 DH; 267/4, 8 R

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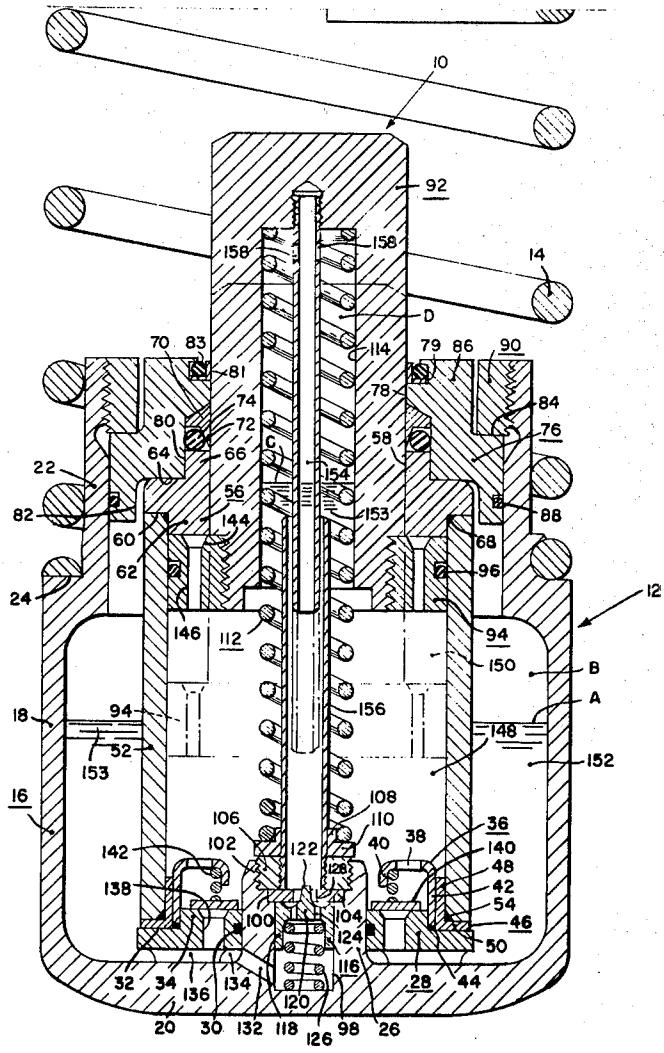
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Assistant Examiner—Howard Beltran
Attorney, Agent, or Firm—Louis V. Schiavo

[57] **ABSTRACT**

The truck of a railroad car or similar vehicle is provided with a hydraulic fluid single action piston and cylinder motion damping device located in each spring group, between the spring seat and the truck bolster. The cylinder is divided by the piston head into a variable volume compression chamber under the piston head and a variable volume compensating chamber over the piston head. The device is also provided with unvalved passages by means of which hydraulic fluid is by-passed around the piston head between the variable volume compression chamber under the piston head and the variable volume compensating chamber over the piston head, and with valved passages by means of which hydraulic fluid flows back and forth between the compression chamber and a reservoir. Within the compression chamber is a purge valve by means of which air is forced out of the cylinder back into the reservoir through the valved passages in response to retraction of the piston.

16 Claims, 5 Drawing Figures



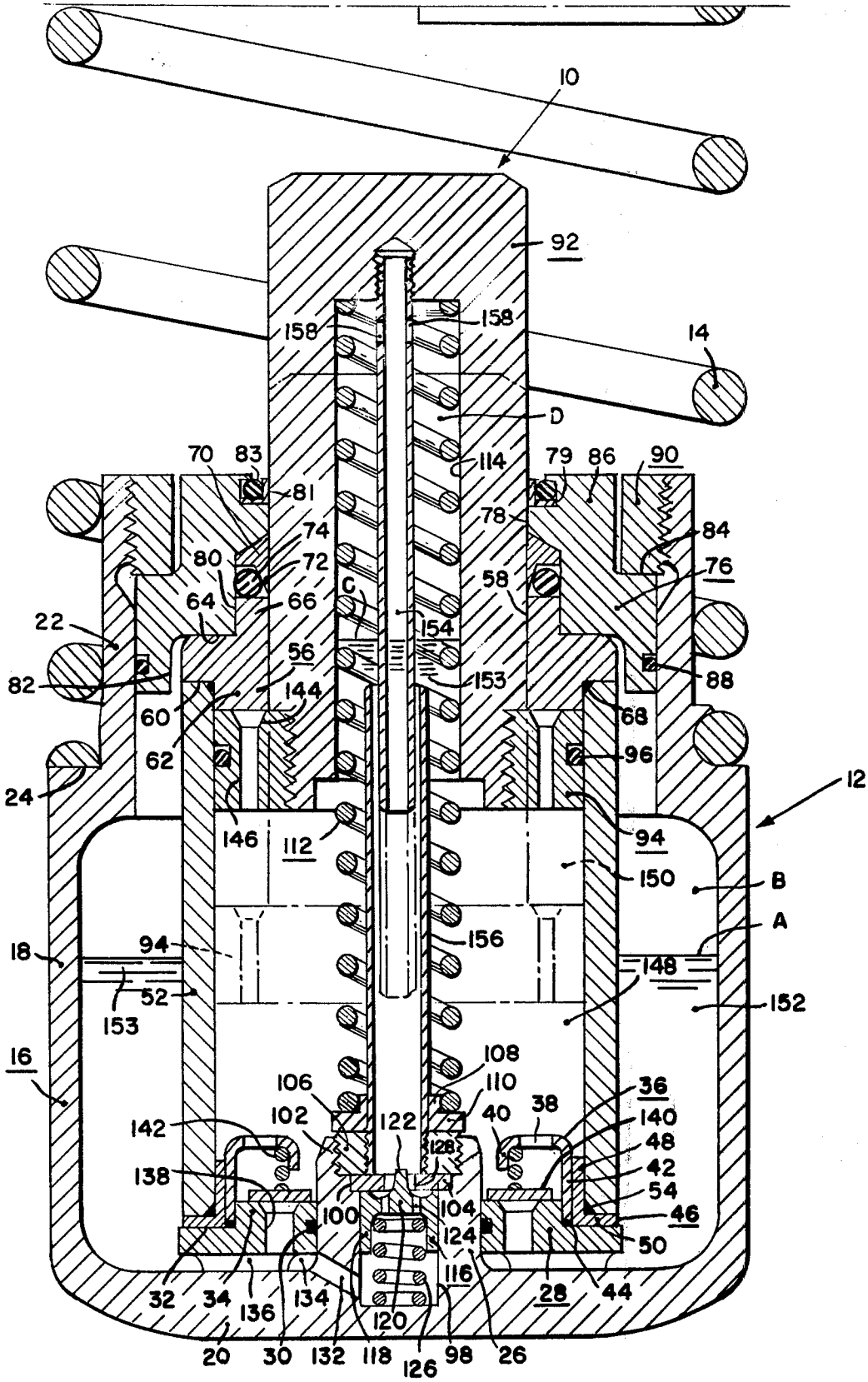

10
92
158
158
14
D
70
83
81
114
79
86
90
78
84
74
80
72
76
C
58
64
66
154
22
56
153
88
82
144
60
68
62
96
12
24
146
112
94
150
B
A
18
94
156
148
52
153
152
16
108
106
110
36
102
40
38
140
142
122
128
48
138
42
54
100
104
46
124
50
116
32
34
136
134
28
44
120
20
30
132
118
126
98
26

FIG. 1.

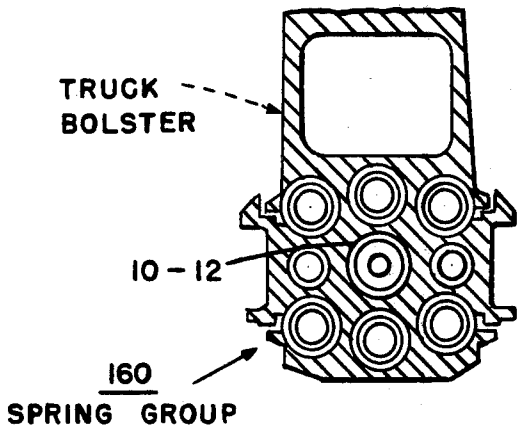

TRUCK
BOLSTER
10 - 12
160
SPRING GROUP

FIG. 2.

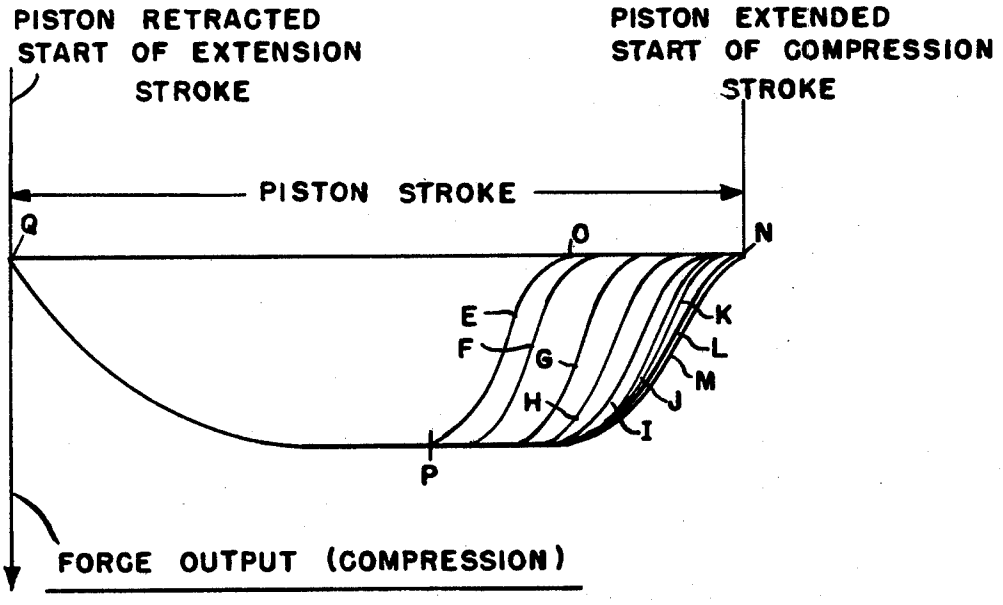

PISTON RETRACTED
START OF EXTENSION
STROKE
PISTON EXTENDED
START OF COMPRESSION
STROKE
PISTON STROKE
Q
O
N
E
F
G
H
K
L
M
J
I
P
FORCE OUTPUT (COMPRESSION)

FIG. 3.

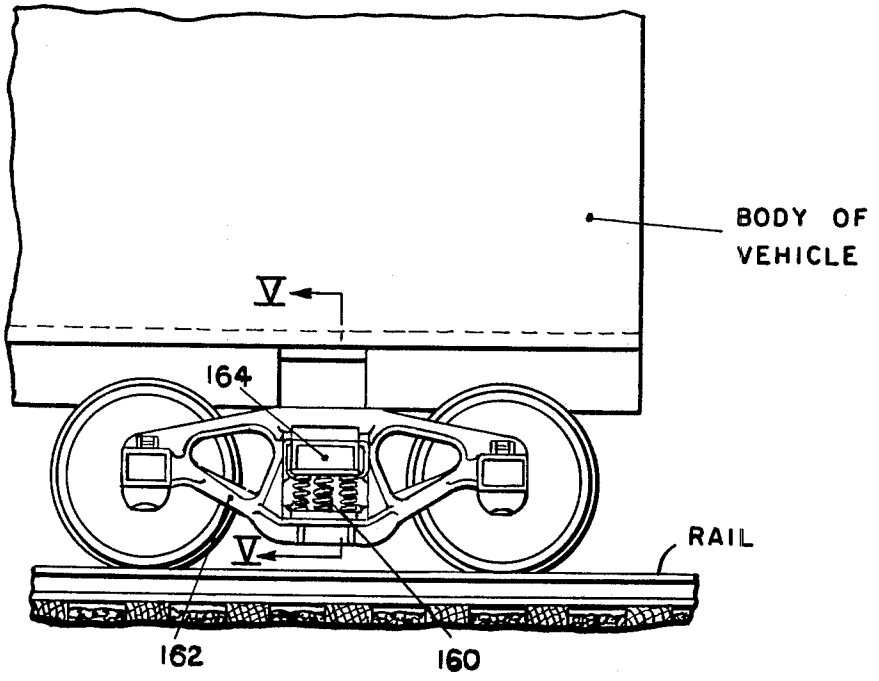

BODY OF VEHICLE
V
164
V
RAIL
162
160

FIG. 4

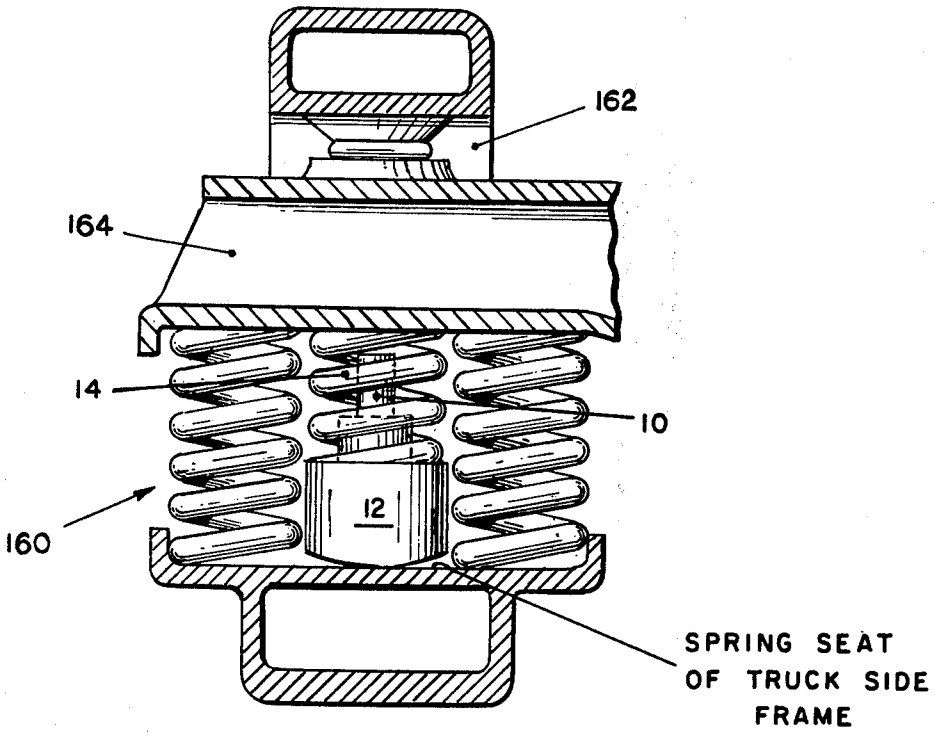

162
164
14
10
12
160
SPRING SEAT OF TRUCK SIDE FRAME

FIG. 5

HYDRAULIC BOLSTER DAMPENING DEVICE

BACKGROUND OF THE INVENTION:

1. Field of the Invention

This invention relates generally to devices for reducing car body roll to a tolerable level at all speeds, the purpose being to eliminate wheel lift-off and to reduce pitch and vertical motion.

2. Description of the Prior Art

In my now abandoned application for U.S. Pat., Ser. No. 300,109, filed Oct. 24, 1972, there is disclosed an improved motion damping device. The device is provided with valved passages at the bottom thereof through which hydraulic fluid flows back and forth between a compression chamber and a reservoir in response to actuation of the piston. The reservoir is only partially filled with hydraulic fluid; the space in the reservoir above the hydraulic fluid is filled with air. When the device is disposed with the right end thereof uppermost, the hydraulic fluid is at the bottom of the reservoir, interposed between the air in the reservoir and said passages. As a consequence, when the piston is extended, hydraulic fluid is readily drawn from the reservoir through said passages into the compression chamber. However, when the device is tilted from the vertical sufficiently or disposed with the wrong end thereof uppermost, the hydraulic fluid and the air in the reservoir exchange places. As a consequence, the air is interposed between the hydraulic fluid in the reservoir and said passages, and when the piston is extended, air, which is highly compressible, instead of hydraulic fluid, which is not compressible, is drawn into the compression chamber. Thus, there occurs a sharp loss of efficiency, and for this reason the device disclosed in my said abandoned application for U.S. Pat. is not entirely satisfactory for some purposes. It is limited to use in situations where the device will always remain generally in a vertical position.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide an improved motion damping device for the truck of a railroad car or similar vehicle, the device being of the hydraulic fluid single action piston and cylinder type located in an associated spring group, between the spring seat and the truck bolster.

Another object of the present invention is to provide such a motion damping device wherein air drawn into the cylinder from the reservoir when the device is tilted from the vertical to one side or the other or disposed with the wrong end thereof uppermost is automatically expelled from said cylinder and forced back into the reservoir when the device is positioned upright again.

Still another object of the present invention is to provide such a device wherein air in the compression and compensating chambers is expelled therefrom and forced back into the reservoir by a few compression strokes of the piston immediately after the device is returned to its upright position.

An additional object of the present invention is to provide such a device wherein air in the compression and compensating chambers is expelled therefrom and forced back into the reservoir through a purge valve within the compression chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section through an hydraulic motion damping device constructed in accordance with the present invention, the piston being shown in its fully extended position (full lines) and in a partially retracted position (broken lines);

FIG. 2 is a plan view showing a spring group supporting one end of a truck bolster and the motion damping device of the present invention in the midst of the springs;

FIG. 3 is a diagram wherein compression force output, i.e., resistance to retraction of the piston, is plotted against a full stroke of the piston to illustrate how the compression force output varies with each successive stroke during the purging operation.

FIG. 4 is a fragmentary side elevation of a railroad car constructed in accordance with the invention; and

FIG. 5 is an enlarged fragmentary section on line V—V in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The following description is directed to the specific form of the invention shown in the drawings. It is not addressed to the scope of the invention, which may be practiced in various forms.

A motion damping device constructed in accordance with the present invention comprises an extensible and retractable assembly **10** working in a stationary main body assembly **12** which mounts a compression coil spring **14**.

The stationary main body assembly **12** includes a casing **16** having an upright cylindrical wall **18** with a top which is open and a bottom which is closed by a wall **20**. The upper portion of the cylindrical wall is reduced in diameter, as at **22**, to provide a circumferentially extending shoulder **24**. The spring **14** embraces the reduced diameter portion of the cylindrical wall, its lower end is seated upon the shoulder **24**, and it is of a length to extend upwardly a substantial distance beyond the casing **16**.

Formed integrally with the bottom wall **20** is a centrally disposed cylindrical boss **26** over which is fitted an annulus **28** seated directly upon the bottom wall **20**. The inner periphery of the annulus is fitted with an O-ring **30** embracing the boss **26**. The outer periphery of the annulus is provided with a recess affording a shoulder **32** extending about a reduced diameter portion **34** of the annulus.

Overlying the annulus is an annular member **36** provided with a series of circumferentially spaced openings **38**. At its inner periphery the member **36** is provided with a short depending cylindrical rim **40**, and at its outer periphery the member **36** is provided with a longer depending cylindrical rim **42**. Thus, in transverse section, the member **36** is of inverted J-shape, as shown. The rim **42** is fitted over the reduced diameter portion **34** of the annulus **28**, and interposed between the rim **42** and the shoulder **32** of the annulus is an O-ring **44** embracing the reduced diameter portion **34** of the annulus **28**. Thus the rim **40** is disposed a substantial distance above the top of the annulus **28**.

Also overlying the annulus is an annular member **46** provided with a cylindrical body **48** fitted over the member **36**, and with a radially outwardly extending flange **50** seated upon the shoulder **32** of the annulus. Thus, in transverse section, the member **46** is L-shaped, as shown.

Fitted over the cylindrical body **48** of the member **46** is the lower end portion of a cylindrical member **52**, the lower terminal edge of which is seated upon the flange **50** of the member **46**. Interposed between the members **46** and **52** is an O-ring **54** embracing the cylindrical body **48**. The member **52** is of a length to extend upwardly into the portion **22** of the casing **16** for mounting a member **56**.

The member **56** is provided centrally with a bore **58**. The outer periphery of the member **56** is provided with a recess in the undersurface thereof affording a shoulder **60** extending about a reduced diameter portion **62** of the member **56**, and with a recess in the upper surface thereof affording a shoulder **64** extending about a reduced diameter portion **66** of the member **56**. The reduced diameter portion **62** is fitted into the upper end portion of the cylindrical member **52**, and interposed between the members **56** and **52** is an O-ring **68** embracing the reduced diameter portion **62** of the member **56**.

Overlying the reduced diameter portion **66** of the member **56** and seated thereon is a ring member **70**, the under-surface of which is provided with a circumferentially extending recess **72** for accommodating an O-ring **74**.

Slidably fitted into the reduced diameter portion **22** of the cylindrical wall **18** is an annular member **76** provided with a central bore **78**. The upper surface of the member **76** is recessed, as at **79**, to accommodate a wiper ring **81**, L-shaped in transverse section, as shown, and an O-ring **83**. The undersurface of member **76** is counterbored, as at **80** and **82**, to accommodate the ring member **70**, O-ring **74** and annular member **56**. The outer periphery of member **76** is provided with a circumferentially extending recess which affords a shoulder **84** and a reduced diameter portion **86**. Interposed between the member **76** and the reduced diameter portion **22** of the cylindrical wall **18** is an O-ring **88**.

Threaded into the reduced diameter portion **22** of the cylindrical wall **18** is a ring member **90** nested in the recess which affords the shoulder **84**. The bottom of the member is seated on the shoulder **84**. Thus members **76, 56, 52, 46** and **28** are clamped in position between the ring member **90** and the bottom wall **20** of the casing **16**.

The extensible and retractable assembly **10** comprises a piston rod **92** which is slidably projected through the central bore **58** of the member **56**, ring member **70**, wiper ring **81** and the central bore **78** of the annular member **76**. Threaded onto a reduced diameter lower end portion of the rod is a piston head **94** for working in the cylindrical member **52**. Interposed between the piston head **94** and the member **52** is an O-ring **96**.

The boss **26** is provided with a central bore **98** and counterbores **100** and **102**. The counterbore **100** accommodates a plate **104**, and threaded into the counterbore **102** is a member **106** which secures the plate **104** in position. Overlying the member **106** is a collar **108** provided with a radially outwardly extending flange **110** seated upon the member **106**. Extending about the collar **108** and seated upon the flange **110** thereof is the lower end portion of a compression coil spring **112**, which extends upwardly therefrom to the piston rod **92**. The piston rod is provided with a central bore **114** for receiving a substantial length of the spring **112**, which urges the piston rod upwardly and the piston head into engagement with the member **56**.

Underlying the plate **104** is a poppet valve **116** provided with a hollow cylindrical body **118** slidably nested in the bore **98**. Extending across the upper end portion of the body **118**, in spaced close relation to the plate **104**, is a cross-axially extending wall **120** mounting a centrally disposed tapered pin **122**. At the base of the pin are a series of circumferentially spaced openings **124** extending through the wall **120**. Underlying the wall **120** is a compression coil spring **126** which urges the poppet valve **116** upwardly and the body **118** into engagement with the plate **104**. Thus the pin **122** is projected freely through an orifice **128** provided in the plate **104**. In a plane coincident with the undersurface of the plate **104**, the orifice **128** is of a diameter sufficient to provide an annular space extending about the base of the pin **122**.

The bore **98** in the boss **26** is permanently in communication with the annular space provided between the cylindrical member **52** and the cylindrical wall **18** of the casing **16** through a system of passages including one or more radially extending passages **132** formed in the boss **26**, a passage **134** extending about the base of the boss **26** and provided by a suitable recess in the undersurface of the annulus **28** extending about the inner periphery thereof, and a plurality of radially extending passages **136** provided by suitably grooving the undersurface of the annulus **28**.

The annular space provided between the cylindrical member **52** and the cylindrical wall **18** of the casing **16** may be placed in communication with the interior of the cylindrical member **52** through the several passages **136**, and a plurality of openings **138** circumferentially spaced about the annulus **28** and extending therethrough, there being one opening **138** for each passage **136**. Overlying the annulus **28** and covering the several openings **138** is a ring plate **140** serving as a check valve. The valve is biased downwardly by a compression coil spring **142**, the upper end portion of which embraces the rim **40** of the annular member **36** and seats against the undersurface of the member **36**.

The upper surface of the piston head **94** is provided with a circumferentially extending groove **144**, and extending from the groove downwardly through the piston head **94** are a series of circumferentially equally spaced passages **146**.

Referring particularly to FIG. **1**, the interior of the cylindrical member **52** affords a working chamber, and the space within the cylindrical member **52**, between the annulus **28** on the one hand and the piston rod **92** and piston head **94** on the other hand, affords a compression chamber **148**. When the piston head moves downwardly against the influence of the return spring **112**, for example, from the extended full line position thereof shown in FIG. **1** to the partially retracted broken line position thereof shown in FIG. **1**, the annular space within the cylindrical member **52** and extending about the piston rod **92**, between the piston head **94** and the member **56**, affords a compensating chamber **150**. The annular space within the casing **16** and extending about the cylindrical member **52**, between the bottom wall **20** of the casing **16** and the member **76**, affords a reservoir **152**. The compression chamber **148** normally is completely filled with hydraulic fluid, and the reservoir **152** is always partially filled with hydraulic fluid, the hydraulic fluid being designated **153**.

The compression chamber is provided with a purge valve consisting of a pair of tubular members **154** and **156** disposed upright within the compression coil spring **112** in axial alignment with the pin **122** of the poppet valve **116** and the orifice **128** in the plate **104.** The lower end portion of member **156** extends freely through the collar **108** and threads into the member **106.** The upper end portion of the member **154** threads into the upper end portion of the piston rod **92.** When the piston head is fully extended, as shown, the lower end portion of the member **154** remains telescoped into the upper end portion of the member **156.** The inside diameter of the member **156** is somewhat greater than the outside diameter of the member **154.** The upper end portion of the member **154** is provided with a pair of diametrically opposite openings **158.**

A motion damping device constructed in accordance with the present invention may be placed in the center of a truck spring group to replace the outer coil or the inner and outer spring combination at that location. No mechanical attachment to either the side frame or bolster of the truck is required, as a consequence of which the device may be applied as simply as a truck spring. Its presence in the spring group is not apparent. Such an arrangement is shown in FIG. **2,** wherein the motion damping device, designated **10–12,** is disposed in the midst of a spring group, generally designated **160.** Referring particularly to FIGS. **4** and **5,** both the motion damping device and the springs of the spring group are seated upon the truck side frame, designated **162,** and when the vehicle is empty, the compression coil spring **14** and the springs of the spring group **160** conjointly act to support the truck bolster, designated **164,** at a predetermined level which provides a substantial distance between the upper extremity of the piston rod **92** and the truck bolster. The compression coil or retention spring **14,** being partially compressed, functions to hold the motion damping device in position.

In the operation of the motion damping device, i.e., when the vehicle is loaded, downward movement of the truck bolster is against the influence of retention spring **14** until the upper extremity of the spring is flush with the upper extremity of the piston rod **92.** Thereafter, downward movement of the truck bolster is not only against the influence of the retention spring **14** but also against the influence of the coil compression spring **112** and the resistance to flow of hydraulic fluid through the annular space extending about the base of the pin **122,** in the plane of the undersurface of the plate **104.**

As the motion damping device is compressed, the piston head **94** moves downwardly, as a consequence of which the compensating chamber **150** forms and increases in volume while at the same time the compression chamber **148** decreases in volume. Hydraulic fluid is forced from the compression chamber into the compensating chamber via the several large unvalved passages **146** in the piston head **94,** but the compensating chamber is incapable of taking all of the hydraulic fluid displaced from the compression chamber. As a consequence, the ring plate or check valve **140** being closed, the major portion of the hydraulic fluid is forced into the reservoir **152** via the purge valve, the annular space at the base of the pin **122** defined by the pin projecting upwardly through the orifice **128** in the plate **104,** the several openings **124** in the poppet valve **116,** the bore **98** and the several passages **132, 134** and **136.**

When the truck bolster moves upwardly, the compression coil spring **112** acts to urge the piston rod and piston head upwardly. As the piston head approaches its initial extended position, the compensating chamber decreases in volume, while at the same time the compression chamber increases in volume. Hydraulic fluid is forced from the compensating chamber into the compression chamber via the several large unvalved passages **146** in the piston head, but the compression chamber is capable of taking more hydraulic fluid than is displaced from the compensating chamber. As a consequence, a vacuum is developed in the compression chamber, and the check valve **140** is raised from its seat against the influence of the compression coil spring **142.** Thereupon, fluid is drawn from the reservoir **152** sufficient to fill the void in the compression chamber, the flow path being via the several passages **136** and the several large openings **138** in the annulus **28.**

With a hydraulic system of the nature described, there is obtained a force output which is solely a function of velocity input. Unlike a spring, which absorbs energy upon compression and returns it back into the system as it extends, the motion damping device of the present invention absorbs energy from the system upon compression and dissipates it in the form of heat. None of the energy is returned to the system.

The motion damping device has an overall height greater than that of the spring group **160** when the retention spring **14** is fully extended. Internally the dimensions are such that internal bottoming is avoided. Externally the dimensions are such that the truck springs will go solid first and function as a mechanical stop preventing the device from going solid.

In the absence of the purge valve **154—156,** the motion damping device described hereinabove can be used to best advantage only in situations where the device will always remain more or less disposed with the right end thereof uppermost, i.e., as shown in FIG. **1.** In this position, the hydraulic fluid in the reservoir is disposed at the bottom thereof, interposed between the air in the reservoir and the valved passages controlling the hydraulic fluid flow path between the reservoir and the compression chamber. As a consequence, when the piston head **94** is extended, hydraulic fluid is readily drawn from the reservoir **152** through said valved passages into the compression chamber **148.** However, when the device is tilted from the vertical a substantial angular distance or disposed with the wrong end thereof uppermost, as when it is installed right end up on a railroad car which is then temporarily turned bodily upside down to unload the same, the hydraulic fluid and the air in the reservoir exchange places. As a consequence, the air is interposed between the hydraulic fluid and said valved passages, and when the piston head **94** is extended as the car dumps its load, air, which is highly compressible, instead of hydraulic fluid, which is not compressible, is drawn into the compression chamber **148.** Accordingly, when the car is turned right side up again and the piston head **94** is retracted, the piston must compress the air in the compression chamber **148** sufficiently to bring the pressure up to a predetermined level before the device can begin to function for the purpose intended. Thus a sharp loss in efficiency occurs. Use of the purge valve **154–156** provides the device with means whereby the compression and compensating chambers are automatically purged of air by a few compression strokes of the piston, pro-

gressively when the device is disposed generally in an upright position.

For example, when the device is disposed with the wrong end thereof uppermost, the hydraulic fluid and the air in the reservoir exchange places. Accordingly, the hydraulic fluid which normally underlies the poppet valve **116** and fills the several passages **132, 134, 136** and **138** is replaced by air, and when the piston is extended, the air is drawn past the ring plate check valve **140** into the compression chamber. The air drawn into the compression chamber lodges next to the annulus **28** and ring plate check valve **140.**

When the device is turned upright again, i.e., again disposed with the right end thereof uppermost, the hydraulic fluid and the air in the reservoir again exchange places. Accordingly, the hydraulic fluid returns to the bottom of the reservoir, for example, to the level A, and the air returns to the space above the level A, designated B. At the same time, the hydraulic fluid and the air in the compression chamber exchange places. Accordingly, the hydraulic fluid returns to the bottom of the compression chamber, for example, to the level C, and the air rises to the space in the bore **114** above the level C, designated D.

The operation of purging the air from the compression chamber normally requires several compression strokes. When the first stroke begins, movement of the piston is against the influence of compression springs **14** and **112.** Hydraulic fluid from the compression chamber passes into the compensating chamber through the several openings **146** in the piston head. However, initially, there is no resistance to movement of the piston due to internal fluid pressure.

As the piston retracts, the air in the space D is compressed, as a consequence of which the internal fluid pressure increases until it is sufficient to actuate the poppet valve **116** against the influence of the compression spring **126.** Continued contraction of the piston increases the internal fluid pressure still further, causing the poppet valve **116** to open still farther. As a result, air, forced into the tubular member **154** through the openings **158** at the upper end thereof, in turn forces the hydraulic fluid in the tubular members **154** and **156,** below the level C, through the poppet valve **116** and passages **132, 134** and **136,** back into the reservoir. At the same time, some of the air from the space D is forced back into the reservoir via the said flow path.

On the return stroke, i.e., when the piston is extended again after being retracted as described hereinabove, the ring plate check valve **140** is raised from its seat against the influence of compression spring **142,** and hydraulic fluid is drawn from the reservoir into the compression chamber through the passages **136** and **138.** The quantity of hydraulic fluid thus drawn into the compression chamber is in excess of that forced back into the reservoir during the preceding compression stroke. Thus the level C of hydraulic fluid in the compression chamber rises and the space D becomes smaller. Thus one cycle of the purging operation is completed. Each succeeding cycled is similar, cycle with each more air is forced from the compression and compensating chambers back into the reservoir. At the same time, the level C of hydraulic fluid keeps rising and the air space D becomes smaller and smaller until it is eliminated altogether.

Referring to FIG. **3,** the several plotted curves E through M illustrate what happens during the few successive cycles necessary to complete the purging operation. Compression force output (due to internal fluid prssure) is plotted against stroke of the piston. The curve E for the first compression stroke is typical. During the initial portion of the compression stroke, i.e., until the internal fluid pressure is sufficient to actuate the poppet valve **116,** there is no compression force output, as indicated by the flat portion of the curve extending from N to O. During the next following portion of the compression stroke, i.e., while air is being forced from the compression chamber back into the reservoir, the compression force output rises rapidly, as indicated by the portion of the curve extending from O to P. Thereafter, as the piston approaches the fully retracted position thereof, the compression force output falls back to zero, as indicated by the portion of the curve extending from P to Q. During the return or extension stroke of the piston, the compression force output remains zero, as indicated by the flat portion of the curve extending from Q to N. The compression force output curves for the compression strokes that follow, designated F through M, in that order, are generally similar to the curve E. However, since some air is expelled from the compression chamber and forced back into the reservoir by each compression stroke, the next following stroke reaches its maximum compression force output sooner, i.e., the distance from N to O becomes progressively shorter with each succeeding stroke until the point O finally coincides with the point N (see curve M), at which time the compresion and compensating chambers have been fully purged of air.

While in accordance with the provisions of the patent statutes, I have illustrated and described the best form or embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the structure described without departing from the spirit and scope of the invention set forth in the appended claims. For example, the tubular member **154,** instead of fitting loosely into the tubular member **156,** i.e., instead of the O.D. of the member **154** being substantially less than the I.D. of the member **156,** may be provided with a sliding fit into the member **156** and an O-ring on the lower extremity thereof. In addition, if desired, a compression coil spring may be housed within the member **156** to react between the lower extremity of the member **154** and the plate **104** in aid of the compression coil spring **112.** Furthermore, as noted hereinabove, the lower end portion of the tubular member **156** extends freely through the collar **108** and threads into the member **106,** which in turn threads into the boss **26,** and, as shown and described, the member **106** and collar **108** are separate members. However, they may be made integral, and the details thereof may follow the teaching of the corresponding part shown and described in my now abandoned application for U.S. Pat., Ser. No. 300,109, filed Oct. 24,1972, and/or my pending application for U.S. Pat., Ser. No. 388,785, filed Aug. 16, 1973.

What is claimed is:

1. In a motion damping device, the combination comprising

A. a casing,

B. a member within said casing defining a working chamber and conjointly with said casing defining a reservoir extending about said member,

C. a piston including
1. a head operating in said working chamber and dividing the same into variable volume compression and compensating chambers, and
2. a rod extending upwardly from said head and through the top of said casing,
D. spring means yieldably biasing said piston head upwardly to extend said piston rod,
E. hydraulic fluid normally filling said compression and compensating chambers and partially filling said reservoir,
F. means valved for passage of said fluid from said compression chamber to said reservoir when said piston is retracted against the influence of said spring means and for passage of said fluid from said reservoir to said compression chamber when said piston is extended by said spring means,
G. purging means in said compression chamber operable in response to retraction of said piston for expelling air from said compression chamber and forcing it into said reservoir, and
H. a compression coil spring seated upon said casing and extending upwardly therefrom a substantial distance above the upper extremity of said piston rod.

2. The combination according to claim **1** wherein the pruging means comprises a first tubular member extending upwardly from the bottom of the compression chamber, a second tubular member depending from the top of said compression chamber and extending downwardly into the upper end of said first tubular member, and means providing for free passage of fluid from said compression chamber into said second tubular member at the upper extremity thereof.

3. The combination according to claim **2** wherein the compression coil spring extends about the tubular members and upwardly from the bottom of the compression chamber, through the piston head and into a hollow in the lower end portion of the piston rod, and the second tubular member is affixed by its upper extremity to the upper end portion of said piston rod and provided with an opening through the wall thereof close adjacent to the upper end portion of said piston rod for passage of fluid from said compression chamber into the interior of said second tubular member.

4. The combination according to claim **3** wherein when the piston is retracted, the movements of the first tubular member into the hollow in the lower end portion of the piston rod and that of the second tubular member into said first tubular member are free and unobstructed at least for distances equal to the stroke of said piston.

5. The combination according to claim **4** wherein the passage for fluid from the compression chamber to the reservoir includes the interior of the purging means.

6. The combination according to claim **5** wherein an orifice plate for a valve at the bottom of the compression chamber and in the fluid flow path from the compression chamber to the reservoir is axially aligned with the tubular members.

7. The combination according to claim **6** wherein the tubular members are concentrically related, and the lower end portion of the second tubular member fits loosely into the upper end portion of the first tubular member, the inside diameter of said first tubular member substantially greater than the outside diameter of said second tubular member.

8. In a motion damping device, the combination comprising
A. a casing provided with an upright cylindrical section,
B. a cylindrical member within the upright cylindrical section of said casing, said member defining a working chamber and said member and casing conjointly defining a reservoir,
C. a piston including
1. a head for operating in said working chamber and thereby dividing the same into a variable volume compression chamber under said piston head and a variable volume compensating chamber above said piston head, and
2. a rod extending upwardly from said piston head and slidably through the top of said casing,
D. hydraulic fluid normally filling said compression and compensating chambers and partially filling said reservoir,
E. hydraulic fluid passage means provided with a fixed area orifice plate for a valve in a flow path from said compression chamber to said reservoir when said piston is retracted,
F. a compression coil spring extending upwardly from the bottom of said compression chamber, through the piston head and into a hollow in the lower end portion of the piston rod, said spring being operative to yieldably urge said piston upwardly to extend the same,
G. means for purging air from said compression chamber when said piston is retracted including
1. a first tubular member axially aligned with the opening in said orifice plate and extending upwardly therefrom with said spring through said piston head into the hollow in the lower end portion of said piston rod, and
2. a second tubular member affixed by its upper extremity to the upper end portion of said piston rod and provided with an opening through the wall thereof close adjacent the upper end portion of said piston rod for passage of fluid from said compression chamber into the interior of said second tubular member, said second tubular member being axially aligned with and loosely telescoped into the upper end portion of said first tubular member, the upper extremity of said first tubular member being set back from the nearest obstruction to movement thereof into the hollow in the lower end portion of said piston rod a distance at least as great as the stroke of said piston, and the lower extremity of said second tubular member being set back from the nearest obstruction to movement thereof into said first tubular member a distance at least as great as the stroke of said piston,
H. unvalved hydraulic fluid passage means providing for a restricted but continuous free flow of hydraulic fluid between said compression and compensating chambers in response to all movement of said piston in either direction,
I. means for converting said fixed area orifice to a variable area orifice and progressively increasing said area and the consequent flow of hydraulic fluid from said compression chamber to said reservoir in response to retraction of said piston and the consequent increase of hydraulic fluid pressure in

said compression chamber as it decreases in volume,

J. valved hydraulic fluid passage means, the valve being operable for checking the flow of hydraulic fluid from said compression chamber to said reservoir through the associated passage means when the compression chamber is decreasing in volume, and being operable for opening and thereby permitting a free flow of hydraulic fluid from said reservoir to said compression chamber through the associated passage means when the compression chamber is increasing in volume, and

K. a compression coil spring seated upon said casing and extending upwardly therefrom a substantial distance above the upper extremity of said piston rod.

9. In a railroad vehicle, the combination comprising

A. a vehicle body,

B. a pair of trucks respectively at opposite ends of said body, each including

1. a pair of wheeled frames,
2. a bolster, and
3. compression coil spring groups each carried by one of said frames and supporting the associated end of said bolster, and

C. unitary motion damping means each associated with one of said spring groups including

1. a casing seated upon the associated one of said frames,
2. a member within said casing defining a working chamber and conjointly with said casing defining a reservoir extending about said member,
3. a piston including
   a. a head operating in said working chamber and dividing the same into variable volume compression and compensating chambers, and
   b. a rod extending upwardly from said head and through the top of said casing,
4. spring means yieldably biasing said piston head upwardly to extend said piston rod,
5. hydraulic fluid normally filling said compression and compensating chambers and partially filling said reservoir,
6. means valved for passage of said fluid from said compression chamber to said reservoir when said piston is retracted against the influence of said spring means and for passage of said fluid from said reservoir to said compression chamber when said piston is extended by said spring means,
7. purging means in said compression chamber operable in response to retraction of said piston for expelling air from said compression chamber and forcing it into said reservoir, and
8. a compression coil spring seated upon said casing and extending upwardly therefrom a substantial distance above the upper extremity of said piston rod and coacting with the associated spring group to support the overlying end of said bolster.

10. The combination according to claim **9** wherein the purging means comprises a first tubular member extending upwardly from the bottom of the compression chamber, a second tubular member depending from the top of said compression chamber and extending downwardly into the upper end of said first tubular member, and means providing for free passage of fluid from said compression chamber into said second tubular member at the upper extremity thereof.

11. The combination according to claim **10** wherein the compression coil spring extends about the tubular members and upwardly from the bottom of the compression chamber, through the piston head and into a hollow in the lower end portion of the piston rod, and the second tubular member is affixed by its upper extremity to the upper end portion of said piston rod and provided with an opening through the wall thereof close adjacent to the upper end portion of said piston rod for passage of fluid from said compression chamber into the interior of said second tubular member.

12. The combination according to claim **11** wherein when the piston is retracted, the movements of the first tubular member into the hollow in the lower end portion of the piston rod and those of the second tubular member into said first tubular member are free and unobstructed at least for distances equal to the stroke of said piston.

13. The combination according to claim **12** wherein the passage for fluid from the compression chamber to the reservoir includes the interior of the purging means.

14. The combination according to claim **13** wherein an orifice plate for a valve at the bottom of the compression chamber and in the fluid flow path from the compression chamber to the reservoir is axially aligned with the tubular members.

15. The combination according to claim **14** wherein the tubular members are concentrically related, and the lower end portion of the second tubular member fits loosely into the upper end portion of the first tubular member, the inside diameter of said first tubular member being substantially greater than the outside diameter of said second tubular member.

16. In a railroad vehicle, the combination comprising

A. a vehicle body,

B. a pair of trucks respectively at opposite ends of said body, each including

1. a pair of wheeled frames,
2. a bolster, and
3. compression coil spring groups each carried by one of said frames and supporting the associated end of said bolster, and

C. unitary motion damping means each associated with one of said spring groups including

1. a casing provided with an upright cylindrical section and seated upon the associated one of said frames,
2. a cylindrical member within the upright cylindrical section of said casing, said member defining a working chamber and said member and casing conjointly defining a reservoir,
3. a piston including
   a. a head for operating in said working chamber and thereby dividing the same into a variable volume compression chamber under said piston head and a variable volume compensating chamber above said piston head, and
   b. a rod extending upwardly from said piston head and slidably through the top of said casing,
4. hydraulic fluid normally filling said compression and compensating chambers and partially filling said reservoir,
5. hydraulic fluid passage means provided with a fixed area orifice plate for a valve in a flow path

from said compression chamber to said reservoir when said piston is retracted,

6. a compression coil spring extending upwardly from the bottom of said compression chamber, through the piston head and into a hollow in the lower end portion of the piston rod, said spring being operative to yieldably urge said piston upwardly to extend the same,

7. means for purging air from said compression chamber when said piston is retracted including

a. a first tubular member axially aligned with the opening in said orifice plate and extending upwardly therefrom with said spring through said piston head into the hollow in the lower end portion of said piston rod, and

b. a second tubular member affixed by its upper extremity to the upper end portion of said piston rod and provided with an opening through the wall thereof close adjacent the upper end portion of said piston rod for passage of fluid from said compression chamber into the interior of said second tubular member, said second tubular member being axially aligned with and loosely telescoped into the upper end portion of said first tubular member, the upper extremity of said first tubular member being set back from the nearest obstruction to movement thereof into the hollow in the lower end portion of said piston rod a distance at least as great as the stroke of said piston, and the lower extremity of said second tubular member being set back from the nearest obstruction to movement thereof into said first tubular member a distance at least as great as the stroke of said piston,

8. unvalved hydraulic fluid passage emans providing for a restricted but continuous free flow of hydraulic fluid between said compression and compensating chambers in response to all movement of said piston in either direction,

9. means for converting said fixed area orifice to a variable area orifice and progressively increasing said area and the consequent flow of hydraulic fluid from said compression chamber to said reservoir in response to retraction of said piston and the consequent increase in hydraulic fluid pressure in said compression chamber as it decreases in volume,

10. valved hydraulic fluid passage means, the valve being operable for checking the flow of hydraulic fluid from said compression chamber to said reservoir through the associated passage means when the compression chamber is decreasing in volume, and being operable for opening and thereby permitting a free flow of hydraulic fluid from said reservoir to said compression chamber through the associated passage means when the compression chamber is increasing in volume, and

11. a compression coil spring seated upon said casing and extending upwardly therefrom a substantial distance above the upper extremity of said piston rod and coacting with the associated spring group to support the overlying end of said bolster.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,874,307 Dated APRIL 1, 1975

Inventor(s) STUART A. SCHWAM

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

COLUMN 7, line 61, after "similar," change "cycle" to --and--.

COLUMN 9, CLAIM 7, line 6, after "ber" and before "substantially" insert --being--.

COLUMN 14, CIAIM 16, line 3, change "emans" to --means--.

Signed and Sealed this

thirtieth Day of *September 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks