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(54) **PORTABLE ROADWAY WARNING DEVICE**  
TRAGBARE STRASSENWARNVORRICHTUNG  
DISPOSITIF D'AVERTISSEMENT ROUTIER PORTABLE

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(73) Proprietor: **Plastic Safety Systems, Inc.**  
**Cleveland, Ohio 44104 (US)**

(72) Inventors:  
• **METTLER, Charles M.**  
**Perry, Ohio 44081 (US)**

• **BROWN, Gregory H.**  
**Chagrin Falls, Ohio 44023 (US)**

(74) Representative: **Gill Jennings & Every LLP**  
**The Broadgate Tower**  
**20 Primrose Street**  
**London EC2A 2ES (GB)**

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**US-A- 2 931 279 US-A1- 2010 215 431**  
**US-B1- 6 309 137**

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**Description****FIELD OF THE INVENTION**

[0001] This invention relates generally to a portable roadway warning device comprising any desired number of portable modular rumble strips for use in various roadway conditions to alert drivers of automotive vehicles including both passenger vehicles and trucks of an approaching condition.

**BACKGROUND OF THE INVENTION**

[0002] It is generally known to use portable rumble strips in roadway applications to provide a perceptible noise and warning vibration when automotive vehicles including passenger vehicles and trucks drive over the rumble strips to warn the drivers of an approaching condition such as a work site, construction site, slow speed zone and so on, without alarming the drivers and without adversely affecting the stability of the vehicles. Portable rumble strips should be reusable and quick and easy to apply and remove. Also they should have the ability to remain in place under the desired level of performance, including for example heavy duty relatively high speed applications and/or lighter duty, lower speed applications. US 2010/0215431 A discloses portable rumble strips comprising strip sections with dovetailed notches and tabs at their end edges to provide a releasable connected joint between them.

**SUMMARY OF THE INVENTION**

[0003] The above and other benefits and advantages of portable rumble strips are accomplished in accordance with the present invention as defined by claim 1 by providing one or more rumble strips each comprised of a plurality of modular strip sections each having a substantially greater length than width, and top and bottom surfaces, and end and side edges, and each fabricated of a suitable flexible polymeric material such as rubber or polyurethane or other polymeric material with similar properties.

[0004] Each of the modular strip sections has alternating notches and tabs at opposite end edges sized and spaced for engagement with respective tabs and notches on opposite end edges of other strip sections to provide a releasable connected joint between the opposite end edges of the strip sections.

[0005] The notches at one of the end edges of the strip sections have axial inwardly angled inner end walls for overlapping engagement by axially outwardly angled outer ends of the tabs at the opposite end edge of other strip sections, and undersides of the tabs have transverse slots adjacent axial inner ends of the tabs for seated engagement by lower outer cross members extending transversely of the notches adjacent axial outer ends of the notches for releasably connecting the end edges of

the strip sections together both laterally and orthogonally relative to the longitudinal axes of the strip sections.

[0006] The alternating notches and tabs in the opposite end edges of the strip sections are dovetailed for dovetailed engagement with one another to carry longitudinal loading of the interconnected strip sections when the interconnected strip sections are pulled by one of the end edges longitudinally along the ground.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0007]

Fig. 1 is a fragmentary schematic top plan view of an exemplary portable rumble strip of the present invention which is comprised of a plurality of modular strip sections.

Fig. 2 is an enlarged top plan view of one of the modular strip sections of Fig. 1.

Fig. 3 is a perspective view of the modular strip section of Fig. 2 as seen from the top right end thereof.

Fig. 4 is an enlarged fragmentary longitudinal section through one of the tabs at the left end edge of the modular strip section of Fig. 2, taken on the plane of the line 4-4 thereof.

Fig. 5 is an enlarged fragmentary longitudinal section through one of the notches at the right end edge of the strip section of Fig. 2, taken on the plane of the line 5-5 thereof.

Fig. 6 is an enlarged fragmentary top plan view of the tab and associated end of the strip section of Fig. 4.

Fig. 7 is an enlarged fragmentary top plan view of the notch and associated end of the strip section of Fig. 5.

Fig. 8 is an enlarged fragmentary longitudinal section through the connected end edges of the two strip sections of Fig. 1, taken on the plane of the line 8-8 thereof.

Fig. 9 is an enlarged fragmentary top plan view of the connected end edges of the two strip sections of Fig. 8 as seen from the plane of the line 9-9 thereof.

**DETAILED DESCRIPTION OF THE INVENTION**

[0008] Referring now more particularly to the drawings, wherein the same reference numbers are used to designate like parts, and initially to Fig. 1, there is shown one form of elongated portable rumble strip 10 of the present invention which may be comprised of two or more modular strip sections 12 connected together. Figs. 2 and 3 show one such strip section 12. Each strip section preferably has substantially flat top and bottom surfaces 14 and 16 and opposite side edges 18 and 20 and end edges 22 and 24 (also see Figs. 4, 5 and 9), and is desirably made of a suitable high strength, weather-resistant polymeric material such as rubber or polyurethane or other polymeric material with similar properties.

**[0009]** Although the dimensions of each rumble strip section 12 may vary, each rumble strip section has a width that is preferably between approximately 203.20 mm (eight inches) and approximately 406.40 mm (sixteen inches) and more preferably approximately 355.60 mm (fourteen inches). Also the rumble strip sections are of sufficient thickness to create a noticeable audible and vibration warning to drivers of automotive vehicles including trucks and passenger vehicles when driven over the rumble strip sections, but not so severe as to alarm the drivers, and without causing adverse effects on the stability of the vehicles. To that end, the rumble strip sections desirably have a thickness of between approximately 12.70 mm (one-half inch) and approximately 25.4 mm (one inch) and more preferably approximately 19.05 mm (three-quarter inch). To provide a better grip between the bottom surface 16 of the rumble strip sections 12 and the roadway and to reduce possible skidding of vehicle tires against the top surface 14 of the rumble strip sections when wet, both the top and bottom surfaces of the rumble strip sections may have texturing 30. Also the texturing may be in the form of an open diamond pattern as schematically shown in Figs. 1-3, to provide a channel effect to permit the escape of water from both underneath and above the strip sections.

**[0010]** Suitable hand grip slots 32 may be provided in each rumble strip section adjacent one or both ends for ease of picking the rumble strip sections up.

**[0011]** One or both side edges 18 and 20 of each rumble strip section may be beveled to help eliminate any possible movement of the rumble strip sections caused by initial contact of the vehicle tires with the rumble strip sections. The included beveled angle of one or both side edges of the rumble strip sections is preferably between approximately 10° and approximately 15° and more preferably approximately 12°. Alternatively, one or both side edges of each rumble strip section may have concave top surfaces to further help eliminate any possible movement of the rumble strip sections caused by initial contact of the vehicle tires with the side edges of the rumble strip sections.

**[0012]** As seen for example in Figs. 1-3, each rumble strip section 12 has alternating notches 34 and tabs 36 at opposite end edges 22 and 24 sized and spaced for overlapping engagement with respective tabs and notches at opposite end edges of other strip sections for connecting the opposite end edges of any desired number of strip sections together to form a rumble strip of any desired length. For example, each of the individual strip sections may have a length of between approximately 1066.80 mm (three and one-half feet) and approximately 1219.20 mm (four feet), whereby three strip sections joined together in end to end relation will be of sufficient length to reach across a single highway lane, which is typically 3352.80 mm (eleven feet) wide. Each of the individual strip sections may be made somewhat longer or shorter than that or of different lengths if desired. Also more or less than three strip sections may be used to

make up a single rumble strip if desired. However, it has been found that strip sections each having a length of between approximately three and one-half feet and approximately four feet can be easily stacked and shipped on pallets with the strip sections lying flat.

**[0013]** The alternating notches 34 and tabs 36 at the opposite end edges of each of the strip sections are sized and spaced for engagement with respective tabs 36 and notches 34 at opposite end edges of other strip sections to provide a releasable connected joint between the opposite end edges of the strip sections. As best seen in Figs. 4, 5 and 8, the notches 34 at the end edge 22 of the strip sections have axially inwardly angled inner end walls 38 for overlapping engagement by correspondingly axially outwardly angled outer end walls 40 of the tabs 36 at the opposite end edge 24 of each of the strip sections. Preferably the inner end walls 38 of the notches 34 and the outer end walls 40 of the tabs 36 are respectively correspondingly inwardly and outwardly angled over a majority of their height and intersect the bottom surface 16 of the respective strip sections. More preferably, the angled inner end walls 38 of the notches 34 and the outer end walls 40 of the tabs are respectively correspondingly concave and convex over a majority of their height for ease of overlapping engagement with one another.

**[0014]** The undersides 42 of the tabs 36 at the end edge 24 of the strip sections have transverse slots 44 adjacent the axial inner ends of the tabs for seated engagement by lower outer cross members 46 extending transversely of the notches 34 adjacent axial outer ends of the notches at the opposite end edge 22 of other strip sections for releasably retaining the joined end edges of the strip sections together both laterally and orthogonally relative to the longitudinal axes of each of the strip sections as further shown in Figs. 4, 5 and 8. Preferably these lower outer cross members 46 are integrally molded to opposite sides of the notches 34 and are made out of the same polymeric material as the strip sections. Also the lower outer cross members 46 may but need not be reinforced as desired.

**[0015]** Insertion of the cross members 46 adjacent the axial outer ends of the notches 34 in the end edge 22 of other strip sections into the slots 44 in the undersides of the tabs 36 of one of the strip sections may be facilitated by placing the tabs 36 at the end edge 24 of one of the strip sections over the notches 34 in the opposite end edge 22 of another of the strip sections and stepping on the overlying tabs of the one strip section to cause the tabs to cam into the notches in the other strip section and press the slots 44 in the undersides of the tabs over the cross members 46 adjacent the axial outer ends of the notches in the other strip section to cause the overlapping end edges to snap into place as shown in Fig. 8 for releasably connecting the end edges of the strip sections together both laterally and orthogonally relative to the longitudinal axes of the strip sections.

**[0016]** When two or more such modular strip sections

are connected together and in place on the ground, the strip sections won't normally come apart. To prevent the strip sections from inadvertently separating from one another if the interconnected strip sections are dragged longitudinally along the ground by pulling one of the end edges of one of the strip sections, the alternating notches 34 and tabs 36 at the opposite end edges of the strip sections have matching dovetailed shapes 54 and 56 for dovetailed engagement with one another as shown in Figs. 1, 6, 7 and 9 to carry longitudinal loading of the interconnected strip sections.

**[0017]** If each rumble strip 10 comprised of two (or more) modular strip sections 12 interconnected together is found not to be heavy enough to remain in place under the desired level of performance, a desired number of laterally spaced, transversely extending ballast/stiffening plates or bars, made for example of steel or cast iron, may be completely or partially embedded in each of the strip sections. Alternatively a plurality of cavities may be provided in the top surface of the strip sections to accept any desired number of plates or bars, or the plates or bars may be mechanically fastened or adhesively affixed to the top surface of the strip sections as desired. Figs. 4, 5 and 8 schematically show such plates or bars 60 embedded within the approximate center of the thickness of the strip sections 12. The plates or bars 60 preferably run transversely across the width of the strip sections to provide stiffness in the transverse direction so the side edges 18 and 20 of the strip sections don't curl in use. The number and spacing of the plates or bars may vary depending on the desired level of performance. For example, the number of plates or bars used may be less for lighter duty, lower speed applications than for heavier duty, higher spaced applications. Also, the thickness of the modular strip sections and required strength of the connections between the interconnected strip sections may be less for lighter duty, lower speed applications than for heavier duty, higher speed applications.

**[0018]** Each of the plates or bars 60 preferably has a width of between approximately 38.10 mm (one and one-half inch) and approximately 63.50 mm (two and one-half inches) and more preferably approximately 50.80 mm (two inches). Further, each of the plates or bars preferably has a thickness of between approximately one-quarter inch and approximately one-half inch and more preferably approximately three-eighths inch.

**[0019]** The length of the plates or bars 60 may vary depending on the width of the rumble strips. For example, if the rumble strips are approximately 330.20 mm to 355.60 mm (thirteen to fourteen inches) wide, the plates or bars preferably have a length of between approximately 254 mm (ten inches) and approximately 279.40 mm (eleven inches) and more preferably approximately 263.53 mm (ten and three-eighths inches). If the width of the rumble strips is more or less than that, the length of the metal plates or bars may be proportionately reduced or increased as desired.

## Claims

1. A portable roadway warning device comprising one or more rumble strips (10), each rumble strip (10) comprising a plurality of interconnected strip sections (12), each of the strip sections being made of a polymeric material having top and bottom surfaces (14, 16) and opposite end edges (22, 24) and side edges (18, 20), the opposite end edges (22, 24) of each of the strip sections (12) respectively having alternating notches (34) and tabs (36) sized and spaced for engagement with respective tabs (36) and notches (34) on opposite end edges (22, 24) of other of the strip sections (12) to provide a releasable connected joint between the opposite end edges (22, 24) of the strip sections (12), the notches (34) having axial inwardly angled inner end walls (38) for overlapping engagement by axially outwardly angled outer end walls (40) of the tabs, and undersides of the tabs having transverse slots (44) adjacent axial inner ends (36) of the tabs for seated engagement by lower outer cross members (46) extending transversely of the notches (34) adjacent axial outer ends of the notches (34) for releasably connecting the opposite end edges (22, 24) of the interconnected strip sections (12) together both laterally and orthogonally relative to a longitudinal axis of each of the strip sections (12), and the alternating notches (34) and tabs (36) in the respective opposite end edges (22, 24) of the strip sections (12) are dovetailed for dovetailed engagement with one another to carry longitudinal loading of the interconnected strip sections (12) when the interconnected strip sections (12) are pulled by one of the end edges (22, 24) of one of the strip sections longitudinally along the ground.
2. The device of claim 1, wherein the inner end walls (38) of the notches (34) are inwardly angled and the outer end walls (40) of the tabs (36) are outwardly angled over a majority of their respective heights for overlapping engagement with one another.
3. The device of claim 2, wherein the inner end walls (38) of the notches (34) and the outer end walls (40) of the tabs (36) intersect the bottom surface (16) of the respective strip sections (12).
4. The device of claim 2, wherein the inner end walls (38) of the notches (34) are concave over a majority of their height, and the outer end walls (40) of the tabs (36) are convex over a majority of their height.
5. The device of claim 1, wherein the lower outer cross members (46) are integrally molded to opposite sides of the respective notches (34) adjacent the axial outer ends of the notches (34).
6. The device of claim 1, wherein the strip sections (12)

are made of rubber.

7. The device of claim 1, wherein at least one of the side edges (18, 20) of each of the strip sections (12) is beveled to help eliminate any possible movement of the strip sections (12) caused by initial contact of vehicle tires with the at least one of the side edges (18, 20).
8. The device of claim 1, wherein at least one of the side edges (18, 20) of each of the strip sections (12) has a concave top surface (14) to help eliminate any possible movement of the strip sections (12) caused by initial contact of vehicle tires with the at least one of the side edges (18, 20).
9. The device of claim 1, wherein the inner end walls (38) of the notches (34) are concave over a majority of their height and the outer end walls (40) of the tabs (36) are convex over a majority of their height for overlapping engagement with one another.
10. The device of claim 9, wherein the inner end walls (38) of the notches (34) and the outer end walls (40) of the tabs (36) intersect the bottom surface (16) of the respective strip sections (12).
11. The device of claim 9, wherein the lower outer cross members (46) are integrally molded to opposite sides of the respective notches (34) adjacent the axial outer ends of the notches (34).

#### Patentansprüche

1. Tragbare Straßenwarnvorrichtung, umfassend einen oder mehrere Rüttelstreifen (10), wobei jeder Rüttelstreifen (10) mehrere miteinander verbundenen Streifenabschnitte (12) umfasst, jeder der Streifenabschnitte aus einem Polymermaterial gefertigt ist und eine obere und untere Oberfläche (14, 16) und gegenüberliegende Endkanten (22, 24) und Seitenkanten (18, 20) hat, die gegenüberliegenden Endkanten (22, 24) eines jeden Streifenabschnitts (12) abwechselnd Kerben (34) bzw. Laschen (36) haben, die so eine Größe und so einen Abstand voneinander haben, dass sie in mit den entsprechenden Laschen (36) und Kerben (34) an gegenüberliegenden Endkanten (22, 24) von anderen Streifenabschnitten (12) in Eingriff kommen können, um eine lösbare Verbindung zwischen den gegenüberliegenden Endkanten (22, 24) der Streifenabschnitte (12) bereitzustellen, die Kerben (34) axial nach innen abgewinkelte innere Endwände (38) haben, für ein überlappendes Eingreifen durch axial nach außen abgewinkelte äußere Endwände (40) der Laschen, und Unterseiten der Laschen Querschlitz (44) neben axialen inneren Enden (36) der Laschen haben,

für ein aufliegendes Eingreifen durch untere äußere Querglieder (46), die sich quer zu den Kerben (34) neben axialen äußeren Enden der Kerben (34) erstrecken, für ein lösbares Verbinden der gegenüberliegenden Endkanten (22, 24) der miteinander verbundenen Streifenabschnitte (12), sowohl seitlich als auch rechtwinklig in Bezug auf eine Längsachse eines jeden Streifenabschnitts (12), und die abwechselnden Kerben (34) und Laschen (36) in den jeweiligen gegenüberliegenden Endkanten (22, 24) der Streifenabschnitte (12) schwalbenschwanzförmig sind, für ein schwalbenschwanzförmiges Eingreifen miteinander, um eine Längsbelastung der miteinander verbundenen Streifenabschnitte (12) zu tragen, wenn die miteinander verbundenen Streifenabschnitte (12) an einer der Endkanten (22, 24) von einem der Streifenabschnitte längs auf dem Boden entlang gezogen werden.

2. Vorrichtung gemäß Anspruch 1, wobei, für ein überlappendes Eingreifen ineinander, die inneren Endwände (38) der Kerben (34) über einen Großteil ihrer Höhe nach innen abgewinkelt sind und die äußeren Endwände (40) der Laschen (36) über einen Großteil ihrer Höhe nach außen abgewinkelt sind.
3. Vorrichtung gemäß Anspruch 2, wobei die inneren Endwände (38) der Kerben (34) und die äußeren Endwände (40) der Laschen (36) die untere Oberfläche (16) der jeweiligen Streifenabschnitte (12) schneiden.
4. Vorrichtung gemäß Anspruch 2, wobei die inneren Endwände (38) der Kerben (34) über einen Großteil ihrer Höhe konkav sind und die äußeren Endwände (40) der Laschen (36) über einen Großteil ihrer Höhe konvex sind.
5. Vorrichtung gemäß Anspruch 1, wobei die unteren äußeren Querglieder (46) einstückig mit gegenüberliegenden Seiten der jeweiligen Kerben (34) neben den axialen äußeren Enden der Kerben (34) geformt sind.
6. Vorrichtung gemäß Anspruch 1, wobei die Streifenabschnitte (12) aus Gummi gefertigt sind.
7. Vorrichtung gemäß Anspruch 1, wobei mindestens eine der Seitenkanten (18, 20) eines jeden Streifenabschnitts (12) abgeschrägt ist, um zur Eliminierung jeder möglichen durch einen Erstkontakt von Fahrzeugreifen mit der mindestens einen der Seitenkanten (18, 20) verursachten Bewegung der Streifenabschnitte (12) beizutragen.
8. Vorrichtung gemäß Anspruch 1, wobei mindestens eine der Seitenkanten (18, 20) eines jeden Streifenabschnitts (12) eine konkave obere Oberfläche (14)

hat, um zur Eliminierung jeder möglichen durch einen Erstkontakt von Fahrzeugreifen mit der mindestens einen der Seitenkanten (18, 20) verursachten Bewegung der Streifenabschnitte (12) beizutragen.

9. Vorrichtung gemäß Anspruch 1, wobei, für ein überlappendes Eingreifen ineinander, die inneren Endwände (38) der Kerben (34) über einen Großteil ihrer Höhe konkav sind und die äußeren Endwände (40) der Laschen (36) über einen Großteil ihrer Höhe konvex sind.
10. Vorrichtung gemäß Anspruch 9, wobei die inneren Endwände (38) der Kerben (34) und die äußeren Endwände (40) der Laschen (36) die untere Oberfläche (16) der jeweiligen Streifenabschnitte (12) schneiden.
11. Vorrichtung gemäß Anspruch 9, wobei die unteren äußeren Querglieder (46) einstückig mit gegenüberliegenden Seiten der jeweiligen Kerben (34) neben den axialen äußeren Enden der Kerben (34) geformt sind.

#### Revendications

1. Dispositif d'avertissement routier portatif comprenant une ou plusieurs bandes rugueuses de ralentissement (10), chaque bande rugueuse de ralentissement (10) comprenant une pluralité de sections de bande interconnectées (12), chacune de ces sections de bande étant faite en un polymère ayant des surfaces supérieure et inférieure (14, 16) et des bords d'extrémité opposés (22, 24) et des bords latéraux (18, 20), les bords d'extrémité opposés (22, 24) de chacune des sections de bande (12) ayant respectivement des encoches (34) et des languettes (36) dimensionnées et espacées de façon à s'engager avec des languettes (36) et des encoches (34) respectives sur les bords d'extrémité opposés (22, 24) d'autres des sections de bande (12) afin de fournir un joint assemblé de manière amovible entre les bords d'extrémité opposés (22, 24) des sections de bande (12), les encoches (34) ayant des parois d'extrémité intérieures axiales inclinées vers l'intérieur (38) pour permettre un engagement à chevauchement par des parois d'extrémité inclinées axialement vers l'extérieur (40) des languettes, et les dessous des languettes ayant des fentes transversales (44) adjacentes aux extrémités intérieures axiales (36) des languettes pour permettre un engagement avec assiette par des traverses extérieures inférieures (46) s'étendant transversalement des encoches (34) adjacentes aux extrémités extérieures axiales des encoches (34) pour assembler de manière amovible les bords d'extrémité opposés (22, 24) des sections de bande interconnectées (12) à la fois latéralement

et orthogonalement par rapport à un axe longitudinal de chacune des sections de bande (12), et les encoches (34) et les languettes (36) alternées dans les bords d'extrémité opposés respectifs (22, 24) des sections de bande (12) sont en queue d'aronde pour permettre un engagement en queue d'aronde les unes avec les autres pour porter une charge longitudinale des sections de bande interconnectées (12) lorsque les sections de bande interconnectées (12) sont tirées par un des bords d'extrémité (22, 24) d'une des sections de bande longitudinalement le long du sol.

2. Dispositif selon la revendication 1, dans lequel les parois d'extrémité intérieures (38) des encoches (34) sont inclinées vers l'intérieur et les parois d'extrémité extérieures (40) des languettes (36) sont inclinées vers l'extérieur sur une majorité de leurs hauteurs respectives pour leur permettre de s'engager avec chevauchement les unes avec les autres.
3. Dispositif selon la revendication 2, dans lequel les parois d'extrémité intérieures (38) des encoches (34) et les parois d'extrémité extérieures (40) des languettes (36) entrecoupent la surface inférieure (16) des sections de bande respectives (12).
4. Dispositif selon la revendication 2, dans lequel les parois d'extrémité intérieures (38) des encoches (34) sont concaves sur une majorité de leur hauteur, et les parois d'extrémité extérieures (40) des languettes (36) sont convexes sur une majorité de leur hauteur.
5. Dispositif selon la revendication 1, dans lequel les traverses extérieures inférieures (46) sont moulées solidairement aux côtés opposés des encoches respectives (34) adjacentes aux extrémités extérieures axiales des encoches (34).
6. Dispositif selon la revendication 1, dans lequel les sections de bande (12) sont faites en caoutchouc.
7. Dispositif selon la revendication 1, dans lequel au moins un des bords latéraux (18, 20) de chacune des sections de bande (12) est biseauté de façon à aider à éliminer tout mouvement possible des sections de bande (12) causé par le contact initial des pneus d'un véhicule avec l'au moins un des bords latéraux (18, 20).
8. Dispositif selon la revendication 1, dans lequel au moins un des bords latéraux (18, 20) de chacune des sections de bande (12) a une surface supérieure concave (14) de façon à aider à éliminer tout mouvement possible des sections de bande (12) causé par le contact initial des pneus d'un véhicule avec l'au moins un des bords latéraux (18, 20).

9. Dispositif selon la revendication 1, dans lequel les parois d'extrémité intérieures (38) des encoches (34) sont concaves sur une majorité de leur hauteur, et les parois d'extrémité extérieures (40) des languettes (36) sont convexes sur une majorité de leur hauteur pour s'engager l'une avec l'autre avec un chevauchement. 5
10. Dispositif selon la revendication 9, dans lequel les parois d'extrémité intérieures (38) des encoches (34) et les parois d'extrémité extérieures (40) des languettes (36) entrecourent la surface inférieure (16) des sections de bande respectives (12). 10
11. Dispositif selon la revendication 9, dans lequel les traverses extérieures inférieures (46) sont moulées solidairement aux côtés opposés des encoches respectives (34) adjacentes aux extrémités extérieures axiales des encoches (34). 15

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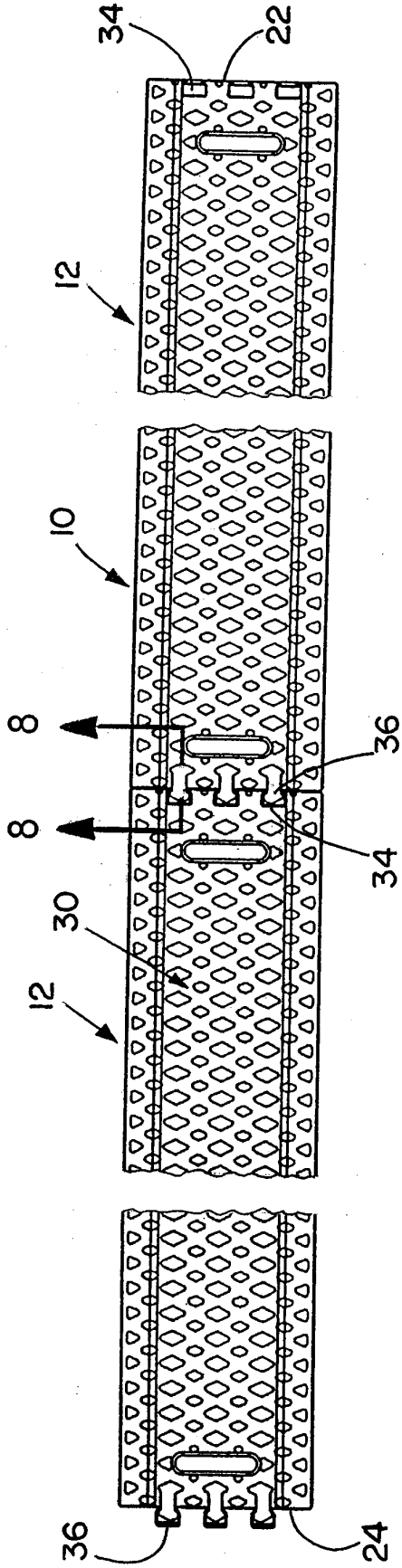


FIG. 1

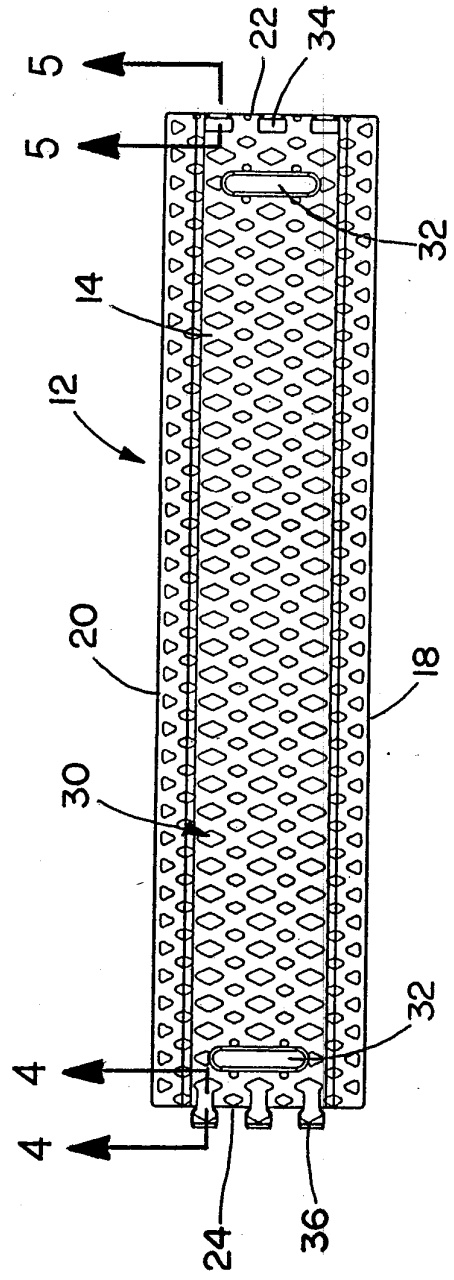


FIG. 2



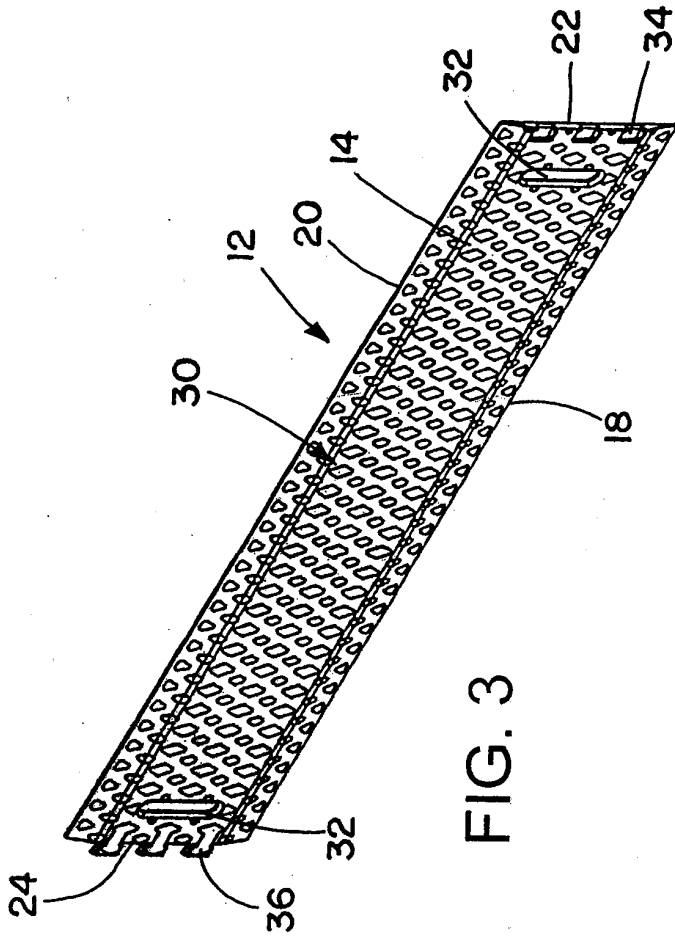


FIG. 3

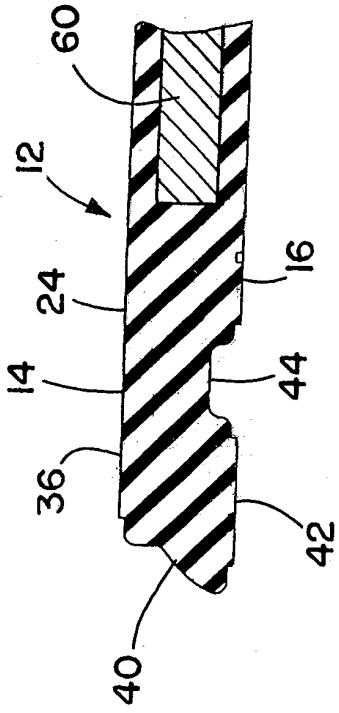


FIG. 4

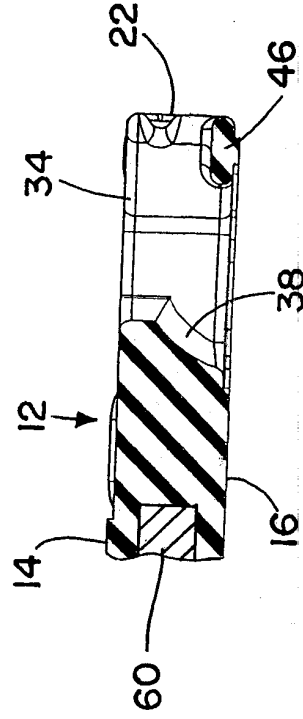


FIG. 5

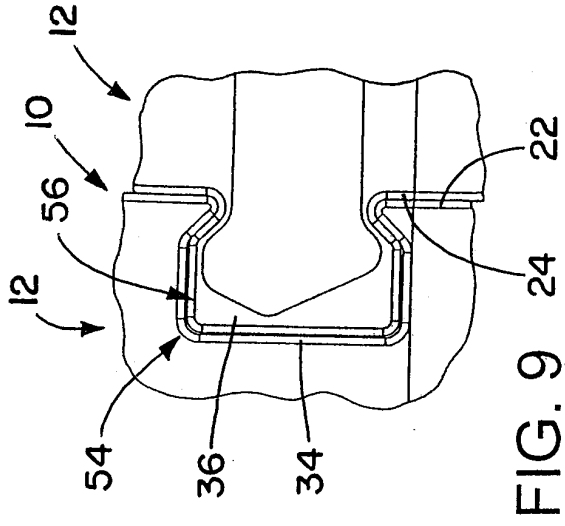


FIG. 9

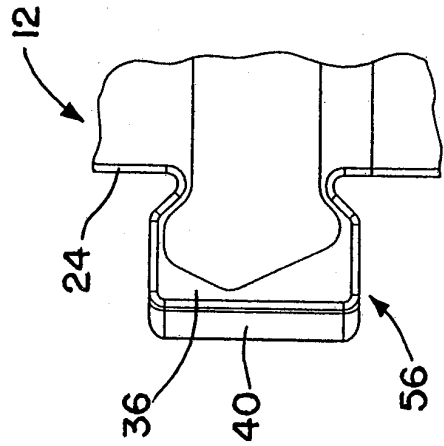


FIG. 6

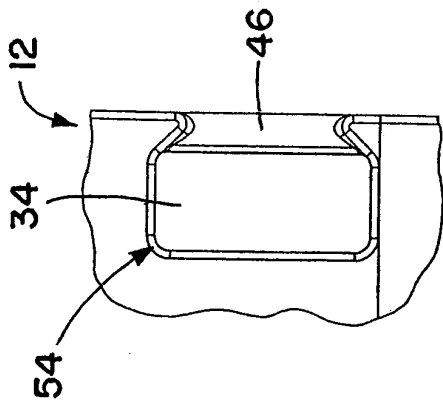


FIG. 7

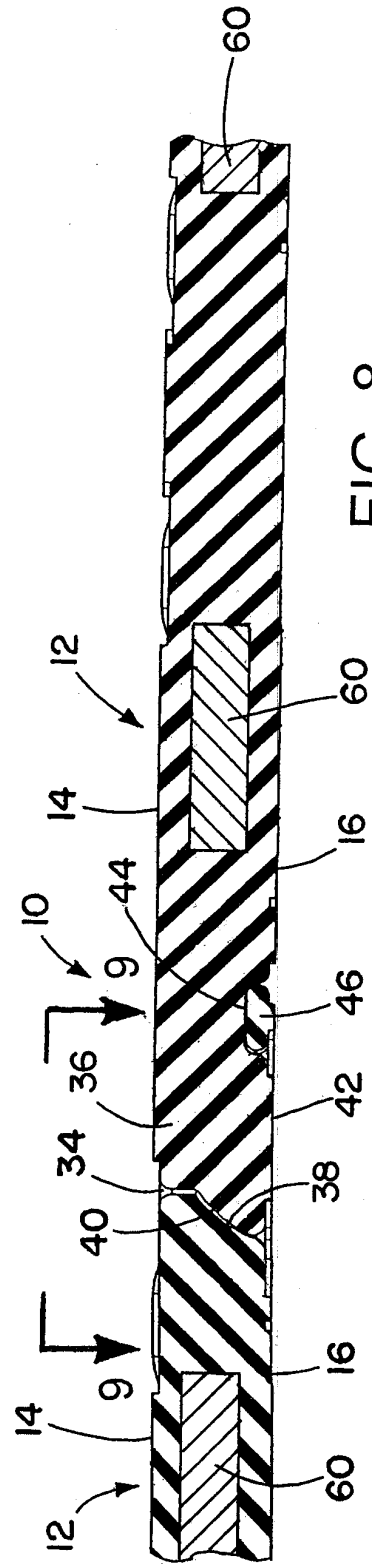


FIG. 8

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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