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(54) **Road safety barrier**

(57) The invention relates to a road safety barrier which comprises at least two posts (5) fixed to the substrate and at least one guide bar, directed in the direction of the road, wherein at least one collision energy absorbing device is fastened by means of the connection means between the post (5) and the guide. The collision energy absorbing device comprises at least one spatial energy absorbing element (1) having a front edge (2), onto which a collision force acts, and, opposite to it, the rear edge (3), by means of which it is constrained in the road safety barrier structure. The energy absorbing element (1) has a surface with shaped folds, transverse to the direction defined between the front edge (2) and the rear edge (3), wherein the shape and distribution of these folds is such that under the influence of the collision force received by the front edge (2) of the element (1) the consecutive folds are crushed.

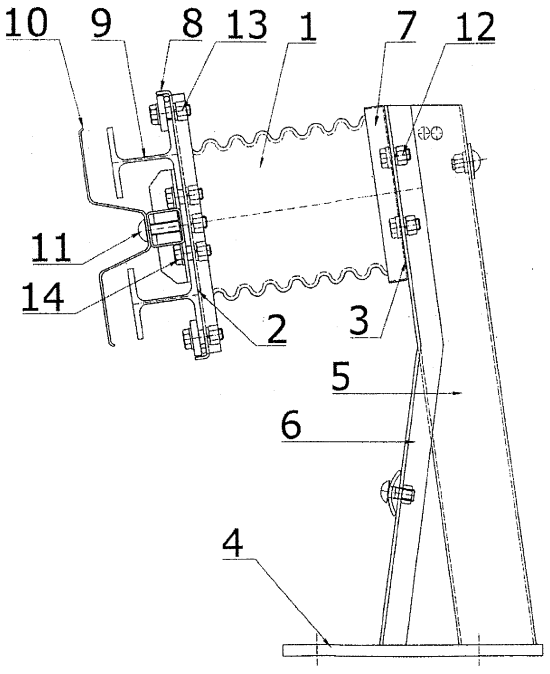

Fig.8

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Description

Technical Field

[0001] This invention relates to a road safety barrier.

Background Art

[0002] Nowadays, at the Polish roads are mounted road barriers that have technical solutions that meet the requirements of the Ordinance of the Minister of Transport and Maritime Economy of 30.05.2000 on the technical conditions to be met by traffic engineering objects and their location. These barriers have posts attached to the bridge or overpass or driven into the properly compacted shoulder ground and Σ shaped sheet guide bars.

[0003] Polish Standard PN-EN 1317-1, which is in force since August 2011, provides that the primary criterion for the correctness of the road barrier construction is that the barrier has to withstand the impact tests, which are well-established in the standard, and that people who are in the vehicle at the time of collision will not undergo overloads specified in the standard.

[0004] To fulfil the above requirements by the barrier it is necessary to use absorbing element between the guide bar and the post. There are design solutions to this problem, in which a set of flat bars for impact transmission or structures consisting of tensioned wire ropes or mixed structures of steel ropes and metal sheet guide bars are provided.

[0005] From the description of Polish utility model No. 65812 a sandwiched road barrier is known comprising supporting posts and a guide band attached to the supporting posts by means of separators with brackets. The separators have a rectangular cross section and a semi-closed channel bar construction and are secured to the supporting post and guide band using fasteners, the screws of which pass through holes located in the guide band, supporting pillars and separators.

[0006] From German patent application DE102009034758 (A1) a safety barrier is known, which is provided with the guide bar directed towards the road and attached to the posts using spacer elements. Along the barrier the tension element extends which is attached to the barrier. The tension element comprises threaded rods that are connected to each other and are attached to the spacer elements at a certain distance from the guide bar. The spacer elements are made of constructional steel and are formed with an upper flange and/or bottom flange.

[0007] The above solutions can meet the requirements of the PN-EN 1317-1 standard, but a counterforce of the barrier is not uniform, which necessitates the use of more rigid solutions having high weight and price.

[0008] To reduce damage to the vehicle and the people in the vehicle during collision with an obstacle or safety barrier it is necessary that the collision energy is absorbed by the vehicle and an obstacle in a possibly uniform way on a longer distance of a road.

[0009] An essential element that can ensure the least damage to the vehicle and the people who are there is a collision energy absorbing element, which is a part of the construction of the road safety barrier.

Summary of the invention

[0010] Therefore the aim of the present invention is a road safety barrier comprising a device for absorbing the collision energy, the design of which ensures an absorption of the collision energy in a uniform way, wherein the device, when placed in a road safety barrier, improves working characteristics of this barrier in order to ensure the least possible damage to the vehicle and the people in this vehicle.

[0011] This object is achieved by means of a road safety barrier having the characteristics specified in claim 1. Preferred and advantageous features of the present invention are defined in the dependent claims.

[0012] The solution according to the present invention eliminates the disadvantages of previously known solutions, ensuring that the road barrier absorbs energy in a uniform way. By changing the parameters of the collision energy absorbing element such as sheet thickness, length, width and height of the element, height and pitch of folds, as well as by an arrangement of the collision energy absorbing elements in a collision energy absorbing device, it is possible to obtain different working parameters of the barrier according to needs.

Brief description of drawings

[0013] The embodiments of the invention are shown in the drawing, in which

Fig. 1 shows a first embodiment of a collision energy absorbing device for use in the road barrier according to the invention, in longitudinal section and cross-section, which comprises one energy absorbing element in the form of a cylinder,

Fig. 2 shows a second embodiment of a collision energy absorbing device for use in the road barrier according to the invention, in longitudinal section and cross-section, which comprises one energy absorbing element in the form of a cylinder having a longitudinal slit,

Fig. 3 shows a third embodiment of a collision energy absorbing device for use in the road barrier according to the invention, in longitudinal section and cross-section, which comprises one energy absorbing element in the form of a cylinder having an elliptical cross section,

Fig. 4 shows a fourth embodiment of a collision energy absorbing device for use in the road barrier according to the invention, in longitudinal section and cross-section, which comprises one energy absorbing element in the form of an undulated sheet,

Fig. 5 shows a fifth embodiment of a collision energy absorbing device for use in the road barrier according to the invention, in longitudinal section and cross-section, which comprises one energy absorbing element in the form of a cylindrical surface sector,

Fig. 6 shows a sixth embodiment of a collision energy absorbing device for use in the road barrier according to the invention, in longitudinal section and cross-section, which comprises one energy absorbing element in the form of a curved surface,

Figs. 7a-e show different shapes of folds of the surface of the energy absorbing element for use in the road barrier according to the invention,

Fig. 8 shows in side view the road barrier according to the invention with the collision energy absorbing device, and

Fig. 9 is a graph illustrating the deformation quantity of the energy absorbing element depending on the resistance force of the absorbing element.

Description of embodiments

[0014] The collision energy absorbing device for use in the road safety barrier according to the invention comprises at least one spatial energy absorbing element 1 having a front edge 2, onto which a collision force acts, and, opposite to it, the rear edge 3, by means of which it is constrained in the road safety barrier structure. The energy absorbing element 1 has a surface with shaped folds, transverse to the direction defined between the front edge 2 and the rear edge 3, wherein the shape and distribution of these folds is such that under the influence of the collision force received by the front edge 2 of the element the consecutive folds are crushed.

[0015] As can be seen in Figure 7a-e, the surface of energy absorbing element 1 can have folds of various shapes: folds with sharp tops (Fig. 7a), wavy folds formed of repeating arches (Fig. 7b), and folds formed from an arcuate and straight sections (Fig. 7c, 7d), sinusoidal shaped folds (Fig. 7e).

[0016] As shown in Figures 1-6, the energy absorbing element 1 may have various shapes. In the first embodiment (Fig. 1) the energy absorbing element 1 has the shape of a cylinder with a cross-corrugated side surface, wherein the end edges of the cylinder form the front edge 1 and the rear edge 3 of the element 1, as shown in longitudinal section in fig. 1.

[0017] In the second embodiment (Fig. 2) the energy absorbing element 1 has the shape of a cylinder with a cross-corrugated side surface, which has a slit extending through the entire length of the cylinder. The end edges of the cylinder form the front edge 2 and the rear edge 3 of the element 1, as shown in longitudinal section in Fig. 2. In order to maintain its cylindrical shape such element can be bound, for example, with at least one transverse band (not shown). Each such band surrounds the cylinder transversely and is disposed in a recess (valley) of the fold.

[0018] In the third embodiment (Fig. 3) the energy absorbing element 1 has the shape of a cylinder with an elliptical cross-section and transversely corrugated side surface. The end edges of the cylinder form the front edge 2 and the rear edge 3 of the element 1, as shown in longitudinal section in Fig. 3.

[0019] In the fourth embodiment (Fig. 4) the energy absorbing element 1 has the shape of a transversally corrugated sheet between its two edges, which form the front edge 1 and the rear edge 3 of the element 1, as shown in longitudinal section in fig. 4.

[0020] In the fifth embodiment (Fig. 5) the energy absorbing element 1 has the shape of a transversely corrugated sheet between its two edges, wherein the sheet is bent into a shape forming a sector of the cylindrical surface. The arcuate end edges of the sector of the cylindrical surface form the front edge 2 and the rear edge 3 of the element 1, as shown in longitudinal section in Fig. 5.

[0021] In the sixth embodiment (Fig. 6) the energy absorbing element 1 has the shape of a transversely corrugated sheet between its two edges, wherein the sheet is bent into a shape forming a surface having any curvature. The arcuate end edges of the surface form the front edge 2 and the rear edge 3 of the element 1, as shown in longitudinal section in Fig. 6.

[0022] The collision energy absorbing device for use in the road safety barrier according to the invention may comprise a single energy absorbing element 1 or can be composed of at least two energy absorbing elements 1. The energy-absorbing elements 1 can be arranged in layers on each other. The energy-absorbing elements 1 can be also connected to each other in one after the other arrangement, so that the rear edge 3 of the first element 1 is connected to the front edge 2 of the second element 1, and/or in a side by side arrangement.

[0023] Energy-absorbing elements 1 arranged in layers on each other and/or connected to each other in one after the other arrangement and/or side by side arrangement can also consist of elements made of a material of different thickness. In particular, a combination of at least two energy absorbing elements 1 made of a material of varying thickness in one after the other arrangement is preferred, in which the rear edge 3 of the element 1 made of a material of lesser thickness is connected to the front edge 2 of the element 1 made of a material having greater thickness.

[0024] If the energy absorbing device comprises an element or elements of the cylindrical shape, the cylindrical element(s) can be empty inside or filled with different plastic-energy absorbing material, such as, for example, the special energy-absorbing foam.

[0025] The energy absorbing element 1 may be made of metal sheet, for example of steel sheet having thickness between 1.5 to 5.0 mm. This element can be made onto rollers using the appropriately shaped rolls, on the press by its bending in the suitable tool or spinning lathe.

[0026] A strength test was made for one energy ab-

sorbing element 1 constructed in the shape of a cylinder shown in Fig. 1 with the following dimensions: diameter D of the cylinder (measured on the tops of the folds) - 250 mm, the length of the cylinder - 300 mm, made of the S235 steel of 2.5 mm thickness, having the shape of the folds in a longitudinal section and dimensions of the folds, as shown in fig. 7b:

S (wave pitch) - 40 mm,
g (sheet thickness) - 2.5 mm,
h (wave height) - 12 mm,
r (radius of the internal wave) - 8 mm
R (radius of the external wave) - 10.5 mm.

[0027] The resulting relationship between the deformation and the resistance force of the energy absorbing element is shown on a graph in Fig. 9. From the graph it results that as the deformation (crushing) of the energy absorbing element 1 is increasing, a resistance force of the element is gradually increasing, but there are local decreases and increases of that force. Decreases of the force are due to deformation (crushing) of consecutive folds, and the subsequent increase of the force is due to the strengthening of the crushed material. The rapid increase in force in the final stage results from the contact between all the folds together.

[0028] Fig. 8 shows a side view of the road safety barrier according to the invention. The barrier includes posts 5. The collision energy absorbing device comprising one energy absorbing element 1 is attached to the post 5 of the safety barrier. The energy absorbing element 1 has a base 7 welded to its rear edge 3. The base 7 is bolted with bolts 12 to angle bars 6 which are welded to the post 5. On the opposite side to the base 7, a channel bar 8 is welded to the front edge 2 of the energy absorbing element 1, wherein T-shaped guide bars 9 are bolted with bolts 13 and 14 and the main guide bar 10 is bolted with a bolt 11 to that channel bar 8.

[0029] A vehicle hitting the main guide bar 10 presses on the T-shaped guide bar 9, loads the channel bar 8 and the energy absorbing element 1 and post 5, causing the displacement of these elements. The impact force is absorbed by the barrier and the vehicle is directed in the direction of the roadway.

[0030] A construction of the energy absorbing device for use in the road safety barrier according to the invention results that the collision energy of the vehicle is absorbed in a uniform way. By changing the parameters of the energy absorbing element 1 such as sheet thickness, length, width and height of the element, height and pitch of folds, as well as by an arrangement of the collision energy absorbing elements, it is possible to obtain working parameters of the barrier according to needs.

Claims

1. The road safety barrier, which comprises at least two posts (5) attached to the substrate and at least one guide bar, directed towards the road, wherein at least one collision energy absorbing device is fastened by means of connection means between the post and the guide bar, which device comprises at least one spatial energy absorbing element (1) having a front edge (2), onto which a collision force acts, and, opposite to it, the rear edge (3), by means of which it is constrained in the structure of the road safety barrier, **characterized in that** the energy absorbing element (1) has a surface with shaped folds, transverse to the direction defined between the front edge (2) and the rear edge (3), wherein the shape and distribution of these folds is such that under the influence of the collision force received by the front edge (2) of this element (1) the consecutive folds are crushed.

2. The barrier according to Claim 1, **characterized in that** the surface of the energy absorbing element (1) has folds of a shape selected, in particular, from the folds with sharp tops, wavy folds formed of repeating arcs, folds formed from arcuate and straight sections, and folds of sinusoidal wave shape.

3. The barrier according to Claims 1 or 2, **characterized in that** the energy absorbing element (1) is made of metal.

4. The barrier according to any of Claims 1-3, **characterized in that** the energy absorbing element (1) has the shape of a cylinder with a transversally corrugated side surface, wherein the end edges of the cylinder are the front edge (2) and the rear edge (3) of the element (1).

5. The barrier according to any of Claims 1-3, **characterized in that** the energy absorbing element (1) has the shape of a cylinder with a transversally corrugated side surface, which has a slit extending along the entire length of the cylinder, wherein the end edges of the cylinder form the front edge (2) and the rear edge (3) of the element (1).

6. The barrier according to any of Claims 1-3, **characterized in that** the energy absorbing element (1) has the shape of a cylinder of an elliptic cross section and with a transversally corrugated side surface, wherein the end edges of the cylinder are the front edge (2) and the rear edge (3) of the element (1).

7. The barrier according to any of Claims 4-6, **characterized in that** the cylinder is filled with a plastic energy-absorbing material.

8. The barrier according to any of Claims 1-3, **characterized in that** the energy absorbing element (1) has the shape of transversally corrugated sheet between

its two edges, which form the front edge (2) and the rear edge (3) of the element (1).

9. The barrier according to Claim 8, **characterized in that** the sheet is bent into the shape forming the surface of any curvature, in particular forming the sector of the cylindrical surface, wherein the arcuate end edges of the sheet are the front edge (2) and the rear edge (3) of the element (1).

10. The barrier according to any of Claims 4-9, **characterized in that** it comprises the energy absorbing device including at least two energy absorbing elements (1) arranged in layers on each other.

11. The barrier according to any of Claims 4-10, **characterized in that** it comprises the energy absorbing device including at least two energy absorbing elements (1) connected to each other in one after the other arrangement and/or in the side by side arrangement.

12. The barrier according to Claims 10 or 11, **characterized in that** the connected energy absorbing elements (1) are made of a material of different thickness.

13. The barrier according to any of Claims 1-12, **characterized in that** a channel bar (8) is attached to the front edge (2) of the energy absorbing element (1), and T-shaped guide bars (9) for transferring of the impact energy are secured to that channel bar (8).

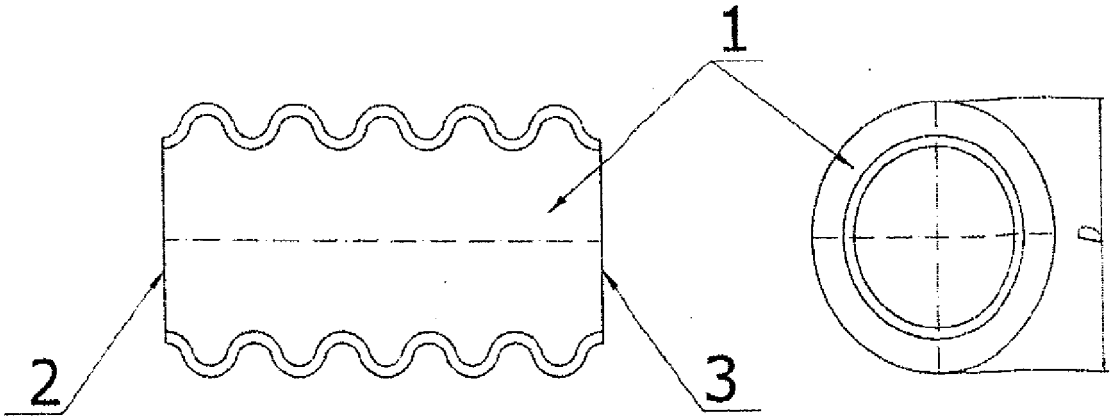


Fig.1

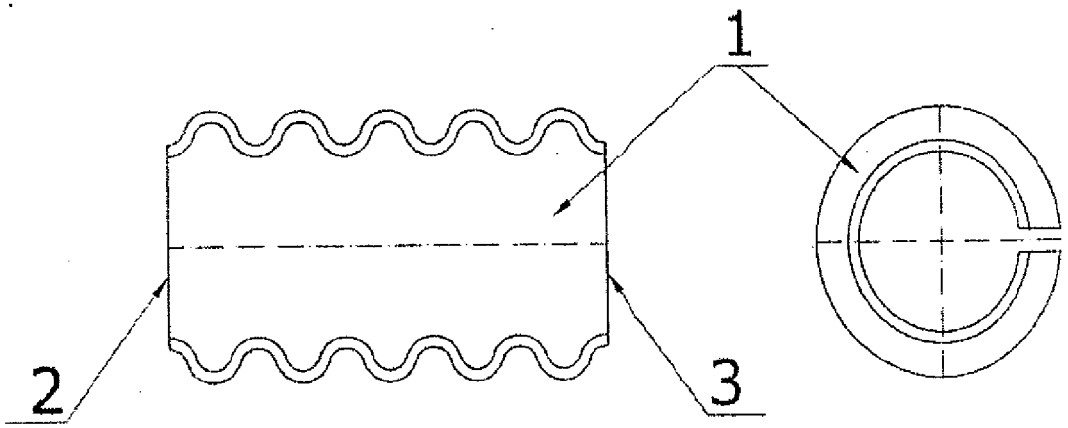


Fig.2

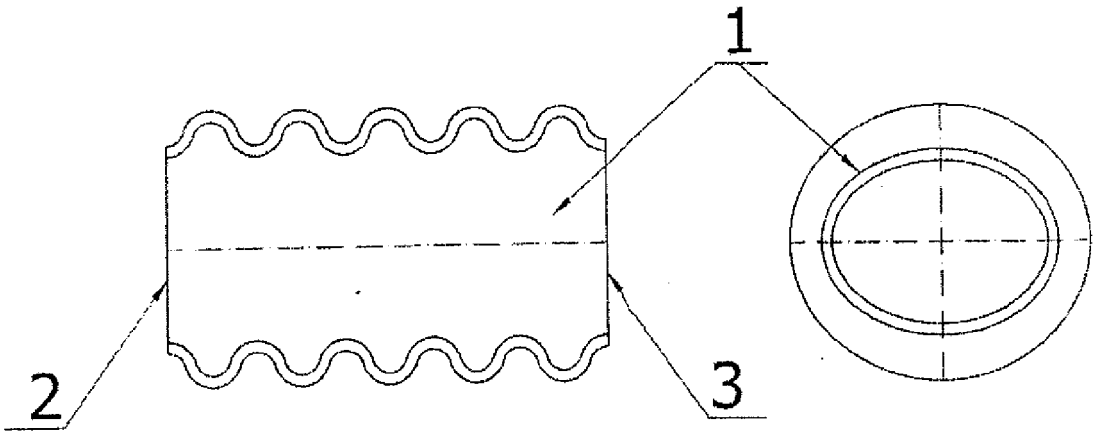


Fig.3

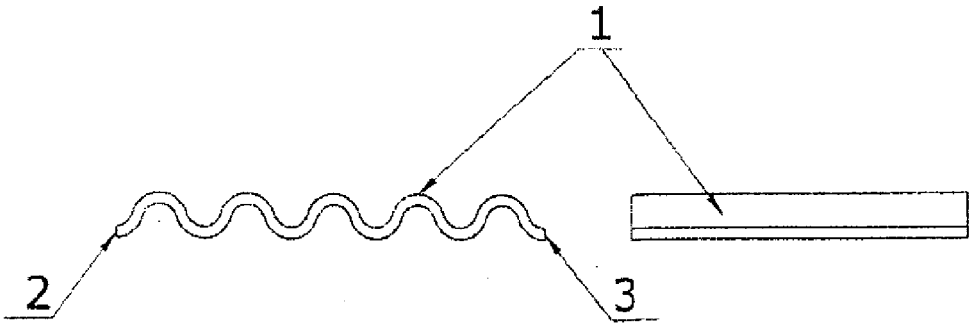


Fig.4

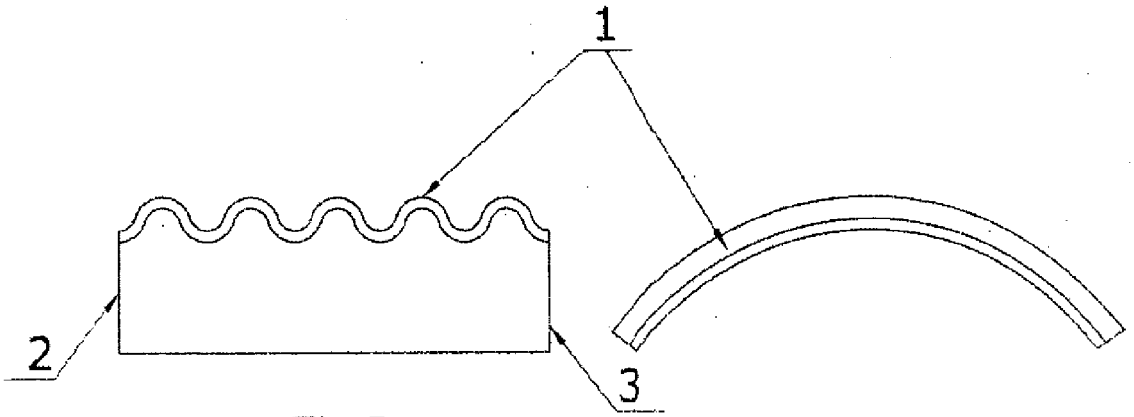


Fig.5

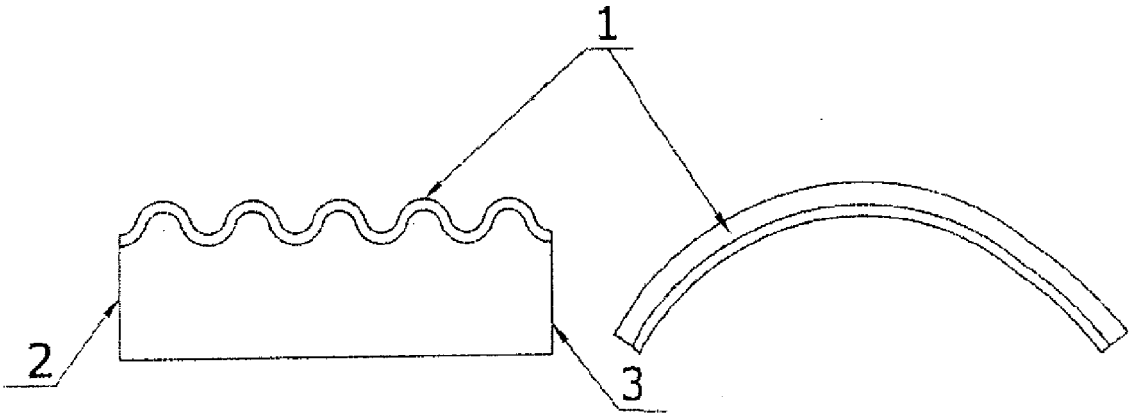


Fig.6

Fig.7a

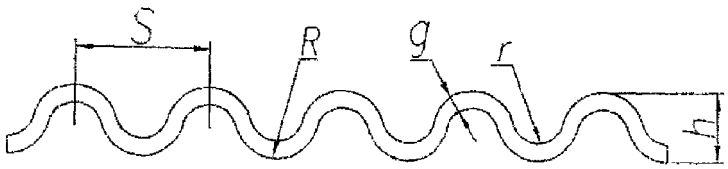


Fig.7b

Fig.7c

Fig.7d

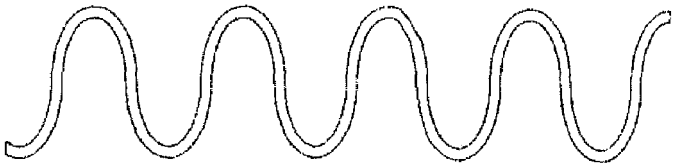


Fig.7e

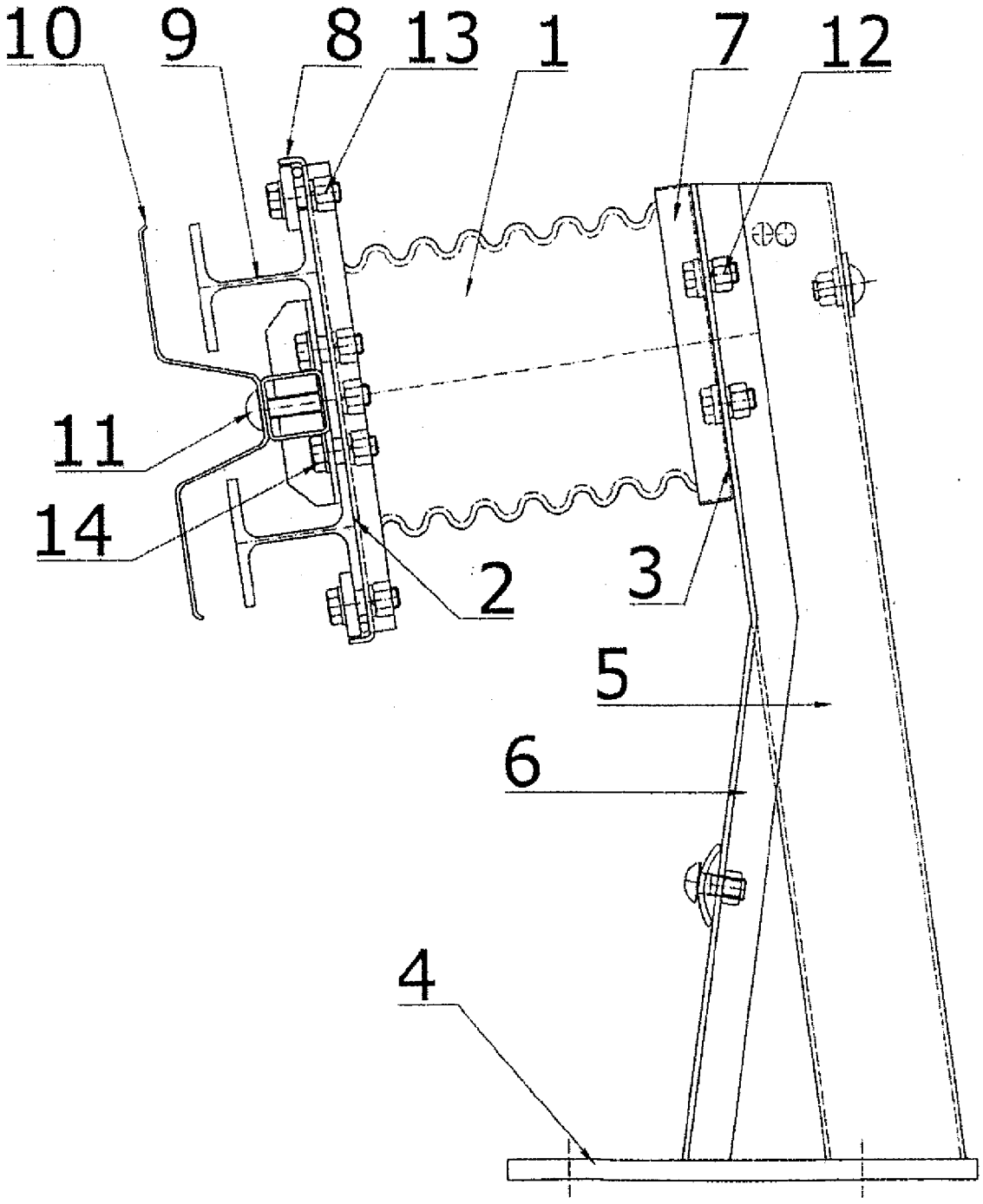
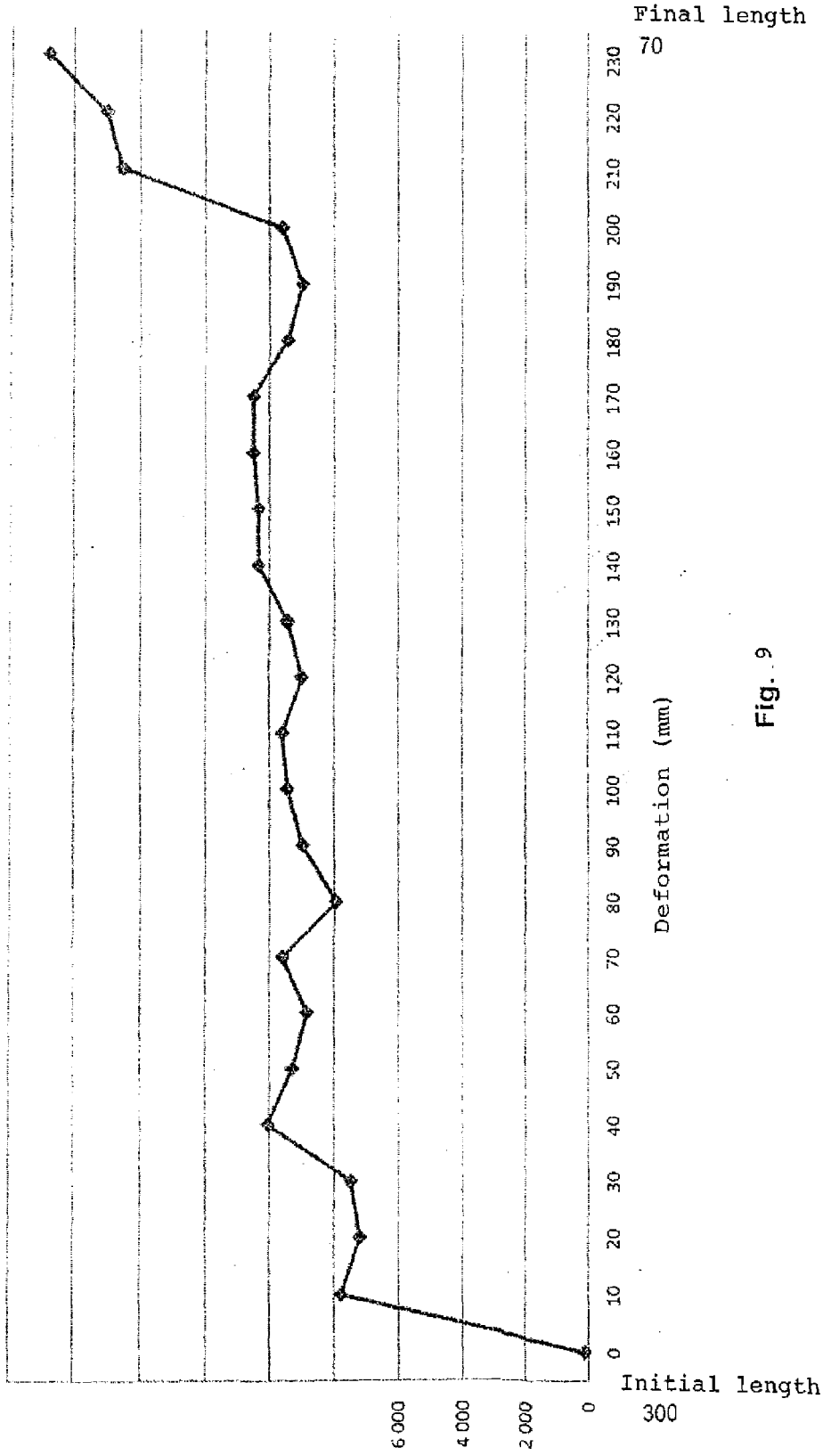


Fig.8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220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Deformation (mm)
Initial length
300
6 000
4 000
2 000
0
Resistance force of the energy absorbing element (kG)

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- PL 65812 **[0005]**
- DE 102009034758 A1 **[0006]**