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[54] **GUIDERAIL FOR STORAGE RACKS**

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[58] **Field of Search** ..... 256/1, 13.1; 293/62, 63, 293/74, 75, 83, 69 R, 88; 267/139, 113, 116; 114/219; 61/48

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[57] **ABSTRACT**

A deflectable guiderail adapted for positioning at the end of a rack aisle to restrain handling equipment from damaging a rack upon such equipment entering or exiting the aisle.

10 Claims, 3 Drawing Figures

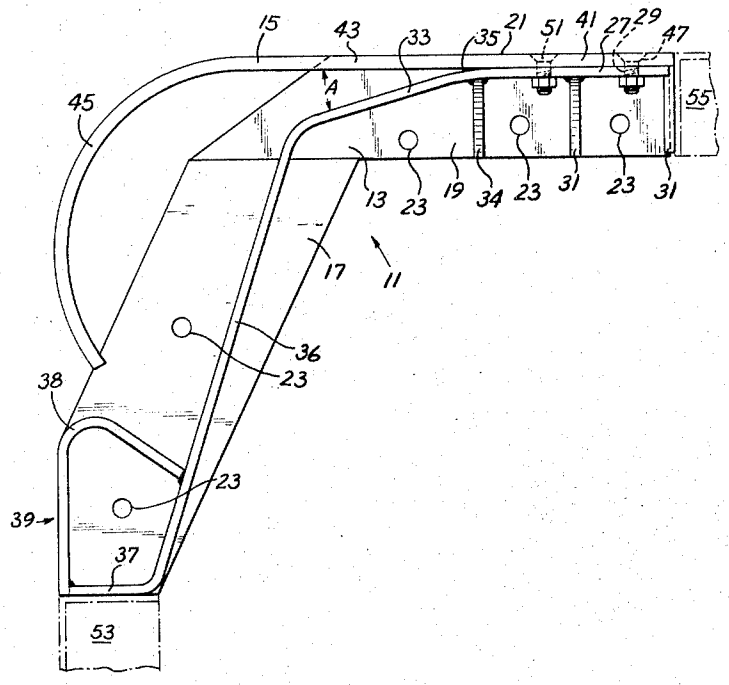


FIG. 1

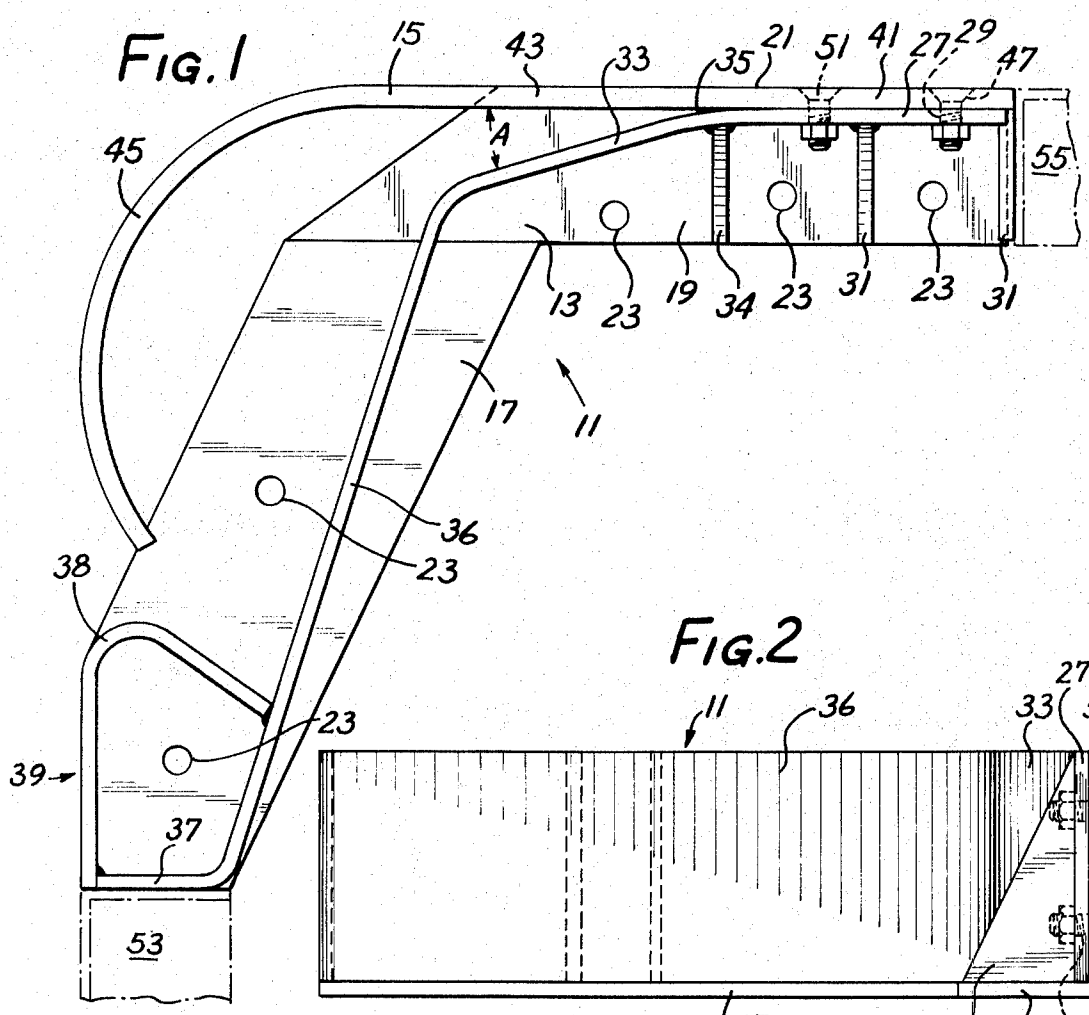
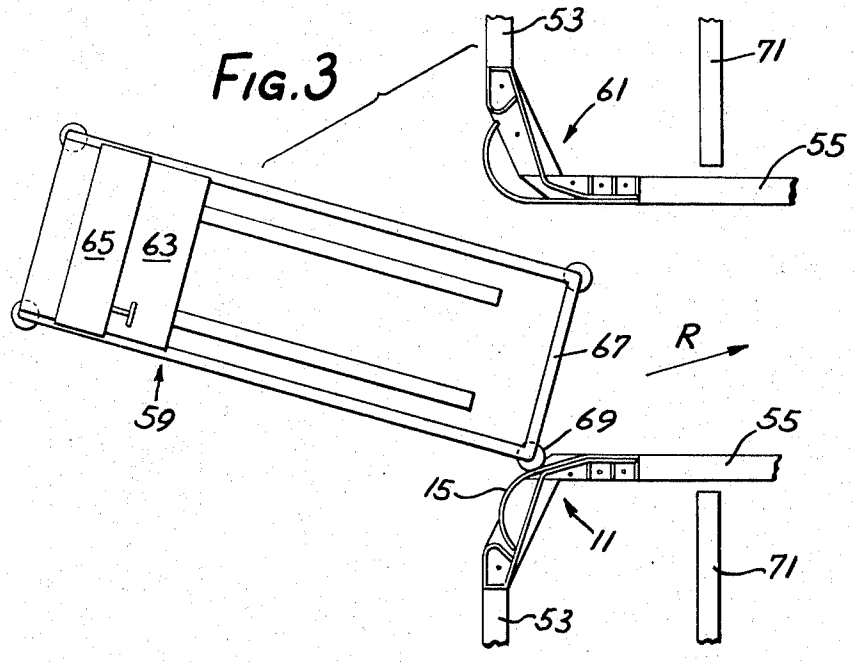


FIG. 2

FIG. 3



GUIDERAIL FOR STORAGE RACKS

The present invention relates to guiderails and is directed to guiderail assemblies which are positioned at the entrance to warehouse rack aisles.

Lift trucks are commonly employed to move goods in a warehouse. These trucks, often called "order pickers," move in and out of the track aisles transporting items which are stored on the racks. The items are carried in front of the trucks on forks or booms which are an integral part of the trucks.

The rack aisles in which these trucks operate are usually narrow to make the maximum utilization of warehouse floor space. As a consequence, it is common for such equipment to strike the racks as the equipment moves into or out of the aisle. When such an accident occurs, the truck, the rack or both may be damaged.

It is therefore desirous to have guiderails or guardrails positioned at the entrances to these rack aisles which will restrain the handling equipment from striking the racks. For optimum efficiency, these guardrails should be capable of limited deflection movement, for if the handling equipment struck a rigid guardrail, the handling equipment could be damaged or the load, which the handling equipment may be carrying, could be jarred. Although these guardrails should allow for deflection, there should be a positive limit to the amount of deflection movement to stop the handling equipment prior to striking a rack if it has not yet altered its course. Further, these guardrails should possess an impact cushioning capability which will be effective in neutralizing impacts throughout a broad range of angles of incidence. As these guardrails are designed to deflect under an impact, they should also be constructed so as to return to their original position after the source of the impact has been removed, and the capabilities of the guardrail should permit repeated deflections to be sustained without losing its efficiency.

It is an object of this invention to provide an assembly for positioning at the entrance or exit to storage rack aisles which provides a deflectable guardrail.

It is another object of this invention to provide a guardrail assembly which protects a rack from impacts which may come from different directions of incidence.

It is another object of this invention to provide a resilient guardrail which becomes relatively rigid after a predetermined amount of lateral movement.

These and other objects of the invention are more particularly set forth in the following detailed description and in the accompanying drawings, of which:

FIG. 1 is a plan view of a guardrail assembly formed in accordance with the present invention;

FIG. 2 is a side elevation view of the guardrail assembly of FIG. 1; and

FIG. 3 is stop motion plan view showing a pair of guardrail assemblies as illustrated in FIG. 1 positioned at the entrance to a rack aisle with one assembly being depicted during the instant it is struck by a truck.

While the invention will be described in connection with a preferred embodiment, it will be understood that this is not intended to limit the invention to this particular embodiment.

The present invention is concerned with a guardrail assembly to protect the entrances and exits to storage rack aisles. A rack aisle is the space between two vertical storage racks, both of which are to be protected. A guardrail assembly is designed to be emplaced adjacent

that corner of both the racks nearest the aisle entrance. Thus, these guardrail assemblies are deployed in pairs, a "right hand" guardrail assembly at the corner of one rack and a "left hand" guardrail assembly at the corner of the other rack. The two assemblies are mirror-images of each other, and only the "left hand" guardrail assembly is hereinafter described.

In the drawings there is illustrated a preferred embodiment of a guardrail assembly (hereinafter sometimes referred to as the assembly) denoted as **11** which possesses features of the present invention. Very generally, the assembly **11**, comprises a base **13** and a guardrail **15**; the base **13** cooperating with the guardrail **15** to mount and support the guardrail for limited swinging or deflection movement in a predetermined direction.

The base **13** is a flat rigid plate, formed from steel or the like and generally L-shaped in plan, having a major let **17** and a minor leg **19.** The base **13** is adapted to be placed flat against the floow of a warehouse and may be formed from a single piece of material, or the major leg **17** and the minor leg **19** may be separate pieces that are joined by welding. One of the minor leg's elongated vertical edges is denoted as the base front edge **21** for purposes of reference. The base **13** is drilled to provide five holes **23** which extend through the plate and are utilized with appropriate bolts for anchoring the base to the floor. These holes are spaced throughout the length of both legs of the base and are arranged to provide an effective transmission of shear and moment forces to floor of the warehouse.

Fixed to one corner of the upper surface of the base **13** is an upstanding bracket **27** which has four bolt holes **29** arranged in vertically aligned pairs. The bracket **27** is preferably made of a rigid metal plate, such as steel, and is welded to the base **13.** The bracket **27** is uniformly recessed a predetermined distance from the base front edge **21.** Welded to the bracket **27** and the base **13** are two triangular supporting gussets **31** which are preferably made of a rigid metal, such a steel plate.

Extending from the left hand end of the support bracket **27** is an upstanding, movement-limiting abutment **33** which is welded to the base surface. The abutment **33** is positioned at an angle A to the front surface of bracket **27,** which in the preferred embodiment is about 15°, and thus extends away from the base front edge **21** toward the rear of the base at this angle A. The abutment **33** is made of a rigid metal plate, such as steel. The illustrated bracket **27** and the abutment **33** are formed from a single piece of plate stock which is bent to provide the desired angular relationship although separate pieces might be used. The single piece of plate stock used to form the bracket **27** and the abutment **33** is bent to gradually define the angle A between the two surfaces so as to provide an angular transition surface **35.** The purpose of this transitional surface **35** will become apparent hereinafter. A reinforcing triangular gusset **34** is welded to the base **13** and the rear of the abutment wall **33.**

A vertically aligned stiffener **36** extends along the upper surface of the base **13** from the free end of the abutment **33** to the rearmost portion of the base **13.** The bottom edge of the stiffener **36** is welded to both the base major **17** and minor **19** legs. The rearmost portion **37** of the stiffener **36** is bent generally at a 90° angle and is generally flush with the rearmost vertical edge of the major leg **17.** An upstanding generally V-

shaped plate **38** is welded to the end of the stiffener **36** to form a quadrangular loop **39** in conjunction with the rear stiffener portion **37** and the stiffener **36**, which loop **39** is located adjacent the rearmost portion of base leg **17**. The stiffener **36** is preferably formed from a single piece of plate stock which is bent to form the bracket **27**, the abutment **33** and the stiffener **36**; however separate pieces may be used and welded together.

The guardrail **15** of the assembly is an upstanding plate of curb height which, in the preferred embodiment, is a leaf spring made of a tempered spring steel. While the guardrail **15** is preferably a resilient metal plate, a hinged rigid metal plate might be used, with the desired resilience being achieved by means of ancillary springs. In the preferred embodiment, the guardrail **15** is about 6 inches high.

When viewed from the top in FIG. **1**, the guardrail **15** has in right to left sequence: a shank portion **41**, an intermediate portion **43** and an arcuate portion **45**. In the shank portion **41** there are four bolt holes **47** which register with the bolt holes **29** in the bracket **27**. The intermediate portion **43** is a straight line extension of the shank portion **41**, and its rear surfaces in conjunction with the front surface of abutment **33** defines the aforementioned angle A of about 15°. The arcuate portion **45**, as viewed from the top, has a constant radius of curvature, the center of curvature being along a vertical line.

The shank portion **41** of the guardrail **15** is rigidly attached to the bracket **27** by four plow bolts **51**, or the like, and is elevated from the floor along its entire length a distance slightly in excess of the thickness of the base **13**. The free terminus of the arcuate portion overlays the major leg **17** at a central location thereon.

The guardrail **15**, mounted on the base **13** as described, is able to deflect, under force, rearwardly toward the center of the base until the intermediate portion comes in contact with the abutment **33**. More specifically, an exterior force delivered to the front surface of guardrail **15** will primarily effect swinging, lateral movement of the intermediate portion **43**. As this occurs, the angular relationship between the intermediate portion **43** and the abutment **33** will change, steadily causing angle A to approach zero as a limit. As the guardrail **15** is a spring, it resists the aforementioned movement with a constantly increasing internally created force. If the exterior force is sufficient to cause the intermediate portion **43** to contact the abutment wall **33**, the intermediate portion **43** becomes a rigid curb preventing further lateral movement thereof. The intermediate portion **43** does not bend sharply at the juncture between the bracket **27** and the abutment **33** rather, it bends gradually, slowly coming into surface to surface contact with succeeding portions of the transition surface **35**. This gradual bending of the guardrail **15** minimizes stress within the guardrail as it is bent. Should an external force be acting against the arcuate portion **45** after the intermediate portion **43** becomes rigid, the arcuate portion is still capable of spring resisted lateral deflection rearward.

After the external force has been removed, the guardrail **15** will return to its original position under the force provided by the inherent resiliency of the guardrail itself. In an alternate embodiment, a rigid post may be positioned adjacent the forward surface of the guardrail **15** in its unstressed position to insure the guardrail does not swing outward in a forward direction beyond its original position.

As the exterior force, in most instances, will be striking the guardrail **15** a substantial vertical distance above the floor, a moment force is created which tends to lift or rotate the front portion of the assembly upward. The stiffened major leg **17** of the base, which is rigidly anchored to the warehouse floor, provides an effective means to counteract this lifting force. The major leg **17** of the base **13** is spaced from the impact force and thus substantially increases the axis of rotation of the assembly **11** as well as providing a wider and more stable foundation for the assembly. Further, the L-shaped configuration of the base **13** provides this stabilization without obtruding into the area in which the racks themselves are located. The stiffener **36** provides increased strength to the minor leg **18** to minimize the possibility that the minor leg **19** would bend under the aforementioned forces.

In the preferred embodiment, the assembly **11** is positioned in the corner defined by two elongated rigid rack protecting curbs **53** and **55** which are aligned perpendicular to each other (the racks which are supported by the columns **71** are not shown). The surface of the intermediate portion **43** of the guardrail **15** is positioned tangent to an imaginary extension of the vertical surface of curb **55**. The arcuate portion **45** is tangent at one point to an imaginary extension of the vertical surface of curb **53**. For maximum rigidity it is preferred that the assembly **11** be rigidly connected to the curbs **53** and **55**. In the preferred embodiment, one of the gussets **31** is welded to curb **55** and the stiffener portion **37** is welded to the curb **53**.

When placed at the entrance or exit of a rack aisle, the assembly protects the racks from being struck by handling equipment. Any blow delivered to the guardrail **15** will cause the intermediate portion **43** to be deflected rearward with increasing resistance to movement until it is forced against the abutment wall **33** thereby making that portion of the guardrail a rigid curb. During this deflection, the point of contact between the guardrail **15** and a laterally moving external force creating agent (an order picker) is constantly changing. Simultaneously the angle of incidence of the external force is decreasing. As the angle of incidence decreases, the resultant force which deflects the spring is decreased. The combination of these factors will cause the order picker to be guided away from the guardrail **15** and into the rack aisle in all but the most severe instances. For an order picker moving generally toward the shank portion of the guardrail, the guiding effect is additionally effective because, as the point of contact moves towards the shank, the effective moment arm of the external force is decreased. In this regard, an order picker approaching the assembly **11** from a location outside the rack aisle is restrained from striking the free terminus of the arcuate portion **45** and forcing it into the aisle as the loop **39** shields it from such an impact.

Shown in FIG. **3** is an illustrative "order picker" **59** entering a rack aisle which is protected by left and right hand guardrail assemblies **11** and **61** respectively. The "order picker" has a vertically movable boom **63** which extends well forward of the truck cab **65**. Fitted around the frame of the truck is a bumper **67**. The bumper extends forward of the cab portion of the truck to envelop an imaginary vertical extension of the boom **63**. Fitted

at the four corners of the bumper are horizontally aligned rotatable guide wheels **69** which project outwardly from the bumper. These wheels are positioned to contact the guardrail **15** before any other part of the truck has struck the protected rack (not shown).

The order picker **59** and the assembly **11** are shown in stop motion to show the relationship of the guardrail **15** to the wheel **69** when the order picker **59** has caused the guardrail **15** to be deflected rearward. The guide wheel **69** is in contact with the guardrail **15,** and the forces created by the deflection of the guardrail **15** and the momentum of the order picker **59** are resolved at the point of contact between the wheel **69** and the guardrail **15.** The ability of the wheel **69** to rotate aids in resolving these forces, and in the illustrated situation, the order picker would move in the direction R away from the edge of the rack (not shown) and its supporting colums **71.**

Thus, the present invention provides an assembly for placement at the entrance or exit of a rack aisle which will protect the racks from impacts from divergent directions. An impact striking the guardrail **15** will cause it to be deflected rearward against resistance until a predetermined deflection has been achieved at which point the guardrail **15** becomes rigid. Upon removal of the impact load the guardrail will automatically return to its original position. The assembly is well suited for receiving and sustaining repeated impact loads from divergent directions with no decrease in efficiency.

While various of the features of the present invention are particularly set forth in the disclosure, it is not intended to limit the scope of the invention which is defined in the following claims.

What is claimed is:

1. A guardrail assembly adapted to be mounted on a horizontal supporting surface, said guardrail assembly comprising

a base adapted to be fixed to the horizontal supporting surface having upstanding rigid bracket means mounted thereon,

elongated horizontally extending leaf spring means of curb height supported at its one end by said upstanding bracket and adapted to permit horizontal swinging movement of the remainder thereof in a rearward direction,

said leaf spring means being constructed to resist swinging movement in said rearward direction with increasing force, and

rigid abutment means fixedly connected to said base engageable by said leaf spring means intermediate its ends after limited swinging movement thereof in said rearward direcion so as to cause said intermediate portion of said leaf spring means to define a rigid curb when in engagement with said abutment.

2. A guardrail assembly in accordance with claim **1** wherein the opposite end portion of said leaf spring means is free and is curved in plan in said rearward direction.

3. A guardrail assembly in accordance with claim **2,** wherein said bracket is in surface contact over a substantial distance with the rearward surface of said leaf spring means.

4. A guardrail assembly in accordance with claim **2** wherein means is included extending generally rearward from said abutment and opposing displacement of said base upward from the horizontal supporting surface.

5. A guardrail assembly in accordance with claim **4** wherein said displacement-opposing means includes a vertical plate portion rigidly attached to and extending rearward from said abutment.

6. A guardrail assembly in accordance with claim **5** wherein said vertical plate portion is located so as to block further deflection of said curved end portion of said leaf spring means after said end portion deflects a predetermined amount following engagement between said abutment and said intermediate portion.

7. A guardrail assembly adapted to be mounted on a horizontal supporting surface, said guardrail assembly comprising

a base adapted to be fixed to the horizontal supporting surface having an upstanding rigid bracket mounted thereon,

an elongated horizontally extending leaf spring of curb height supported at its one end by said upstanding bracket, the opposite end portion of said leaf spring being free to allow horizontal swinging movement thereof in a rearward direction, and

rigid abutment means fixedly connected to said bracket means engageable by said leaf spring intermediate its ends after limited swinging movement thereof in said rearward direction so as to cause said intermediate portion of said leaf spring to act as a rigid curb when in engagement with said abutment.

8. A guardrail assembly in accordance with claim **7,** wherein upstanding second abutment means is included disposed generally adjacent the free end portion of said leaf spring and blocking such contact by a lift truck with said end portion that would deflect said leaf spring in a forward direction.

9. A guardrail assembly in accordance with claim **8** wherein a vertical stiffener portion rigidly attached to said abutment extending generally rearward therefrom opposes displacement of said base upward from the horizontal supporting surface.

10. A guardrail assembly in accordance with claim **9** wherein said vertical stiffener portion is located so as to block further deflection of said curved end portion of said leaf spring after said end portion deflects a predetermined amount following engagement between said abutment and said intermediate portion.

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