Nov. 7, 1967 E. MUELLER 3,351,322

HIGHWAY GUARD FENCE

Filed July 6, 1966

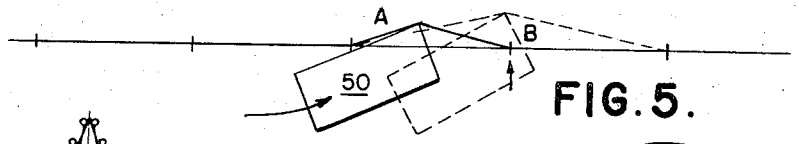


FIG. 5.

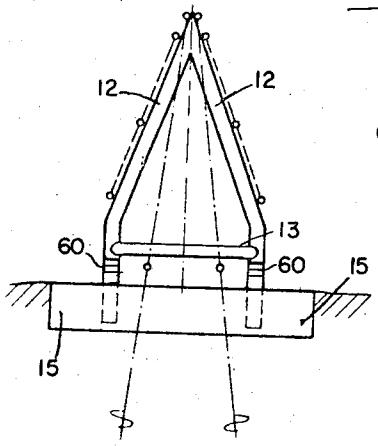


FIG. 7a.

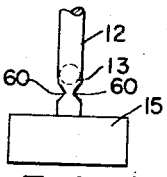


FIG. 7b.

FIG. 4.

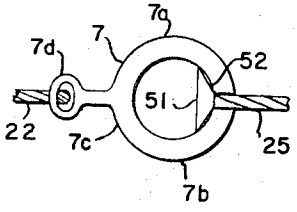


FIG. 6.

FIG. 1.

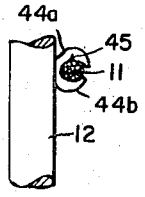


FIG. 2.

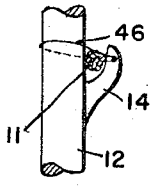


FIG. 3.

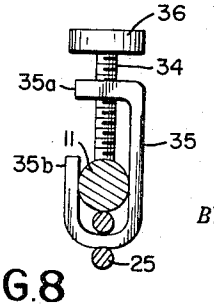


FIG. 8.

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HIGHWAY GUARD FENCE

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Claims priority, application Germany, Jan. 8, 1963, M 63,339
2 Claims. (Cl. 256—13.1)

This is a continuation-in-part application to copending patent application S.N. 335,155, now abandoned, and the priority date of Jan. 8, 1963, to which the parent application is entitled is claimed for all subject matter common therewith.

The present invention relates to guard fences for use along the borders of highways and roads.

Objects of the invention are to provide a highway guard cable fence:

That prevents vehicles from crossing over into the oncoming lane of traffic or from leaving the right side of a highway;

That does not deflect excessively under impact;

That prevents rebound of vehicles striking thereon;

That stops a vehicle striking thereon, whether the vehicle is large or small;

That stops a vehicle striking thereon, but which is of a construction not likely to damage the vehicle catastrophically or to injure its occupants.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIGURE 1 is a schematic view of the guard fence of the invention along the side of a highway.

FIGURE 2 is a partly sectional view and shows a modified attachment of a cable to the frame in a guard fence.

FIGURE 3 is a partly sectional view and shows a modified attachment of a cable in the guard fence.

FIGURE 4 is an elevational view showing a wire mesh attached to the fence of FIGURE 1.

FIGURE 5 is a top schematic view of a vehicle colliding with the guard fence of the invention.

FIGURE 6 is a partially sectional view of a release mechanism inserted between an anchor and a bracing wire.

FIGURE 7*a* is a front view of a modified frame of the invention.

FIGURE 7*b* is a side view of a part of FIGURE 7*a*.

FIGURE 8 shows a detail of FIGURE 1.

Referring in detail to the figures, FIG. 1 shows the side of a highway. Bordering the highway are concrete foundations **15**, spaced at regular intervals. Ten meters is a preferred length of the interval. A frame **10** is mounted on each of the foundations. The plane of each frame is perpendicular to the highway. Attachment of the frame is by way of U-shaped strap bearings **16**, which surround pipe **33** and are secured to the concrete. The separation of the points of attachment enables the frame to resist large torques about an axis parallel to the highway. The size of the separation and the strength of the attachment can be determined experimentally by conventional engineering methods as functions of the dimensions, weights and impact speeds of vehicles using the highway.

The frame is constructed in a triangular shape from three steel pipe sections **12**, **12**, **33**. For added rigidity and for purposes of attachment of accessories, a steel plate **17** is welded in place within the triangle.

Steel rods **20** run between points of rigid attachment on the plate to the eye **18** of anchors **19** in the ground. A usable diameter for the rods is 6 mm. This dimension must be varied according to the particular steel being used. Design factors are that the rods must break when a vehicle collides with a frame and that the rods must nevertheless be able to withstand forces arising only from deflection of cables supported on the frame.

Hooks **14** are welded onto the upright pipes on the highway-side of the frame. These hooks are open upwards. FIGURE 1 shows three hooks, in which rest three cables **11**. The cables must must be sufficiently strong to withstand the stresses arising from the impact of a vehicle. Commonly available steel cable of two centimeter diameter is usable. This dimension must be adjusted depending on the particular steel cable being used and on the weight and speed of the heaviest vehicles using the highway.

FIGURE 1 shows conventional fasteners **26** attached to the three cables. These fasteners are preferably of the screw-friction type and provide a non-slipping connection between the cables and bracing wires **25**. FIGURE 8 is an example of an applicable conventional screw-friction type fastener. Screw **34** passes through a threaded bore in bracket **35**. A bracing wire **25** is looped through the bottom of the bracket and a cable **11** is passed between bracket ends **35***a* and **35***b* to rest on the loop of the bracing wire. The square head **36** is then used to tighten the screw into frictional engagement on the cable. The bracing wires are connected in FIGURE 1 at their other ends by way of hooks **22** and turnbuckles **24** to an earth anchor **23** in the ground. These wires have preferably a 6 mm. diameter and are made of hardened steel. Depending on the actual steel used and on expected conditions of loading, the diameter is accordingly varied. The strength and heat treatment of the wires is such that they break when the vehicle runs into them, thus preventing hooking or catching thereof.

As an alternative to strength and heat treatment as a means of assuring that the wires break, each wire can be provided with a notched fracture site by scribing with a file.

Every 3 and ⅓ meters, distance wires **40** are connected between the cables to damp oscillations of the cables.

Operation of the invention is best explained with the aid of FIG. 5. In case A, a vehicle **50** is running into the guard fence as it veers toward the side of the highway. In this example, the top cable of FIG. 1 has slid up onto the top of the left front fender. The central cable is bearing against the left front fender and the tire, while the bottom cable has passed under the left front tire. Thus the top and bottom cables are shown in the original line of the guard fence, while the central cable is shown deflected. The top and central cables have caught the vehicle and are preventing its running off the highway. As it slows down either by braking or by friction, the car continues moving approximately parallel to the highway direction.

Case B shows the circumstances in dashed lines some time after case A. The vehicle has collided with one of the frames. The frame has fallen, pivoting around its hinged attachment on the foundation, and has released the cables supported on it. The vehicle has thus been allowed to continue sliding along the cables. While, as shown in case A, the frames support the cable and prevent the vehicle from leaving the highway, they do not interrupt its movement parallel thereto. Thus the vehicle does not suffer any catastrophic decelerations. This prevents excessive damage to the vehicle and avoids possible fatal injury of the occupants.

It can be seen in FIG. 5 that those frames not hit by the

vehicle remain standing and support the cables. This, combined with the action of the bracing wires, prevents excessive deflection of the cables perpendicular to the highway.

The bracing wires furthermore prevent excessive stretching of the cables. This and the entanglement of the vehicle in the cables lessens the chance for rebound and reentry onto the highway.

If the vehicle comes into direct contact with the bracing wires, they are broken and thus no forces are exerted tending to pull the cables toward the ground, out of contact with the vehicle.

While the cables rest, in FIG. 1, in upwardly open hooks, it is in some cases desirable to provide a more secure attachment of the cables to the frame, in order that oscillations and loading during impact not result in premature release of the cables from their frames. Thus, FIG. 2 shows a cable held by upper and lower claws **44***a* and **44***b*. The upper claw **44***a* has a fracture site **45** that breaks and allows falling of the frame. Alternatively, FIG. 3 shows the cable held in a hook and strapped in by a 1 mm. diameter security wire **46**, which breaks when the frame is hit by the vehicle.

Where more secure distancing of the cables is desired, the distance wires **40** can be replaced or supplemented by the wire mesh **47** shown in FIG. 4.

Although, as disclosed above, the bracing wires **25** are designed to break when hit by the vehicle, FIG. 6 shows a release coupling **7** that can be inserted between turnbuckle **24** and wire **25** to release the bracing wires when they are contacted by the vehicle. In this modification, bracing wire **25** has a conical end **51** integrally connected to it. This conical end is inserted from the side of the coupling between jaws **7***a* and **7***b* and sits in a funnel-shaped recess **52** on the inner side of the jaws. On its rear side, the coupling has an eye **7***d*, which is attached to the hook **22** of the turnbuckle. After insertion and seating of the conical end, the wire is tensioned by the turnbuckle. If the vehicle should hit the bracing wire, the tension in it is increased to such a level, that end **51** slides in the recess, expands the jaws by spring deflection action centered at **7***c*, and finally leaves the coupling, thereby releasing the wire.

In a modified form of the invention, shown in FIGS. **7***a* and **7***b*, the hinges of FIG. 1 are omitted and pipes **12** of the frame are extended directly into the concrete foundation **15**. Pipe **13** completes the triangular frame. Notches **60** are placed in the pipes **12** near to the concrete. This practice retains the stability of the frames with respect to torques about an axis parallel to the highway and yet makes it easy for a vehicle to knock the frame over, should it actually strike the frame. Upon being struck by the vehicle, the frame pivots about the notches and possibly breaks there.

Although the embodiment presented above is for use on the side of a highway, it can easily be adapted for use between two opposing lanes of traffic by the addition of three more cables on the other side of the frame.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

I claim:

1. A guard fence for use on a highway, comprising: a plurality of foundations spaced along a curb of the highway; a plurality of two-dimensional frames; attachment means to mount one of said frames on each of said foundations tightly secured thereto in upright position to execute a rigid-body rotational movement about axes extending approximately perpendicular to the run of the highway at the points of mounting, when the torque exerted by an impacting vehicle about these axes reaches a minimum value; each of said frames attached to its foundation at two points lying on a line extending approximately perpendicular to the run of the highway; said points separated a distance sufficient to enable the frames to withstand large torques about axes approximately parallel to the run of the highway, said torques calculated upon the maximum expected weights and impact speeds of the vehicles using the highway; a plurality of cable holding means spaced on each of said frames for releasably holding cables to said frames; and a plurality of cables tautly stretched approximately parallel to the highway from frame to frame and each held at each of said frames by one of said holding means, said attachment means comprising: pairs of journal bearings, one for each frame; one pair rigidly mounted on each of said foundations; said frames being pivotable in said pairs of bearings; and rod means for each frame to hold each frame in the upright position and to release each frame for pivoting when struck by a vehicle.

2. A guard fence as claimed in claim **1**, further comprising: a plurality of sets of bracing wires; a plurality of earth anchors; a plurality of fasteners; each of said sets having an associated earth anchor and an associated number of fasteners equal to the number of wires in the set; the earth anchor of each set lying approximately on a straight line between two adjacent frames; the fasteners of a set being connected to said cables between the anchor of a set and its adjacent frames, at least one fastener connected to each cable running between the adjacent frames; each of the wires of a set being connected tightly between the earth anchor and a fastener, there being only one wire per fastener; and means to release said connected wires by the impact of a vehicle on the wires.

References Cited

UNITED STATES PATENTS

286,182	10/1883	Cunningham et al.	256—47 X
361,291	4/1887	Hume	256—48 X
619,030	2/1899	Waterbury	256—47 X
625,526	5/1899	Warner	256—47 X
786,307	4/1905	Novess	256—41
1,085,363	1/1914	Smith	256—48 X
1,094,741	4/1914	Oliphant	256—13
1,647,585	11/1927	Sargent	256—12.5
1,805,251	5/1931	Matthews et al.	
1,964,404	6/1934	Lynch.	
2,227,948	1/1941	Camp	256—13.1
2,365,900	12/1944	Newkirk	52—116

FOREIGN PATENTS

220,185	3/1962	Germany.
174,694	3/1961	Sweden.

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