United States Patent

[11] 3,602,151

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[54] **ENERGY DISSIPATING CONSTRUCTION FOR TRAINS**
9 Claims, 5 Drawing Figs.

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[51] Int. Cl. B61k 7/18, F16f 9/10
[50] Field of Search 104/256; 293/51, 1; 267/1

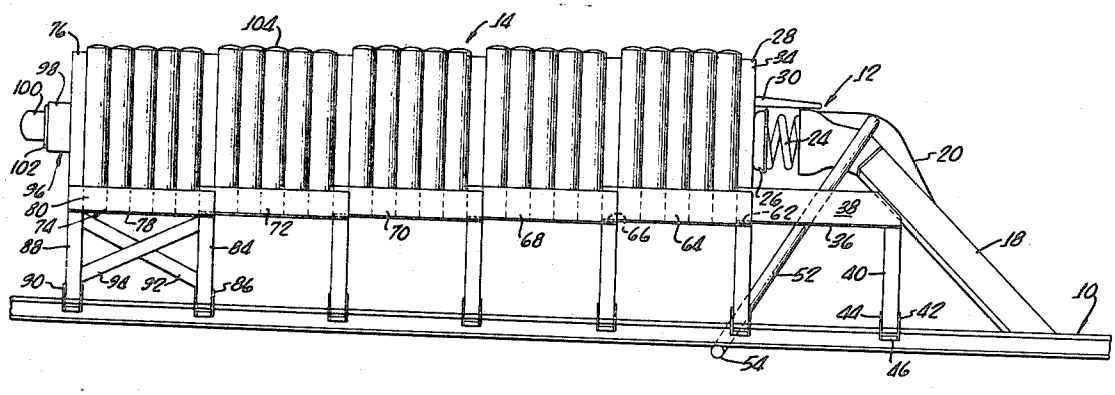
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ABSTRACT: An energy dissipating construction for absorbing and dissipating the kinetic energy of moving trains is disclosed which comprises a backstop fixedly secured with respect to the rails which support the train, a plurality of telescoping diaphragm members each consisting of a vertical diaphragm plate and a horizontal support plate and an energy dissipating assembly comprising a plurality of vertical liquid containing resilient cylinders between the backstop and the first diaphragm plate and between succeeding diaphragm plates, each of the cylinders having one or more openings adapted and constructed to permit escape of the liquid therefrom at a rate commensurate with the energy of impact on the construction. Upon impact each of the diaphragm assemblies telescopes with the adjacent diaphragm assembly thereby crushing the resilient liquid filled cylinders and forcing the liquid therefrom to thereby dissipate the kinetic energy of the train and bring the train to a stop.



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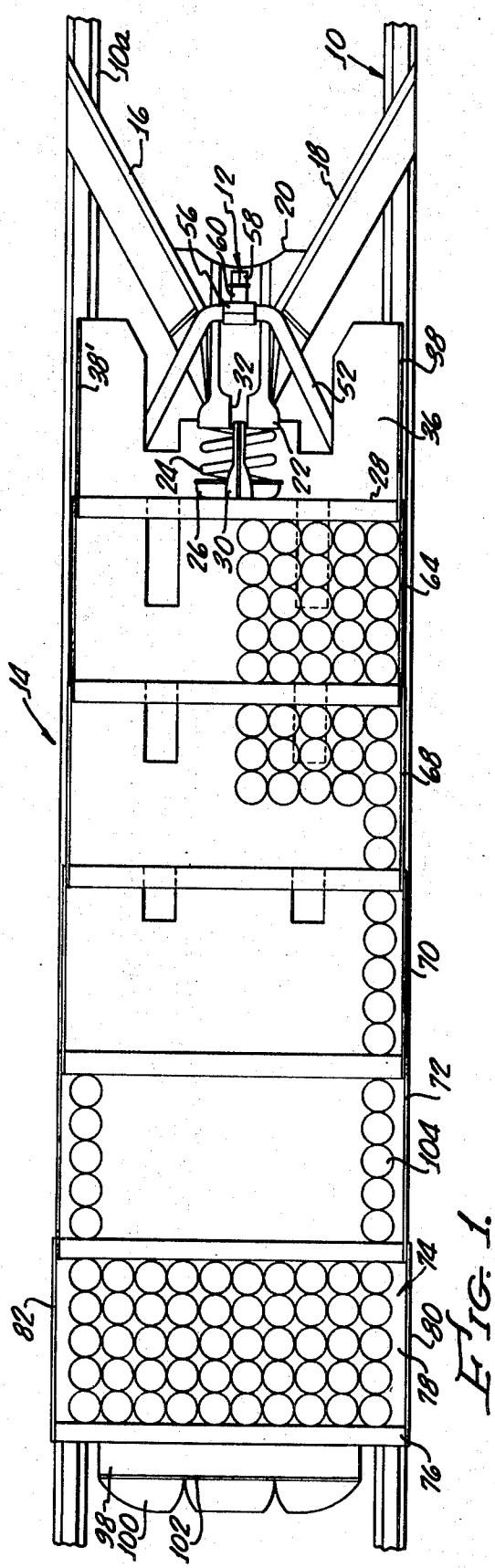


FIG. 1.

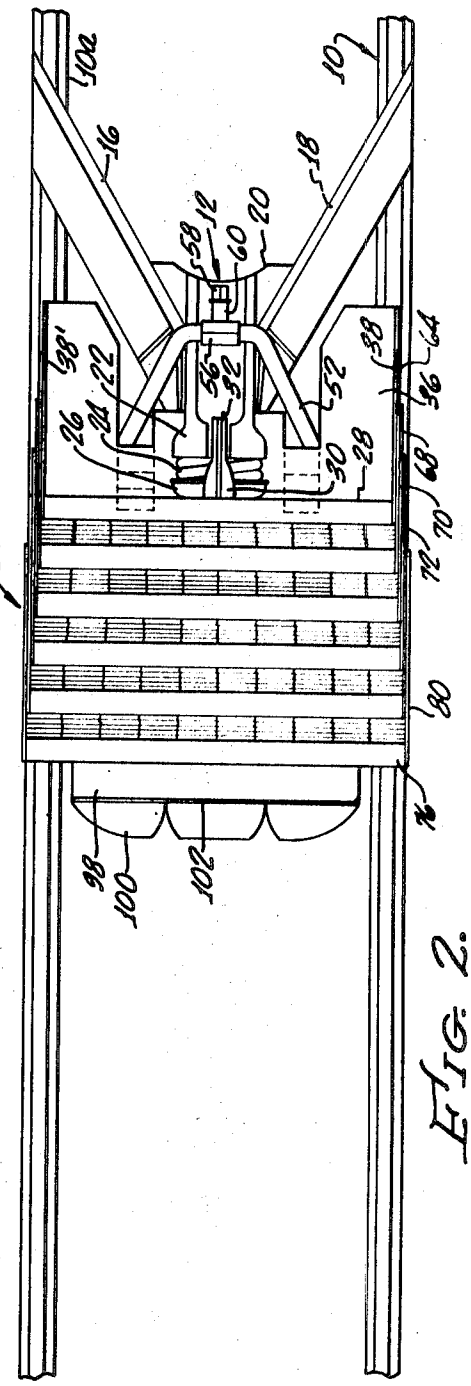


FIG. 2.

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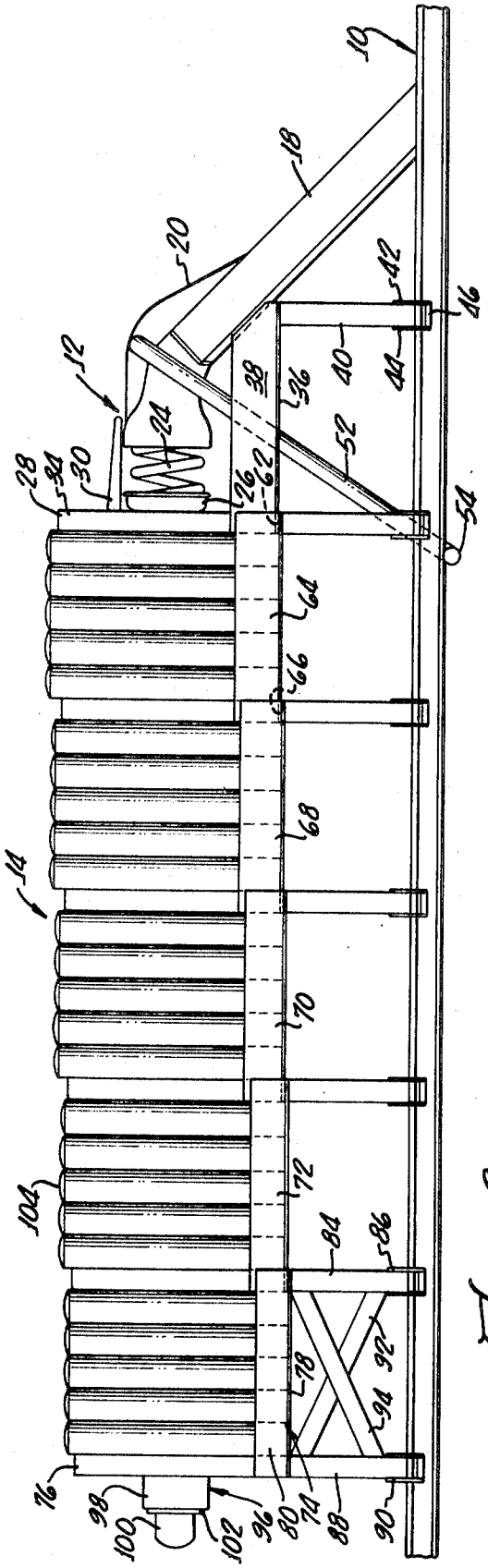


FIG. 3.

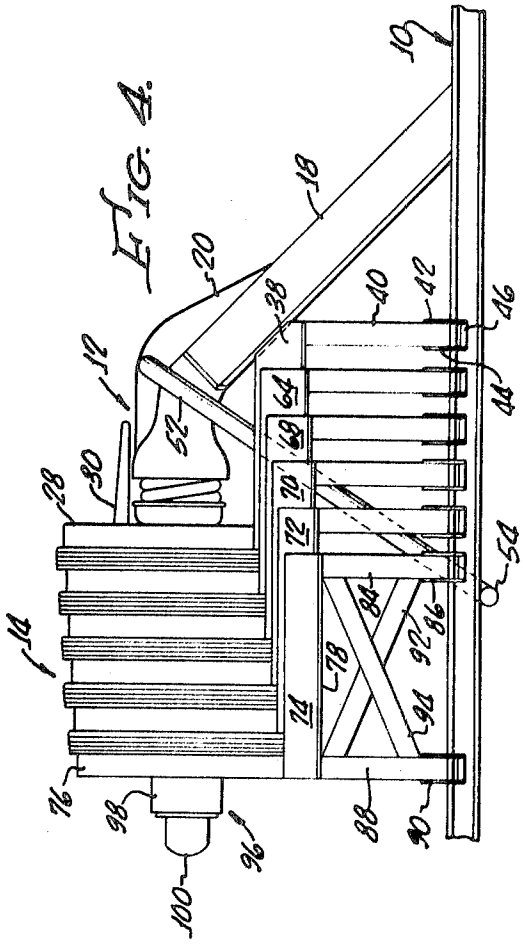


FIG. 4.

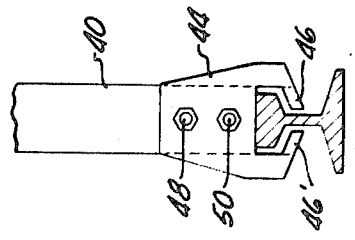


FIG. 5.

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ENERGY DISSIPATING CONSTRUCTION FOR TRAINS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to railroad equipment and, more particularly, to energy absorbing stops for trains.

2. Description of the Prior Art

It is known, in the prior art, to provide stops at the end of railroad spurs and at the end of rails in train stations. These stops may simply be in the form of a pile of sandbags or the like, a concrete abutment, or a steel stop welded to the rails. Energy absorbing devices such as springs and compressible fluid devices, in addition to the structures mentioned, are not generally successful for the intended purpose.

Trains traveling toward the end of a spur or the end of the rail in a station are usually not moving at a very high velocity. However, because of the enormous inertia of a train it is impractical, and often impossible, to bring the train to a dead stop instantly without severe damage to the train, the stopping mechanism, and/or to the cargo of the train. The problem is particularly acute where passengers may be riding on the train.

Similarly, it is not a satisfactory solution to the problem simply to store up the kinetic energy of a moving train, as by means of a spring alone, since as soon as the train comes to a halt, the stored up energy acts against the train and causes a second, and often equally serious, jolt to the passengers and/or cargo.

What is required, for a practical train stopping mechanism, is means for permitting the train to travel over a short distance, which often may be significant, while dissipating the kinetic energy of the train without storage of the energy. It is, accordingly, a principal object of this invention to provide an improved nonenergy storing construction for bringing moving trains to a gentle stop.

SUMMARY OF THE INVENTION

A novel construction for utilizing liquid filled kinetic energy dissipating devices has now been invented. This construction comprises, as its major components, a backstop fixedly secured to the rails or relative thereto, a plurality of relatively telescoping diaphragm assemblies, supported for movement along the rails, each of the diaphragm assemblies including a vertical diaphragm plate and a horizontal support portion and a plurality of nonenergy storing normally noncompressible fluid containing energy dissipating cylinders in the space between the diaphragm and the backstop and between the adjacent diaphragms. The dissipating devices are supported on the support plate of the diaphragm assembly. It will be apparent, from the foregoing, that the primary object of this invention is to provide a novel combination energy absorbing construction of the type briefly described. It is a further object of the invention to provide a novel energy absorbing construction which includes a fixed backstop means and one or more relatively rigid diaphragm means separated by energy dissipating means, the diaphragm means being supported for relative movement toward the backstop means by a moving train for forcing fluid from the energy dissipating means at a rate commensurate with the energy of the moving train.

A novel combination of backstop means, energy absorbing means and relatively rigid diaphragm means is an important more specific object of the invention.

A still more specific object of the invention is to provide a novel backstop means for use in combination with movable diaphragm means.

A highly significant and important object of the invention is to provide an energy absorbing construction which includes a plurality of relatively telescoping diaphragm means separated by energy dissipating means.

The specific construction disclosed herein have the combination of parts and elements described and illustrated constitutes a further and more specific, but nonlimiting, object of the invention.

Other objects of the invention will become apparent from the specification which follows and from the drawings to which reference is now made.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top plan view of the construction of this invention shown in its normal configuration, prior to impact by a train.

FIG. 2 is a top plan view of the embodiment of FIG. 1 shown in its completely compressed position as it would appear following maximum impact by a train or the like.

FIG. 3 is a side view of the construction of FIG. 1.

FIG. 4 is a side view of the construction of FIG. 4 shown in the compressed configuration.

FIG. 5 is a detail showing the support means for the movable elements of the construction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The major components of the invention are adapted to be used on rail means such as 10 which may include a second rail 10*a*. It will be understood, however, that it is well within the skill of the art to adapt the construction of this invention, in view of the teachings which will follow, for use on a monorail or equivalent. The main components include backstop means shown generally at 12 fixedly secured relative to the rails and an energy absorbing assembly including moving components shown generally at 14.

The backstop means 12, which may be of the type supplied to the railroad industry, for example, by Hayes Track Appliance Company, Richmond, Indiana, or others, comprises a pair of legs 16 and 18 connected by a bite portion 20. The legs 16 and 18 are, in the preferred embodiment, welded to the rails. In the case of a monorail, however, only one supporting leg would normally be used. The bite portion 20 may include a spring receiving member 22 for receiving and securing one end of a spring 24, the other end of the spring 24 being received in a cap 26 which is in contact with and may be secured to a backing member 28 which is constructed and adapted to be restrained from movement by the support stop which comprises the legs 16 and 18 and the bite portion 20. Limited relative movement is permitted against the resilient bias of the spring 24, however, a guide 30 may be secured to the cap 26 or to the backing member 28, as shown in the drawing, and is received in a slot 32 of the bite portion 20 in the support stop.

As best shown in FIG. 3, the backstop 20 includes a generally vertical backstop plate 34 connected to a horizontal support having a bottom plate 36 and sideplates 38 and 38'.

The rearwardmost end of the backing member is supported by a pair of legs 40 connected to a slidable rail gripping foot portion comprising a pair of plates 42 and 44 connected by bite portions 46 and 46' which may be secured to the bottom of the legs 40 by means of frictional fasteners such as bolts 48 and 50, the latter being best shown in FIG. 5. A similar arrangement is used on the diaphragm means as will be described hereinafter.

As best shown in FIGS. 1 and 2, the rearwardly extending bottom plate portion 36 is cut out and adapted to be received around anchor cable 52 which extends from an anchor, shown at 54, below the rails 10 and over the bite portion 20 of the support stop where it is secured by means of a receiving sleeve 56 and a bolt 58 extending through an opening in a ring 60 which is formed, preferably, integrally with the bit portion 20.

As indicated at 62, the front or forwardmost end of the backing member 28 is supported by the rearwardmost end of a diaphragm assembly indicated generally at 64, the front end of which is supported, as indicated at 66, on the rearwardmost end of a relatively telescoping diaphragm assembly 68 which is supported in like manner on the rear end of diaphragm member 70. Diaphragm member 70 is similarly supported on the rearwardmost portion of diaphragm member 72 which is supported in the same manner on the rearwardmost portion of diaphragm 74. Diaphragm assembly 74 differs from the other assemblies in that it also includes a front support.

The diaphragm assembly **74** will be described in detail and it is to be understood that, except as noted, the elements of the other diaphragm assemblies are similar except for dimensions. To avoid undue repetition, however, the elements of the remaining diaphragm assemblies will not be described in detail.

The diaphragm assembly **74** includes a vertical diaphragm plate **76** which is connected to a bottom support plate **78** and to sideplates **80** and **82**, shown best in FIG. **1**. The rearwardmost portion of the diaphragm assembly **74** is supported by a pair of legs **84** which are secured to feet members **86** of the type shown in FIG. **5** and previously described.

To this point, the diaphragm assembly **74** is substantially identical with the other diaphragm assemblies **64–72** except that it is wider than the remaining diaphragm assemblies. It will be apparent from FIG. **1** that each diaphragm assembly is slightly smaller than the next succeeding diaphragm assembly forwardly thereof and that the sidewalls are received inside the sidewalls of the next adjacent diaphragm assembly and the bottom support plate is received on top of the bottom support plate of the succeeding diaphragm assembly in such a manner that all of diaphragm assemblies may telescope over each over. Similarly, the diaphragm assemblies **64**, **66**, and **68** are adapted to telescope over the backing plate **28** in a similar manner.

In addition to the components common to all of the diaphragm assemblies, however, the forwardmost diaphragm assembly **74** includes a pair of front legs **88** secured to shoes **90** of similar construction and may include bracing **92** and **94** on each side as best shown in FIG. **3**. It is to be understood that except as described or illustrated, the construction of the assembly is symmetrical and like elements will appear on the side of the construction obscured from view by the drawing.

In the preferred embodiment, it is desirable to provide engaging means shown generally at **96** which may include a block **98** secured to the vertical diaphragm plate **76** of the diaphragm assembly and an energy absorbing buffer **100**, such as a liquid filled buffer generally of the type described in U.S. Pat. No. 3,284,122 secured as by means of a plate **102** to the block **98**. This engaging means prevents or reduces damage to the construction but is otherwise not necessary.

Between each of the diaphragm plates and between the first diaphragm plate and the backing plate there is provided a nonenergy storing dissipating means. In the preferred embodiment, the dissipating means comprises a plurality of liquid filled buffers for absorbing kinetic energy of the type described and illustrated in the application of John W. Rich, Ser. No. 664,333 filed Aug. 30, 1967, now U.S. Pat. No. 3,503,600 the entire disclosure of which is incorporated herein by reference.

Briefly described, buffer members of the type under consideration comprises a vertical semiresilient cylinder which is partially or fully filled with water. The cylinders provided, normally in the upper portion thereof, with one or more openings. These openings are constructed and adapted to permit escape of water only at a rate commensurate with the energy of impact on the walls thereof. The walls are described as semiresilient in that the cylinders may be collapsed and will, upon removal of external forces, return to their original shape but have little energy storing capacity. These cylinders may be made of rubber but are preferably made of plastics such as highly plasticized polyvinylchloride or vinylchloride-vinylacetate copolymers, and the like. Reference is made to the aforementioned application for a detailed description of devices of this type.

OPERATION

FIGS. **1** and **3** shown the construction of this invention in its normal configuration ready for use; i.e., prior to any impact by a moving train. As will readily be seen, each of the diaphragm plates is spaced from each adjacent diaphragm plate and the first diaphragm plate is spaced from the backing plate **28**. The spaces between these plates are filled with a plurality of the energy absorbing cylinders. These cylinders are normally approximately filled with water or some other noncompressible or substantially noncompressible fluid. Cylinder **104** is exemplary of such constructions.

Since each of the diaphragms are substantially rigid they will transmit the impact energy equally to all of the energy dissipating cylinders in contact therewith and, through the series of energy dissipating cylinders, to the next diaphragm plate and so on along the length of the construction so that ultimately, any nondissipated kinetic energy is transmitted to the backing plate **28**. As the train strikes the construction, preferably engaging the cushion buffer **100**, the last diaphragm **74** begins moving toward the backing plate **28** and transmitting energy to the diaphragm **72** which, in turn, begins to move in the same direction and so on down the line such that, upon sufficient impact, all of the diaphragms will begin moving toward the backing plate. Not all of the diaphragms will, however, necessarily move at the same velocity. Indeed, in the preferred embodiment, the diaphragm **74** moves faster than the diaphragm **72** and likewise with the diaphragms **70**, **68**, and **64**. As the diaphragms are moved closer relative to each other, the energy of impact is dissipated as the water contained in the cylinders **104** is spewed forth out of the orifices therein, as described in detail and illustrated in the aforementioned application of John W. Rich.

Upon maximum impact by a moving train, all of the diaphragms will be moved very close to each other relatively as shown in FIGS. **2** and **4**. When this occurs, substantially all of the water will have been blown out of the cylinders, and the spring **24** will be in compression. Normally, however, the spring **24** is utilized merely to even out the rate of dissipation of energy by absorbing minor portions of the kinetic energy of the train and retransmitting this energy to the energy dissipating buffer cylinders. Thus, it will be apparent from the foregoing that a moving train is brought gradually to a stop and the kinetic energy thereof is dissipated by the discharge of large quantities of noncompressible fluid from the semiresilient cylinders and, as a major factor, through the viscous flow of the liquid through the orifice arrangement in each of the cylinders as described in detail in the aforementioned application of John W. Rich. It is important to note that the kinetic energy of the train is not simply stored and retransmitted to the train. The advantages of this invention has been discussed previously and, upon reflection, will be appreciated. If an energy storing device were used, the train would simply suffer a second jolt which may cause damage as severe as the original impact. There is, of course, no second jolt utilizing the present invention.

Furthermore, it will be realized that, contrary to prior practices, no effort is made to bring the train instantly to a stop but rather, the construction is so designed as to dissipate the energy of movement of the train over a considerable distance. This maximum utilization of distance and energy dissipation is accomplished by the novel telescoping arrangement of the diaphragm system and the energy dissipating means of this invention.

In the present invention, the feet on the supporting legs are simply adapted to restrain vertical movement of the diaphragm assemblies. The diaphragm assemblies and the backing plate assembly is slidably supported on the rails. Of course, this support may be accomplished by means of wheels, rollers, or by other means. All such relatively movable supports would be equivalent for purposes of the present invention. However, it is more economical to use simple sliding friction devices and such devices are ample for present purposes because a moving train possesses sufficient momentum to overcome the initial coefficient of friction.

Furthermore, it will be understood that while the present diaphragm arrangement is adapted to be supported by and slid upon the same rails upon which the train runs, other relatively movable arrangements could be provided. All that is necessary is that the backstop assembly be fixed relative to the rail or the like upon which the train moves and that the diaphragms

be movable relative to the rail or the like toward the backstop assembly. The foregoing embodiment is exemplary of the invention and may be used as a model for constructing the invention, however, many variations of the invention may be made without departing from the spirit and scope of the invention as defined in the following claims.

We claim:

1. An energy absorbing construction for absorbing and dissipating the kinetic energy of trains and the like without storing said energy which in combination comprises:

a backstop means fixedly secured relative to rail means, said rail means being adapted to support a train or the like;

a plurality of relatively rigid diaphragm means supported for movement along said rail means toward said backstop means, said diaphragm means in normally spaced disposition along said rail means and being spaced from said backstop means;

a plurality of nonenergy storing normally noncompressible fluid containing energy dissipating means in the space between the diaphragm means and the backstop means and separating said diaphragm means, said energy dissipating means including container means for said fluid, said container means including collapsible portions and being adapted and constructed for being collapsed by relative movement of the diaphragm means toward the backstop means, said container means including at least one orifice adapted and constructed for permitting escape of said fluid at a rate commensurate with the kinetic energy transmitted to the diaphragm means;

said diaphragm means and energy absorbing means being so constructed and arranged that a series of energy absorbing subconstructions is formed by adjacent pairs of diaphragm means, energy being dissipated by energy dissipating means between the respective diaphragm means as said diaphragm means move relatively close upon impact of a train or the like.

2. The construction of claim 1 wherein said diaphragm means are constructed and adapted to telescope into each other upon impact by a train or the like.

3. The construction of claim 1 wherein said diaphragm means are adapted and constructed to support said energy dissipating means.

4. The construction of claim 3 wherein said diaphragm means are constructed and adapted to telescope into each other upon impact by a train or the like.

5. The construction of claim 4 wherein the backstop means comprises:

a fixed support stop;

a movable backing member; and

resilient means separating the backing member from the support stop for temporarily storing energy for transmittal into said energy dissipating means.

6. The construction of claim 1 wherein the backstop means comprises:

a fixed support stop;

a movable backing member; and

resilient means separating the backing member from the support stop for temporarily storing energy for transmittal into said energy dissipating means.

7. The construction of claim 1 wherein said diaphragm means are constructed and adapted to support said energy dissipating means.

8. A nonenergy storing construction for dissipating kinetic energy of trains and the like comprising:

a support stop fixed relative to train supporting rail means;

a backing member constructed and adapted to be restrained from movement by said support stop;

a plurality of diaphragm means supported for movement on said rail means, each of said diaphragm means including a generally vertical diaphragm plate and a generally horizontal platform plate and being constructed and adapted to telescope with one another and with the backing member;

a plurality of nonenergy storing dissipating means separating said diaphragm means and supported on said platform plates between said diaphragm plates, each of said dissipating means comprising at least one semiresilient container normally at least partially filled with a noncompressible fluid, said container including at least one orifice constructed and adapted to expel fluid commensurate with a train impact energy when the diaphragms move toward the backing member collapsing said container; and

additional dissipating means disposed between one of said diaphragm means and said backing member.

9. The construction of claim 8 wherein said additional dissipating means comprises:

resilient means for permitting limited relative movement for temporary storage of energy and retransmittal of said energy to dissipating means.