

[54] **ENERGY ABSORBING IMPACT
ATTENUATING HIGHWAY SAFETY
SYSTEMS**

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3,503,600	3/1970	Rich.....	256/1 X
3,606,258	9/1971	Fitch.....	256/13.1
3,643,924	2/1972	Fitch.....	256/1 X
3,674,115	4/1972	Young et al.	256/1 X
3,680,662	8/1972	Walker et al.	256/1 X
3,768,781	10/1973	Walker et al.	256/1

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& Kurz

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[51] Int. Cl. **E01f 15/00**
[58] Field of Search..... 256/13.1, 1;
404/6-9

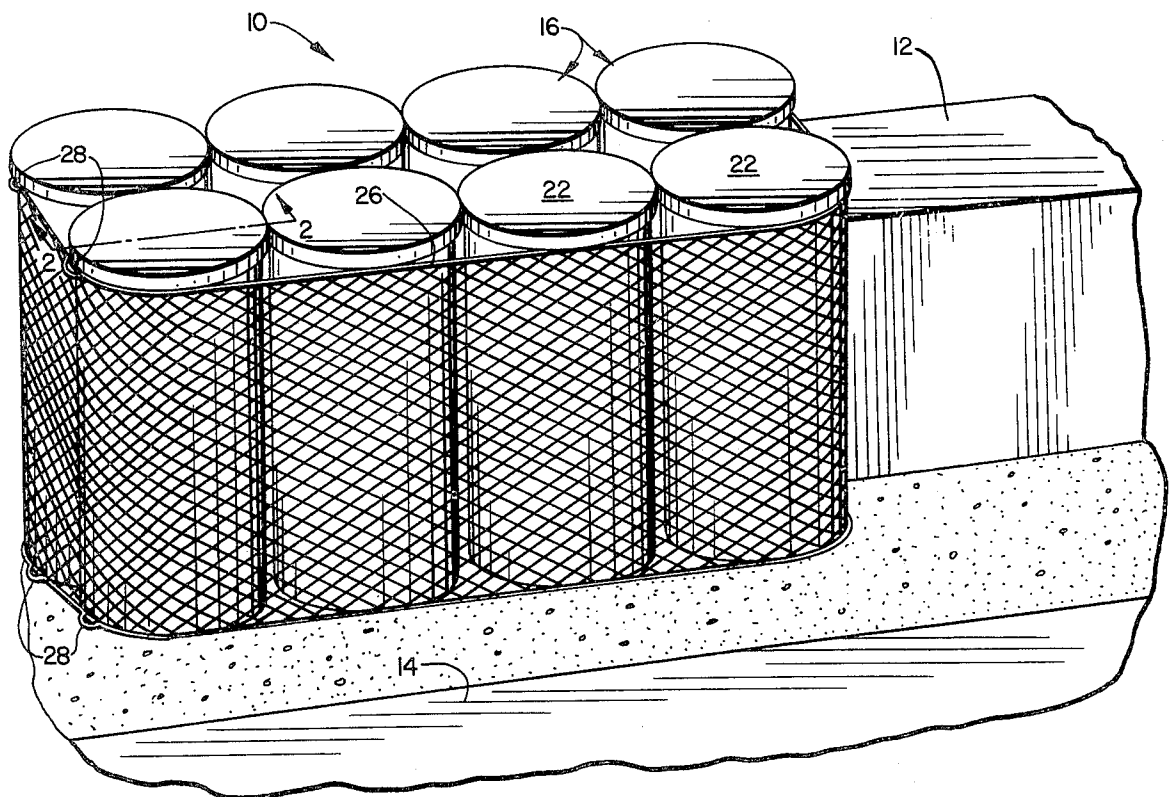
[56] **References Cited**
UNITED STATES PATENTS

1,808,767	6/1931	Gloria et al.	256/1
2,088,087	7/1937	Hudson.....	256/1

[57] **ABSTRACT**

An energy-absorbing impact attenuating system particularly adapted for use in urban locations, where vehicle speeds are moderate. The system retains its structural integrity upon normal impact and is thus reusable.

4 Claims, 3 Drawing Figures



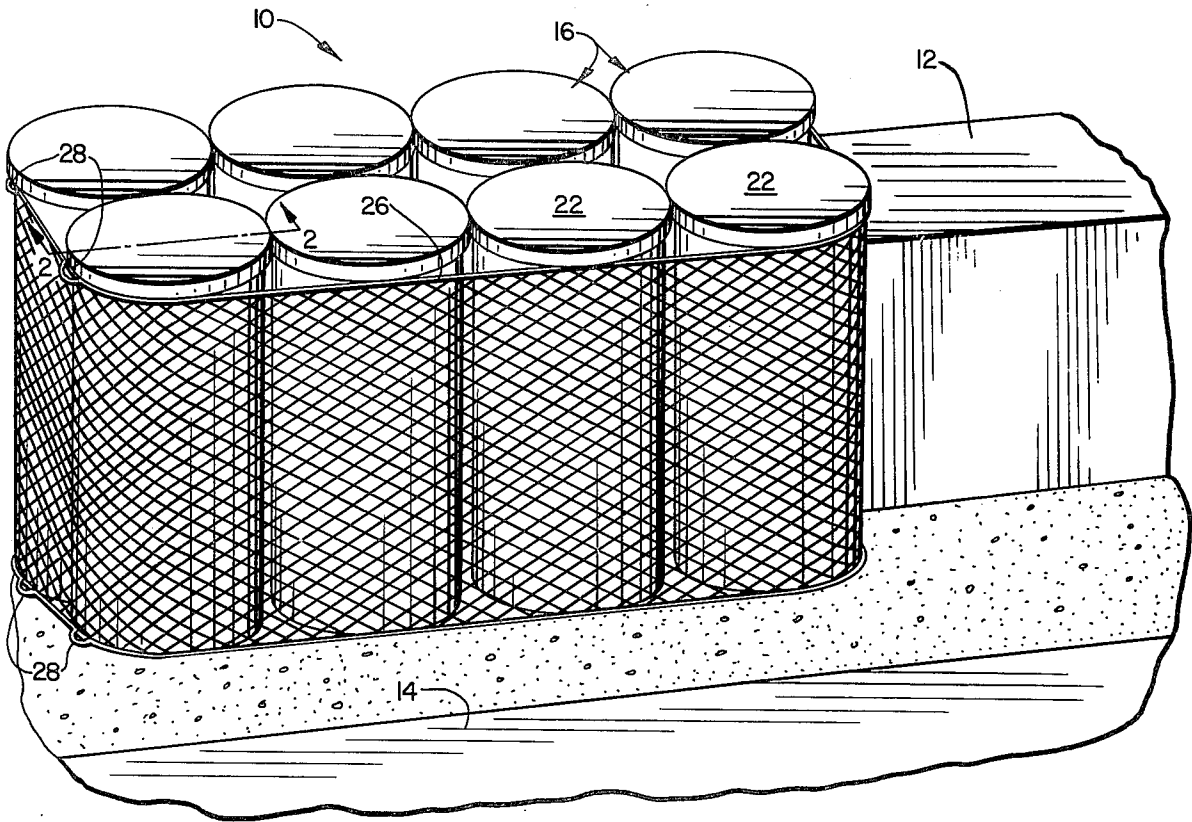


FIG. 1

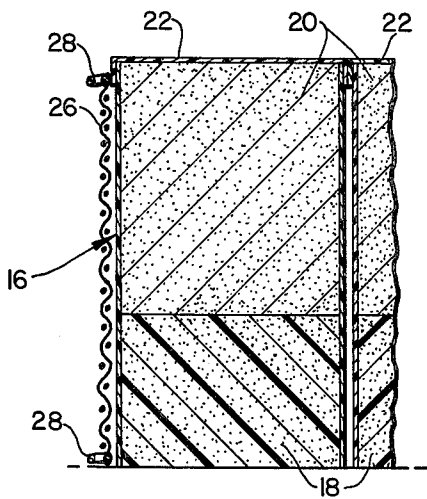


FIG. 2

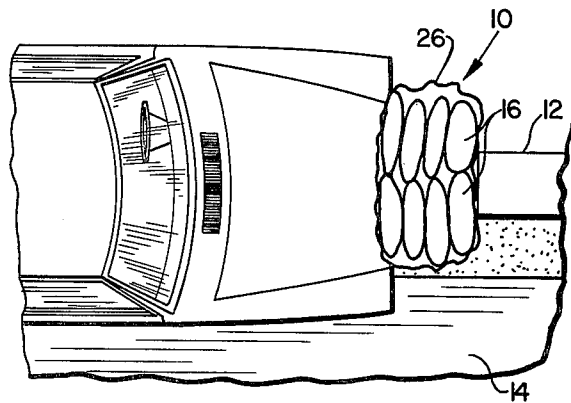


FIG. 3

ENERGY ABSORBING IMPACT ATTENUATING HIGHWAY SAFETY SYSTEMS

BACKGROUND OF THE INVENTION

In recent years, many proposals have been made to provide impact attenuators to control the rate of deceleration of an errant vehicle as it approaches a hazard such as a bridge abutment or other fixed object adjacent to a highway.

One of the most successful of such devices is disclosed in U.S. Pat. No. 3,606,258, owned by applicant's assignee. The impact attenuator there disclosed comprises one or more frangible containers of considerable size, each containing a dispersable mass.

These impact attenuators or barriers have proved to be extremely successful in effecting controlled deceleration of vehicles traveling at normal highway speeds. However, to provide the necessary energy absorption capacity they are of considerable bulk and cannot be used in many urban locations where available space is severely restricted. Also they are sacrificial barriers, designed to be destroyed on impact.

Other previously proposed barriers or impact attenuators are subject to essentially the same limitations.

SUMMARY OF THE PRESENT INVENTION

It is the principal purpose and object of the present invention to provide improved vehicle impact attenuators which are of compact construction, which may be used in urban locations where space is severely restricted, and which may be reused after normal impact, thus reducing the overall cost of the barrier system and minimizing the time during which the hazard is left unprotected.

In attaining this and other objects, the present invention includes an array of cells, preferably of cylindrical form, fabricated from rupture-resistant but flexible plastic. The lower portions of the individual cells are provided with a flexible lightweight plastic spacer structure and the upper portion of each of the cells is filled with a dispersable mass such as sand. The array of cells, in a typical case eight such cells, are encircled and confined by a flexible belt or band structure strong enough to withstand normal impact but sufficiently flexible to yield under impact. Upon impact, the cells are deflected, the sand mass within the cells is dispersed or displaced and the energy exchange between the vehicle and the sand mass decelerates the vehicle in the desired controlled manner.

After impact, the belt or band encircling the array of cells is pulled back to its original shape, thus restoring the cells to their original configuration. After the cells are refilled with sand, the barrier is again ready to perform its intended function.

Additional objects and advantages will become apparent as the description proceeds.

THE DRAWINGS

FIG. 1 is a perspective view of a typical installation of the impact attenuator system of the present invention;

FIG. 2 is a vertical central section through one of the cells of the barrier of FIG. 1; and

FIG. 3 is a top plan view of the impact attenuator system as it appears after a normal impact.

DESCRIPTION OF PREFERRED EMBODIMENT

FIG. 1 illustrates in perspective a typical application of the invention in which the barrier system indicated generally 10, is positioned in front of a fixed object 12, the barrier extending away from the fixed object in a direction opposite to the travel of vehicles on the adjacent roadway 14.

The barrier assembly comprises a series of identical cells or container units 16 shown in greater detail in FIG. 2.

The cells are of cylindrical configuration and are fabricated from tough flexible plastic material, having sufficient strength to resist rupture upon impact. Special vinyl and polyethylene materials have been found suitable for this purpose. The lower portion of each of the cells is provided with a lightweight flexible plastic foam spacer 18 and the space within the cell above the core is filled with a dispersable mass such as sand indicated at 20. Preferably the spacer 18 is bonded to the inner wall of the cell 16 to assure retention of the sand in the upper portion of the cell. The cell is completed by a lightweight flexible plastic cover 22 which is provided to prevent the entry of moisture into the sand mass, to improve the appearance of the unit, and to inhibit tampering.

In a typical case, the cells are 18 inches in diameter, 32 inches in height, and the spacer is 12 inches in height so that the space within the cell above the spacer may accommodate approximately 300 pounds of sand. Because of the high density of the sand and low density of the spacer, the center of gravity of the overall unit is located approximately 22 inches above ground level, which closely approximates the level of the center of gravity of the average passenger vehicle. Accordingly, upon impact, the nose of the vehicle is neither depressed nor raised, and the barrier exerts no overturning moment on the vehicle.

Another important purpose of the spacer is to prevent the presence of large masses of sand below the bumper, the strong cross-member structure and the wheel center elevation of typical passenger cars, which are all at approximately the same elevation. Because the cells will tend to fold at this level and eject sand from either end, the flexible foam spacer effectively replaces the sand below this "hinging point" of the cell, thus little or no sand is ejected to the ground level, which would lift the vehicle as its wheels rode up upon the sand.

The barrier unit is installed by placing the individual cells 16 in a tight grouping in front of the fixed object 12 in the configuration shown in FIG. 1. After the cells are in place, they are filled with sand and the covers are installed. Thereafter, the array or group of cells is encircled with a flexible plastic woven mesh belt 26 which is preferably of essentially the same vertical height as the cells. The ends of the belt are joined together by any suitable means not shown. The belt is a tough, stiff material to resist tearing upon oblique impacts and to contribute to the lateral stability of the cluster of cells prior to impact.

The belt is preferably attached to the fixed object to stabilize the barrier alignment and to prevent it from being displaced in case of impact from an unexpected angle, which conceivably could force it into a travelled lane. Attachment of the belt to the fixed object also would facilitate relocation and reshaping of the barrier

when it is pulled back into position following an impact.

Upon impact, the cells 16 will be progressively flattened as the vehicle progresses through the barrier. A portion of the sand will be expelled out of the tops of the containers and the remainder of the sand will be laterally displaced toward the fixed object 12. The dispersement and displacement of the sand mass results in a momentum exchange between the vehicle and the sand, resulting in a smooth controlled deceleration of the vehicle at a rate which will minimize damage to the vehicle and injury to the occupants.

In case of an over-design impact, being one which exceeds the designed-for vehicle weight and/or speed, a final decelerating force of higher value is applied to the impacting vehicle as a result of the resistance to compression which the belt, the cells and the residual sand within them will exert in opposition to the vehicle's final traverse toward the fixed object. This final high value decelerating force is in addition to the inertial forces originating from the displacement of the sand mass and depends upon the "back up" stability of the fixed object, into which the compression force is transmitted.

Because there will always be occasional over-design impacts, the timing of the operation of the final compression-phase resistance to it is, in this barrier design, ideal. This is true because the human tolerance to high G_x (or forces of gravity) is also higher after the vehicle occupants are relocated within the vehicle against the passenger compartment interior.

The relocation of the occupants as above and their consequent impact velocity against the interior of the vehicle, is completed during the relative low- G , inertial phase of the barrier operation, thus reducing injury exposure to the occupants.

Following a normal impact, the barrier will assume the configuration in FIG. 3. After the vehicle has been removed, a truck attached to suitable hooks 28 on the belt 26 may be used to pull the barrier and the cells 40

back into their original configuration. The cells are then refilled with sand, the covers installed, and the barrier is ready for reuse.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A reusable impact attenuating barrier system for decelerating an errant vehicle as it approaches a fixed object comprising an array of individual hollow cells positioned adjacent said object, each cell being formed of a flexible rupture-resistant sheet material, a lightweight flexible spacer filling the lower portion of each cell, the upper portion of each cell containing a high density dispersable mass, said spacers being of sufficient height to dispose the center of gravity of the cells substantially at the center of gravity of said vehicle, and a flexible belt encircling said cell array, whereby upon normal impact by a vehicle, said cells are deformed without rupture to expel and displace said mass to decelerate said vehicle by momentum exchange, and said barrier may be readied for reuse by restoring said cells to their original configuration and replacing said mass.

2. A barrier according to claim 1 wherein said spacers are bonded to the interior of said cells.

3. A barrier according to claim 1 wherein said cells, said spacers, and said belt are each fabricated from flexible material, such as plastic.

4. The barrier according to claim 1 wherein said cells are of elongated, cylindrical configuration and are held in tight tangential contact by said belt.

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