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(54) A piston assembly for hydraulically operated piston-type retarders

(57) The invention relates to a piston assembly for use in a hydraulically operated piston-type retarder. The piston assembly comprises a piston rod 1, a piston head 2, a speed spring 3, a closure member 4, a spacer member 5, a retainer member 9 and a lock nut 6. The piston head 2 is provided with a set of first hydraulic fluid passageways with corresponding energy extraction ports 8 and a set of second hydraulic fluid passageways with corresponding idling ports 7. A method of retarding wagon stock is also provided.

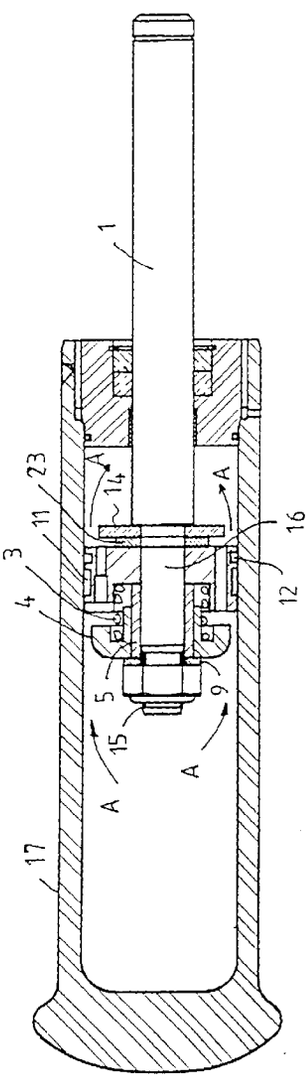

FIGURE 1

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Description

Technical Field

This invention relates to a hydraulically operated piston-type retarder. More particularly, the invention relates to a piston assembly for such retarders and a method of retarding wagon stock using the same.

Various hydraulically operated piston-type retarders are known and presently incorporated in wagon controlling systems for wagon stock marshalling in hump yards, such as those described in U.S.A. patent no. 4,721,189, U.K. patent no. 1,328,086 and South African patent no. 90/3086. This type of retarders includes a piston assembly and sleeve arrangement, the arrangement in use being associated with a housing, or a so called pot, the latter being bolted to the inside of a rail with the piston assembly operably retained therewith.

Background of the Invention

In use, the piston assemblies either directly or indirectly are brought into contact with the wheel flanges of passing wagon stock, forcing the piston assemblies into the corresponding sleeves in a shock absorber-type manner, thereby inserting retarding forces on the wagon wheels and therefore on the corresponding wagon stock. However, a primary disadvantage of some of these hydraulically operated, piston-type retarders is the high manufacturing cost of the piston assemblies. More particularly, many of these piston assemblies require extensive engineering steps during the manufacturing process, utilizing expensive tooling and a substantial degree of skilled labour. A further primary disadvantage of the known piston assemblies is the type and number of moving parts which operate under stress, causing deterioration of and fatigue in the parts that often lead to a drop in operating efficiency and/or a lack of durability. Also, due to the substantial number of moving parts and their respective mechanical designs, substantial test and installation procedures are required before and during the utilization of these retarders in general and the piston assemblies in particular. Skilled labour therefore is a necessity for the effective utilization of these retarders to carry out the various technical procedures required for such setting, installation, in-line inspection and maintenance.

A consequential disadvantage of the mechanical design of some of the existing piston assemblies and more particularly the hydraulic fluid passageways is that to provide for specific energy extractions and the corresponding retardation of wagon stock , various types of springs are utilised, including helical springs and Bellville washers, the springs requiring predetermined and specific physical characteristics to ensure correct operation variables. However, and due to manufacturing variances, the use of these springs requires the incorporation of specific adjustment mechanisms in the piston assemblies to ensure that the springs and other moving parts are correctly set so that the fluid passageways between the various parts are dimensioned and configured correctly, allowing for predetermined and required fluid flows therethrough. Additionally, expensive testing and setting equipment are required to ensure the continuously correct setting and/or testing of these piston assemblies with regard to the specific wagon speeds prior and subsequent to retardation and the associated energy extractions required.

It is accordingly an object of this invention to provide a relatively inexpensive and simple piston assembly, for use in the hydraulically operated piston-type retarders described hereinbefore, aimed at overcoming or at least minimizing the above disadvantages, or to provide a novel and alternative piston assembly to the designs presently in use.

Summary of the Invention

According to a first aspect of the invention there is provided a piston assembly for linear, reciprocal displacement relative to a piston sleeve in a hydraulically operated retarder comprising:

a piston rod;
a piston head, having at least one first hydraulic fluid passageway extending linearly therethrough with an energy extraction port of predetermined dimensions to allow in use a specific hydraulic fluid flow through the energy extraction port so as to create a predetermined pressure differential over the energy extraction port; and
an idling mechanism, operatively associated with the energy extraction port and operative between an inactive condition, wherein a second passageway for the hydraulic fluid is provided linearly through the piston head, and an active condition, wherein the second hydraulic fluid passageway is closed, the idling mechanism being bias towards the inactive condition and in use rendered active at a predetermined pressure differential over the second fluid passageway.

The idling mechanism may include a closure member, operatively displaceable relative to the piston head between a first position, wherein the second hydraulic fluid passageway is open to define the inactive condition, and a second position, wherein the second hydraulic fluid passageway is closed therewith to define the active condition, the closure member being bias towards the first position; and a retaining member, disposed relative to the piston head to define a predetermined extreme location for the closure member in the first position.

The piston assembly may be provided with a set of first hydraulic fluid passageways extending linearly through the piston head. The piston assembly further

may be provided with a set of second hydraulic fluid passageways extending linearly through the piston head, each second hydraulic fluid passageway having an idling port of predetermined dimensions to allow in use a specific hydraulic fluid flow therethrough.

The energy extraction port may have an orifice diameter of between 0.5mm and 5.0mm.

According to a second aspect of the invention a method for retarding a wagon moving in excess of a specific speed along a track with a hydraulically operated, piston- type retarder includes the steps of:

allowing a first specific hydraulic fluid flow through at least one first hydraulic fluid passageway, extending linearly through a piston head with an energy extraction port of predetermined dimensions;
allowing a second specific hydraulic fluid flow through at least one second hydraulic fluid passageway, extending linearly through the piston head; and
closing the second hydraulic fluid passageway at a predetermined pressure differential over the second hydraulic fluid passageway to create a required pressure differential over the energy extraction port and hence a required energy extraction in accordance with the excess speed of the moving wagon.

Description of Drawings

In the accompanying drawings:

Figure 1 is a cross sectional side view of a piston assembly and corresponding sleeve arrangement in accordance with the invention;
Figure 2 is an enlarged exploded side view of the piston assembly illustrated in Figure 1;
Figure 3 is an enlarged exploded cross sectional side view of part of the piston assembly illustrated in Figure 1;
Figure 4 is a top and cross sectional side view of the piston head illustrated in Figure 1; and
Figure 5 is an energy versus speed graph obtained from the preferred embodiment of the piston assembly with energy extraction ports of between 2.3mm and 3.2mm.

The same reference numerals are used to denote corresponding parts in the accompanying drawings.

Specific Description of the Invention

A piston assembly for use in a hydraulically operated piston-type retarder and as illustrated in the accompanying drawings comprises a piston rod 1, a piston head 2, a speed spring 3, a closure member 4, a spacer member 5, a retainer member 9 and a lock nut 6.

The piston rod 1 is configured and dimensioned, including having a specific diameter and length to be retained, in combination with a corresponding piston sleeve 17, in a conventional housing, or so called pot [not shown]. The piston rod 1 at one longitudinal end thereof is provided with an end portion 16 with reduced diameter for receiving the piston head 2, the speed spring 3, the closure member 4, the spacer member 5 and the retaining member 9. The end portion 16 is further provided with a threaded end section 15 to receive the correspondingly threaded lock nut 6 thereon.

The piston head 2 is provided with two, linearly spaced, ring grooves to receive two adjacent piston rings 11, made of a suitable bronze based material, and a third piston ring 12, made of suitable plastics material, such as teflon. The piston head 2 is also provided with a set of first hydraulic fluid passageways with corresponding energy extraction ports 8, located equispaced, radially about the piston head and extending linearly therethrough. Each energy extraction port 8 in turn is provided with a recessed inlet 10.

The energy extraction ports 8 typically have orifice diameters of between 2.3mm and 3.2mm.

The piston head 2 is further provided with a set of second hydraulic fluid passageways with corresponding idling ports 7, located equispaced, radially about the piston head, extending linearly therethrough.

The piston head 2 is further provided with a spacer ring 23, a clack plate 13 and a retainer washer 14. The piston head 2 is further also provided with a locating formation 20, for locating the speed spring 3 therein, and a passageway 17, for receiving the end portion 16 slidingly therethrough.

The speed spring 3 consists of a helical spring with predetermined physical characteristics.

The closure member 4 consists of a disk-like plate with a passageway 21 extending axially therethrough for receiving the spacer member 5 slidingly therethrough. The closure member 4 is further provided with an annular recess 18, extending radially around the passageway 21 for locating the speed spring 3 therein. The closure member 4 is also provided with an annular abutting formation 19.

The spacer member 5 is in the form of a bush, having a passageway 22 extending axially therethrough for receiving the end portion 16 slidingly therethrough. The spacer member 5 is of predetermined dimensions to locate the retainer member 9 relative to the piston head 2 while receiving the closure member 4 slidingly thereon.

The retainer member 9 defines a flange-like stopper formation at a distil end of the spacer member 5 relative to the piston head 2 in use to provide a predetermined extreme position for the closure member 4 relative to the piston head.

For use, the piston head 2 is located on the end portion 16 whereafter the closure member 4, with the speed spring 3 positioned therebetween, is located linearly opposite the piston head 2. Thereafter, the spacer member 5 is located on the end portion 16, followed by the re-

tainer member 9 for abutting the closure member to ensure the predetermined extreme distal position relative to the cylinder head 2. The retainer member 9 is threadedly secured with the lock nut 6 to the piston rod 1.

In use, with wagons moving at speeds below a predetermined and specific speed and when the piston assembly is forced into the piston sleeve 17 in a shock absorber-type manner, hydraulic fluid is allowed to flow freely from one end of the piston head 2 between the piston head and the closure member 4 to a linearly opposite end through the idling ports 7 in the direction of A with the idling mechanism in the inactive condition. At speeds equal to and above the predetermined and specific speed, the flow of hydraulic fluid in the direction of A overcomes the bias of the speed spring 3, causing the closure member 4 to be forced against the speed spring to abut the piston head 2 by means of the abutting formation 19 to define the active condition, thereby closing off the set of second hydraulic fluid passageways and the corresponding idling ports 7. Hydraulic fluid thus flows through the set of first hydraulic fluid passageways and the corresponding energy extraction ports 8 only, thereby creating a required pressure differential and hence achieving a required energy extraction in accordance with the excess speed of the passing wagon.

In use and at speeds varying between 1.4m/s to 6.4m/s, energy extractions were obtained by means of the preferred embodiment of the piston assembly as herein described of between 600 joules and 2 300 joules, as illustrated graphically in Figure 5.

It is envisaged that energy extraction ports of between 0.5mm and 5.0mm could be designed to provide for wagon stock speeds of between 0.5m/s and 6.5m/s.

It will be appreciated that many variations in detail are possible without departing from the scope and/or spirit of the invention as claimed in the claims hereinafter.

Claims

1. A piston assembly for linear, reciprocal displacement relative to a piston sleeve in a hydraulically operated retarder comprising:

   a piston rod;
   a piston head, having at least one first hydraulic fluid passageway extending linearly therethrough with an energy extraction port of predetermined dimensions to allow in use a specific hydraulic fluid flow through the energy extraction port so as to create a predetermined pressure over the energy extraction port; and
   an idling mechanism, operatively associated with the energy extraction port and operative between an inactive condition, wherein a second passageway for the hydraulic fluid is provided linearly through the piston head, and an active condition, wherein the second hydraulic fluid passageway is closed, the idling mechanism being bias towards the inactive condition and in use rendered active at a predetermined pressure differential over the second fluid passageway.

2. A piston assembly as claimed in claim 1 wherein the idling mechanism includes a closure member, operatively displaceable relative to the piston head between a first position, wherein the second hydraulic fluid passageway is open to define the inactive condition, and a second position, wherein the second hydraulic fluid passageway is closed therewith to define the active condition, the closure member being bias towards the first position; and a retaining member, disposed relative to the piston head to define a predetermined extreme location for the closure member in the first position.

3. A piston assembly as claimed in claim 1 or 2 having a set of first hydraulic fluid passageways extending linearly through the piston head.

4. A piston assembly as claimed in claim 3 having a set of second hydraulic fluid passageways extending linearly through the piston head, each second hydraulic fluid passageway having an idling port of predetermined dimensions to allow in use a specific hydraulic fluid flow therethrough.

5. A piston assembly as claimed in claim 1 wherein the energy extraction port has an orifice diameter of between 0.5mm and 5.0mm.

6. A method for retarding a wagon moving in excess of a specific speed along a track with a hydraulically operated, piston-type retarder including the steps of:

   allowing a first specific hydraulic fluid flow through at least one first hydraulic fluid passageway, extending linearly through a piston head with an energy extraction port of predetermined dimensions;
   allowing a second specific hydraulic fluid flow through at least one second hydraulic fluid passageway, extending linearly through the piston head; and
   closing the second hydraulic fluid passageway at a predetermined pressure differential over the second hydraulic fluid passageway to create a required pressure differential over the energy extraction port and hence a required energy extraction in accordance with the excess speed of the moving wagon.

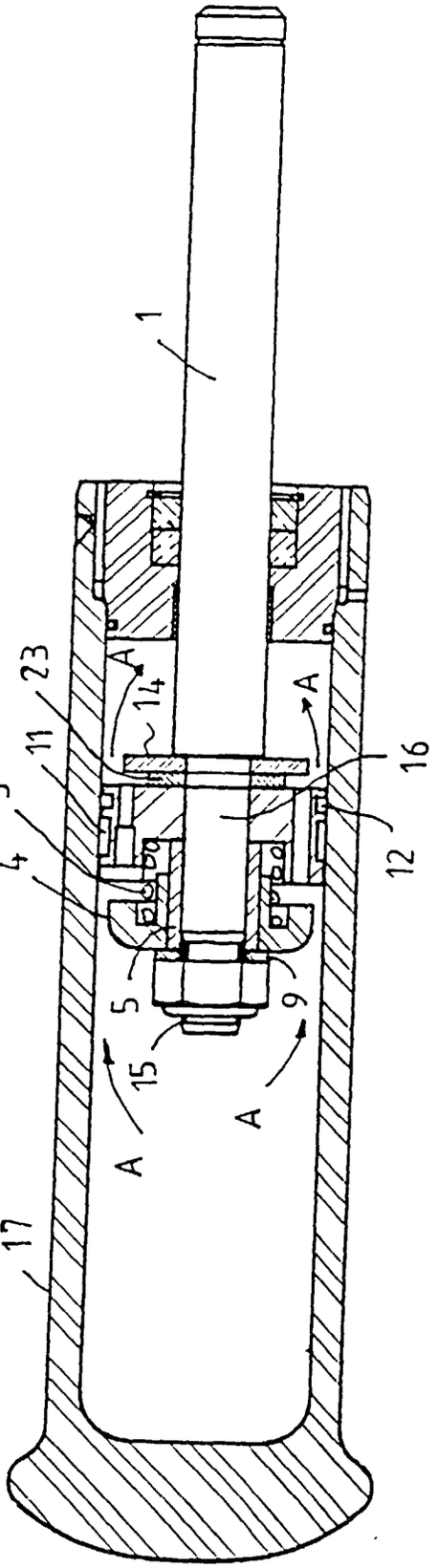

FIGURE 1

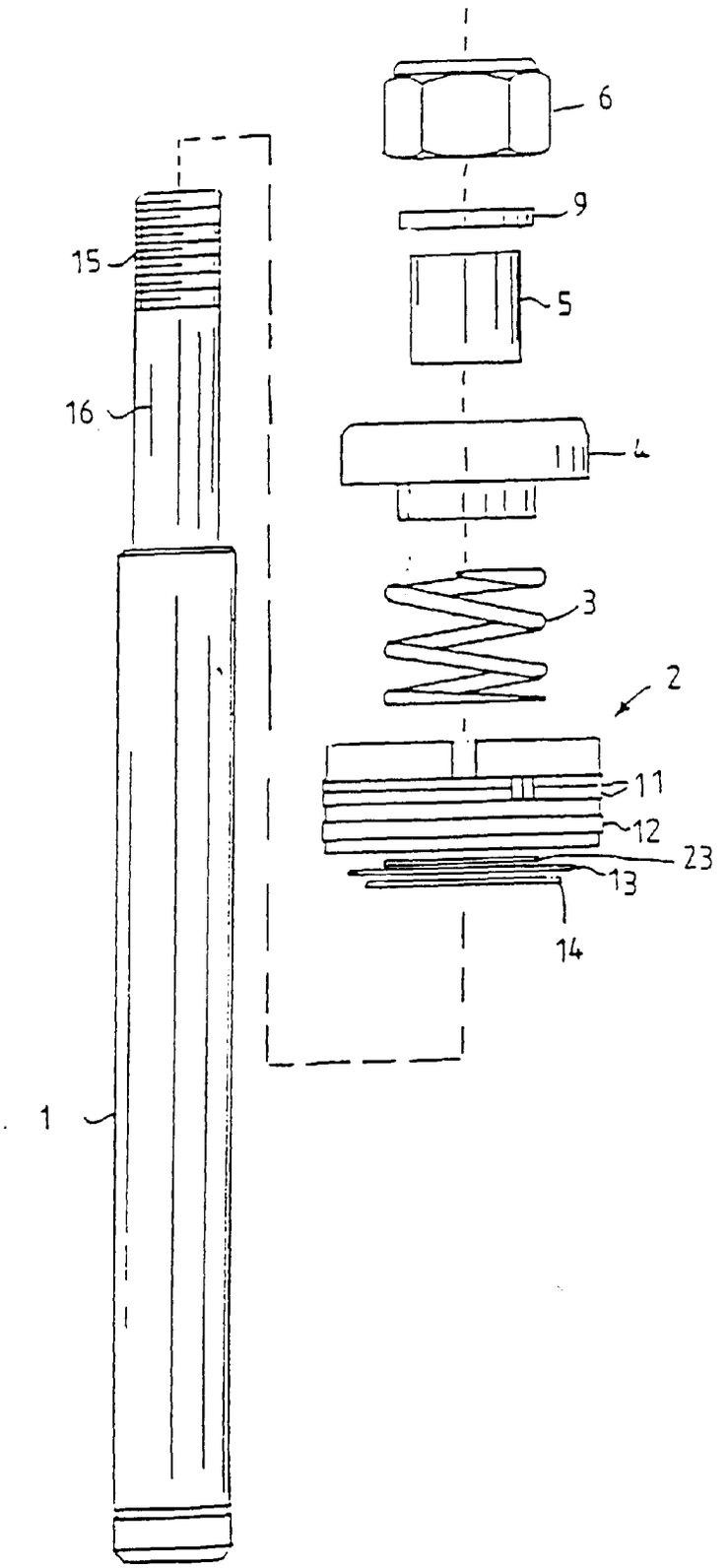

FIGURE 2

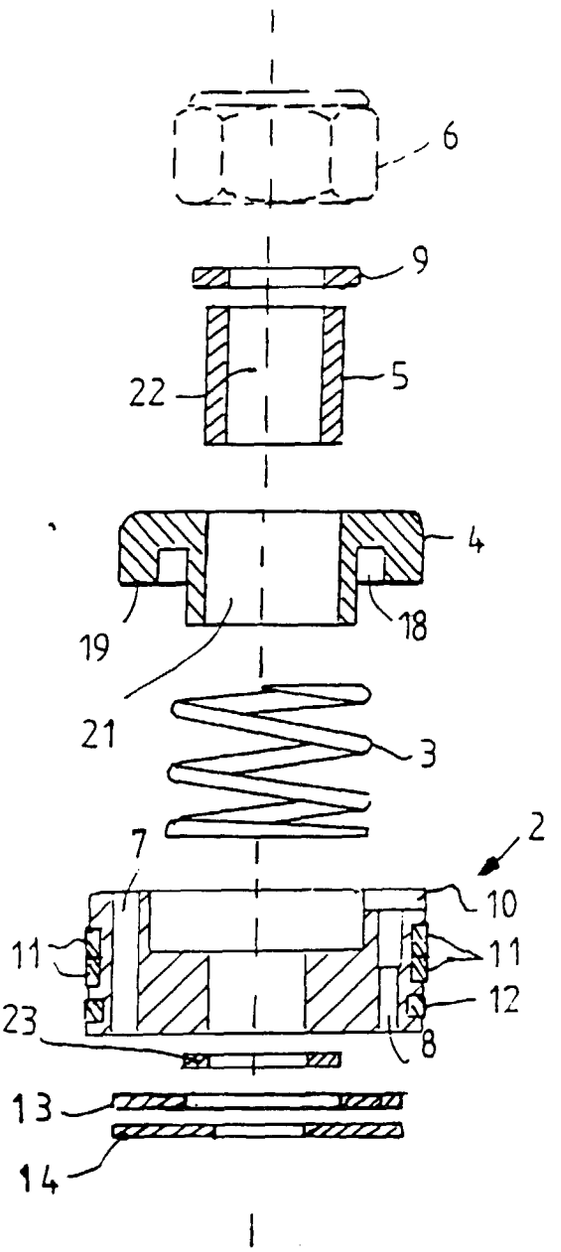

FIGURE 3

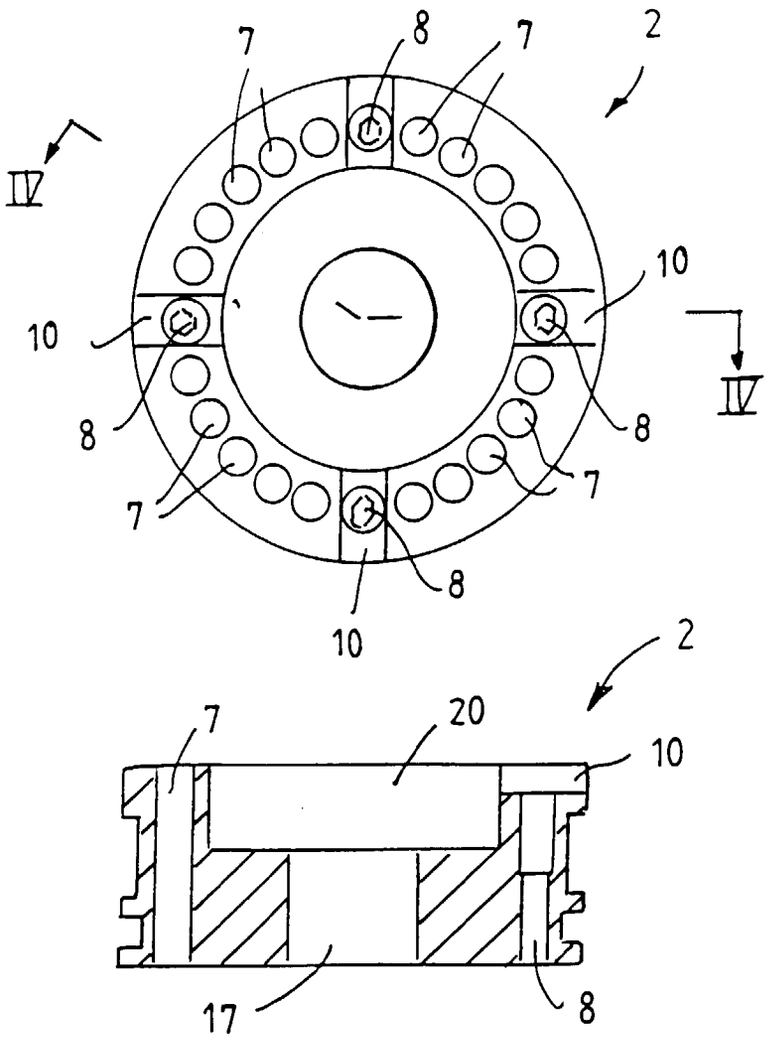

FIGURE 4

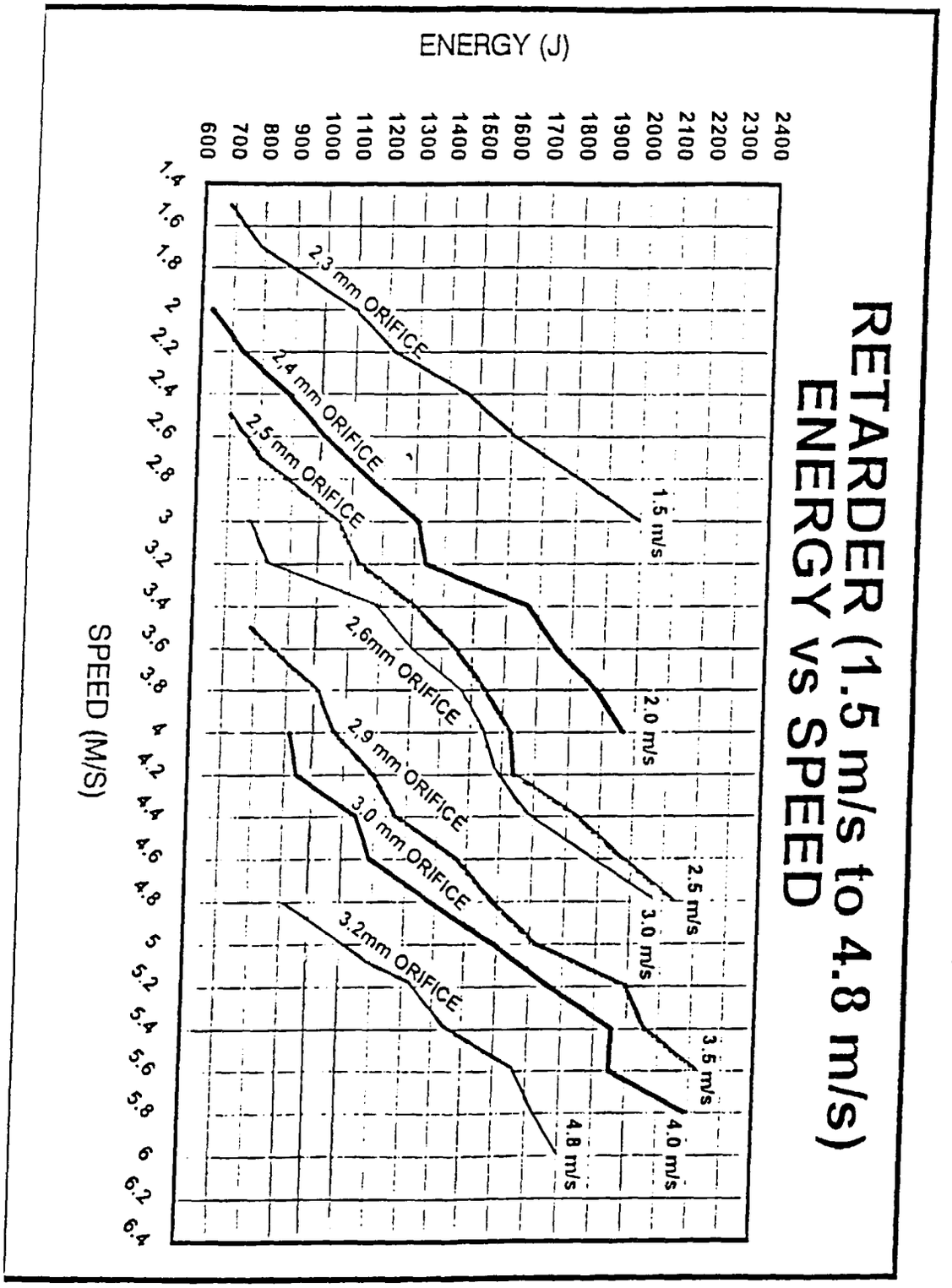
RETARDER (1.5 m/s to 4.8 m/s)
ENERGY vs SPEED
ENERGY (J)
SPEED (M/S)
2400 2300 2200 2100 2000 1900 1800 1700 1600 1500 1400 1300 1200 1100 1000 900 800 700 600
1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.2 3.4 3.6 3.8 4 4.2 4.4 4.6 4.8 5 5.2 5.4 5.6 5.8 6 6.2 6.4
2.3 mm ORIFICE
2.4 mm ORIFICE
2.5 mm ORIFICE
2.6mm ORIFICE
2.9 mm ORIFICE
3.0 mm ORIFICE
3.2mm ORIFICE
1.5 m/s
2.0 m/s
2.5 m/s
3.0 m/s
3.5 m/s
4.0 m/s
4.8 m/s

FIGURE 5