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(54) Road safety device for impact damping

(57) The road safety device (1) comprises a plurality of uprights (2) ordered in longitudinal rows (21) which extend in the direction of the longitudinal axis (L) of the device (1) from the front side (3) to the rear side (4) of the device (1), and in transverse rows (2t) which extend from one lateral side (5) to the other (6) of the device (1) transversely with respect to the direction of the longitudinal axis (L) of the device (1), a plurality of collapsible primary profiles (7) forming a rigid interconnection between the adjacent uprights (2) of the longitudinal rows (21), a fixed and undeformable rear stop (8) to which the rear transverse row (2t) of uprights (2) is rigidly connected, and means for supporting and guiding the sliding of the uprights (2) in the direction of the longitudinal axis (L) of the device (1), the primary profiles (7) being collapsible in succession as a result of opposition of said rear stop (8) following frontal impacts against the front side (3) of the device (1) in such a way as to progressively absorb the kinetic energy released by the frontal impacts.

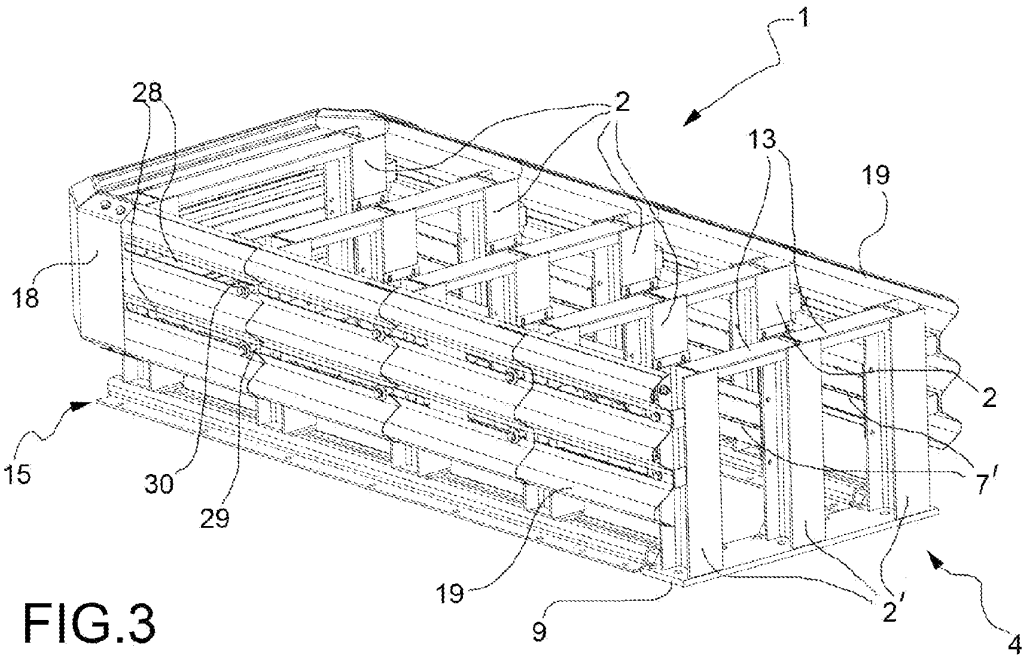


FIG.3

EP 2 383 391 A2

Description

[0001] The present invention relates to a road safety device for impact damping, in particular but not exclusively for barrier cusp terminal sections and singular points, adapted to obtain a gradual and controlled deceleration especially for light and medium-light impacting vehicles.

[0002] The safety devices of this type used nowadays, in order to be effective, generally have design features which make them particularly bulky.

[0003] This has a negative effect on the flexibility of use, especially when installation is required in particular zones such as barrier cusp terminal sections where there is limited lateral and/or longitudinal space, cusp terminal sections in road and motorway tunnels, around by-passes, etc.

[0004] Some of these devices also cannot be installed in tunnels, as they do not have the necessary fire-resistance characteristics.

[0005] The design choices may be subject to further constraints, when it is required that the device should not move back beyond the fixed rear point, for installation in particular conditions, such as, for example, against the wall of a by-pass in a tunnel.

[0006] The technical task set by the present invention is therefore that of providing a shock-absorbing road safety device which is able to eliminate the drawbacks associated with the prior art.

[0007] In connection with this technical task, one object of the invention is to provide a shock-absorbing road safety device which is extremely effective, but which has a small volume.

[0008] Another object of the invention is to provide a shock-absorbing road safety device which has a greater versatility of use so that it may be employed in a greater number of applications.

[0009] Last but not least, an object of the invention is to provide a shock-absorbing road safety device which is compact and fire-resistant.

[0010] The technical task, as well as these and other objects, according to the present invention are achieved by providing a road safety device characterized by comprising a plurality of uprights ordered in longitudinal rows which extend in the direction of the longitudinal axis of the device from the front side to the rear side of the device, and in transverse rows which extend from one lateral side to the other of the device transversely with respect to the direction of the longitudinal axis of the device, a plurality of collapsible primary profiles forming a rigid interconnection between the adjacent uprights of the longitudinal rows, a fixed and undeformable rear stop to which the rear transverse row of uprights is rigidly connected, and means for supporting and guiding the sliding of the uprights in the direction of the longitudinal axis of the device, said primary profiles being collapsible in succession by means of opposition of said rear stop following frontal impacts against the front side of the device in such a way as to progressively absorb the kinetic energy released by said frontal impacts.

[0011] Preferably the rear stop comprises a further transverse row of fixed uprights made integral with each other by means of a common support base and rigidly connected, by means of further collapsible primary profiles, to the slidable uprights of the rear transverse row.

[0012] Preferably at least one primary profile has a box-like configuration with a longitudinal axis oriented in the direction of the longitudinal axis of the device.

[0013] Preferably at least one primary profile has means for creating a preferential deformation path in the direction of its own longitudinal axis.

[0014] Preferably at least one primary profile is formed by two sheet-metal strips folded and joined by means of spot-welding.

[0015] Preferably the sheet thickness of the primary profiles positioned at the front is less than the sheet thickness of the primary profiles positioned at the rear.

[0016] Preferably the uprights of each transverse row are rigidly connected by means of spacers.

[0017] Preferably the uprights have a double C-shaped cross-section.

[0018] Preferably the means for supporting and guiding the sliding of the sliding uprights comprise sliding shoes mounted on the base at least of the longitudinal lateral rows of the uprights and slidably engaged in fixed rails which extend in the direction of the longitudinal axis of the device.

[0019] Preferably the front transverse row of uprights carries at the front one or more collapsible secondary profiles capable of receiving the initial phase of said frontal impacts.

[0020] Preferably at least one secondary profile has an Ω-shaped section and a longitudinal axis oriented transversely with respect to the longitudinal axis of the device.

[0021] Preferably a plate is provided so as to surround the front side of the device for uniform distribution, over the device, of the kinetic energy released by said frontal impacts.

[0022] Preferably means for redirection in the event of lateral impacts are present along at least one of the lateral sides of the device.

[0023] Preferably the redirection means comprise corrugated sheets supported by the lateral uprights.

[0024] Preferably the device is made of steel.

[0025] Further characteristic features and advantages of the invention will emerge more clearly from the description of a preferred, but not exclusive embodiment of the shock-absorbing road safety device according to the invention, illustrated by way of a non-limiting example in the accompanying drawings in which:

Figure 1 shows a side elevation view of the device;
Figure 2 shows a plan view of the device;
Figure 3 shows a perspective view, from the rear side, of the device;

Figure 4 shows a perspective view, from the rear side, of the device, partly exploded; and

Figure 5 shows a perspective view, from the front side, of the device with the sheets and the front plate removed for greater illustrative clarity.

[0026] With reference to the figures described, the road safety device 1 comprises a plurality of uprights 2 ordered in longitudinal rows 21 and transverse rows 2t.

[0027] The longitudinal rows 21 of uprights 2 extend in the direction of the longitudinal axis L of the device 1 from the front side 3 to the rear side 4 of the latter, while the transverse rows 2t extend from one lateral side 5 to the other lateral side 6 of the device 1 transversely with respect to the direction of the longitudinal axis L of the device 1.

[0028] In particular, four transverse rows 2t of uprights 2 are shown, the front transverse row 2t thereof comprising only two lateral uprights 2, while the three remaining transverse rows 2t each comprise, in addition to the two lateral uprights 2, also a third central upright 2. Consequently there are three longitudinal rows 21 of uprights 2, the central one of which has only three uprights 2 and the lateral ones of which each have four uprights 2.

[0029] The device 1 has, for each transverse row, a plurality of collapsible primary profiles 7 forming a rigid interconnection between the adjacent uprights 2 of the longitudinal rows 21.

[0030] A fixed and undeformable rear stop 8 is provided, to which stop the rear transverse row 2t of uprights 2 is rigidly connected.

[0031] Also present are special means for supporting and guiding the sliding of the uprights 2 in the direction of the longitudinal axis L of the device 1.

[0032] The primary profiles 7 are collapsible in succession as a result of opposition of the rear stop 8 following front impacts against the front side 3 of the device 1 so as to progressively absorb the kinetic energy released by the frontal impacts.

[0033] The rear stop 8 comprises in turn a further transverse row 2't of fixed uprights 2' made integral with each other by means of a common support base 9 and rigidly connected, by means of further collapsible primary profiles 7', to the slidable uprights 2 of the rear transverse row 2t of sliding uprights 2.

[0034] In particular the further transverse row 2't also comprises two lateral uprights 2' and a third central upright 2', each aligned in the direction of the longitudinal axis L with the uprights of a corresponding longitudinal row 21 of sliding uprights 2.

[0035] The base 9 is fixed at a suitable laying depth on a support surface by means of chemical fixing agents.

[0036] The rear stop 8 plays a fundamental role since it must restrain the entire device 1 during impact. In fact, in order to be able to be positioned in particular locations (for example in front of stationary obstacles), the device 1 must not absolutely move backwards during the impact. Basically, the three uprights 2', being static, absorb all the energy of the device 1 during the impact. Transmission of the energy onto the uprights 2' is not of an impulsive nature, but instead gradual (this being due to the gradual deceleration of the impacting object as the primary profiles 7, 7' are compressed).

[0037] The rear transverse row 2't of uprights 2' does not undergo either deformation, or displacement, owing to the fact that it is interlocked to the support surface and to its rigidity which is also ensured by reinforcing gussets 20 which connect the uprights 2' to the base 9.

[0038] The arrangement of the uprights 2, 2' is overall symmetrical with respect to the central, vertical, longitudinal plane of the device 1.

[0039] Each primary profile 7, 7' has a box-like configuration with a longitudinal axis oriented in the direction of the longitudinal axis L of the device 1. Each primary profile 7, 7' is formed by two sheet-metal strips 10, 11 folded and joined by means of spot-welding and by two base plates 21 which allow mounting thereof on the uprights 2, 2'.

[0040] Each of the primary profiles 7, 7' has means for creating a preferential deformation path in the direction of its own longitudinal axis, in particular eyelets 12 cut along its longitudinal folding edges.

[0041] The front portion of the primary profiles 7, 7' are provided with other wider eyelets 22 which offer a further preferential path for deformation of the primary profiles 7, 7' in the direction of their longitudinal axis.

[0042] The sheet thickness of the primary profiles 7 positioned at the front is less than the sheet thickness of the primary profiles 7' positioned at the rear.

[0043] In particular, the primary profiles 7 have a thickness which is less than that of the primary profiles 7'.

[0044] The variation in the thicknesses has been chosen so as to have different stages for absorption of the energy.

[0045] In the solution described there are eleven primary profiles 7, 7', two between the front transverse row 2t and the transverse row 2t immediately behind it, and three between each of the three pairs of transverse rows 2t, 2't facing each other.

[0046] The uprights 2 of each transverse row 2t which have a double C-shaped cross-section are rigidly connected by means of spacers 13 which have a U-shaped cross-section.

[0047] In particular, in each transverse row 2t and 2't of uprights 2 and 2', respectively, the adjacent uprights 2 and 2' are respectively connected at their top end and at the base by two spacers 13.

[0048] The spacers 13 allow uniform and symmetrical displacement of the sliding uprights 2 in the event of frontal impact, while in the event of lateral impact they ensure the rigidity of the device 1 and keep both the sliding uprights 2 and the fixed uprights 2' vertical.

[0049] The means for supporting and guiding the sliding of the uprights 2 comprise sliding shoes 14 mounted on the base of the longitudinal lateral rows of the uprights 2 and slidably engaged in fixed rails 15 which extend in

the direction of the longitudinal axis L of the device 1, along the whole length of the device.

[0050] The sliding shoe 14 has a plate 26 sliding inside a flattened, tubular, top element 24 of the rail 15 which has, in turn, a plate-like bottom element 25 welded to the top element 24.

[0051] When frontal impact occurs, the sliding shoe 14 tends to be raised and it is therefore the top surface of the plate 26 which makes contact with the top part of the inner surface of the tubular element 24. The small degree of friction created ensures sliding of the sliding shoe 14 along the entire length of the rail 15.

[0052] The rails 15 are fixed onto the support surface by means of chemical fixing agents, for example by means of dual-component epoxy chemical resin, at a suitable minimum fixing depth within the support surface.

[0053] The front transverse row 2t of uprights 2 carries at its front two collapsible secondary profiles 16 adapted to receive the initial phase of said frontal impacts.

[0054] Each secondary profile 16 has an Ω-shaped section and a longitudinal axis oriented transversely with respect to the longitudinal axis L of the device 1.

[0055] Each secondary profile 16 also has means for creating a preferential deformation path in the direction transverse to its longitudinal axis, in particular grooves 17 on its top wall and bottom wall which extend in the direction of its longitudinal axis.

[0056] Means for redirection in the event of lateral impacts are present along the lateral sides 5, 6 of the device 1.

[0057] The redirection means comprise corrugated sheets 19, in particular four sheets 19 for each lateral side 5, 6 of the device 1, three of which are slidably supported by the three lateral uprights 2 and one of which is fixed to the lateral upright 2'.

[0058] Suitable spacers 27 connect the sheets 19 to the lateral uprights 2, 2'.

[0059] During frontal impact, the spacers 27 transfer the translatory movement of the sliding sheets 19 to the sliding uprights 2. Instead, during lateral impact, the spacers 27 absorb a small part of the energy of the impacting object.

[0060] Some spacers 27 have been tapered to prevent sheets 19 jamming during their sliding movement.

[0061] At least the sliding sheets 19 have various channels 28 which are slidably engaged with special cylindrical members 29 fixed onto the spacers 27 of the uprights 2. The sheets 19 which are thus able to slide in turn allow relative sliding of the sliding uprights 2.

[0062] The cylindrical members 29 fixed to the sliding uprights 2 also have on their outer end a locking washer 30 which prevents separation of the sliding sheets 19.

[0063] A shaped plate 18, which is supported by the two front lateral sheets 19, surrounds the front side 3 of the device 1 for uniform distribution, over the device 1, of the kinetic energy released by the frontal impacts.

[0064] The particular semi-circular shape of the plate 18 allows it to be fixed directly onto the front lateral sheets 19. In this way the plate 18 ensures the displacement of the sheets 19 longitudinally, the compression of the secondary profiles 16 and finally the overall absorption of the kinetic energy of the impacting object by means of the primary profiles 7, 7'.

[0065] Advantageously, the primary profiles 7, 7', the uprights 2, 2', the spacers 13, the base 9, the front plate 18 and the sheets 19 are made of steel, for example Fe360 steel for all the components, except for the uprights 2, 2' and the base 9 which are made of Fe43 0 steel.

[0066] The device 1 ensures absorption of energy in the event of frontal impacts and redirection of the vehicle in the event of a lateral impact.

[0067] In the event of a frontal impact, there is an initial very short stage, during which the two secondary profiles 16 absorb a first part of the energy of the vehicle, and a subsequent stage involving deformation of the primary profiles 7, 7' which gradually compress as the uprights 2 of the front transverse row 2t are pushed by the impacting vehicle. The uprights 2 then stop when the energy of the impacting vehicle has been fully absorbed or when they reach the end of their travel path. The sheets 19 slide on each other, together with the uprights 2, owing to the channels 28 created inside them.

[0068] By means of the two actions described the impact response times may be managed so as to lessen, in both temporal and spatial terms, the deceleration, ensuring a gradual and calibrated absorption of the impact force and therefore the action transmitted to the vehicle and the passengers.

[0069] The device 1 advantageously ensures that there is no displacement of the rear stop 8 which may therefore protect the obstacle even when the rear stop 8 is positioned flush with the obstacle.

[0070] Redirection of the vehicle is instead ensured by the sheets 19 which absorb most of the energy of the vehicle before deflection. The lateral force is then transferred to the uprights 2, 2'. In this case the sliding shoe 14 / rail 15 system acts as a jamming mechanism and prevents the sliding uprights 2 from assuming a horizontal position.

[0071] The device 1 has proved to be suitable for inclusion in classes Z1 (dimensions of the deflection zone) and D1 (dimensions of the permanent lateral displacement zone) defined by the standard EN 1317-3.

[0072] The most usual application of the device 1 is that envisaged for confined zones with a small amount of space available at the rear where fire-resistance is required, typically for the protection of cusp terminal sections of by-passes in tunnels.

[0073] The road safety device thus conceived may be subject to numerous modifications and variations all falling within the scope of the inventive idea; moreover, all the details may be replaced by other technically equivalent elements.

[0074] In practice, the materials used, as well as the dimensions, may be of any nature depending on the requirements and the state of the art.

Claims

1. Road safety device (1) **characterized by** comprising a plurality of uprights (2) ordered in longitudinal rows (21) which extend in the direction of the longitudinal axis (L) of the device (1) from the front side (3) to the rear side (4) of the device (1), and in transverse rows (2t) which extend from one lateral side (5) to the other (6) of the device (1) transversely with respect to the direction of the longitudinal axis (L) of the device (1), a plurality of collapsible primary profiles (7) forming a rigid interconnection between the adjacent uprights (2) of the longitudinal rows (21), a fixed and undeformable rear stop (8) to which the rear transverse row (2t) of uprights (2) is rigidly connected, and means for supporting and guiding the sliding of the uprights (2) in the direction of the longitudinal axis (L) of the device (1), said primary profiles (7) being collapsible in succession as a result of opposition of said rear stop (8) following frontal impacts against the front side (3) of the device (1) in such a way as to progressively absorb the kinetic energy released by said frontal impacts.

2. Road safety device (1) according to Claim 1, **characterized in that** said rear stop (8) comprises a further transverse row (2't) of fixed uprights (2') made integral with each other by means of a common support base (9) and rigidly connected, by means of further collapsible primary profiles (7'), to the slidable uprights (2) of the rear transverse row (2t).

3. Road safety device (1) according to one or more of the preceding claims, **characterized in that** at least one of said primary profiles (7, 7') has a box-like configuration with a longitudinal axis oriented in the direction of the longitudinal axis (L) of the device (1).

4. Road safety device (1) according to the preceding claim, **characterized in that** at least one of said primary profiles (7, 7') has means of creating a preferential deformation path in the direction of its own longitudinal axis.

5. Road safety device (1) according to one or more of the preceding claims, **characterized in that** at least one of said primary profiles (7, 7') is formed by two sheet-metal strips (10, 11) folded and joined by means of spot-welding.

6. Road safety device (1) according to one or more of the preceding claims, **characterized in that** the sheet thickness of the primary profiles (7) positioned at the front is less than the sheet thickness of the primary profiles (7') positioned at the rear.

7. Road safety device (1) according to one or more of the preceding claims, **characterized in that** the uprights (2, 2') of each transverse row (2t) are rigidly connected by spacers (13).

8. Road safety device (1) according to one or more of the preceding claims, **characterized in that** said uprights (2, 2') have a double C-shaped cross-section.

9. Road safety device (1) according to one or more of the preceding claims, **characterized in that** said supporting and guiding means for sliding of the uprights (2) comprise sliding shoes (14) mounted on the base at least of the longitudinal lateral rows (21) of the uprights (2) and slidably engaged in fixed rails (15) which extend in the direction of the longitudinal axis (L) of the device (1).

10. Road safety device (1) according to one or more of the preceding claims, **characterized in that** the front transverse row (2t) of uprights (2) carries at the front one or more collapsible secondary profiles (16) adapted to receive the initial phase of said frontal impacts.

11. Road safety device (1) according to the preceding claim, **characterized in that** at least one secondary profile (16) has an Ω-shaped section and a longitudinal axis oriented transversely with respect to the longitudinal axis (L) of the device (1).

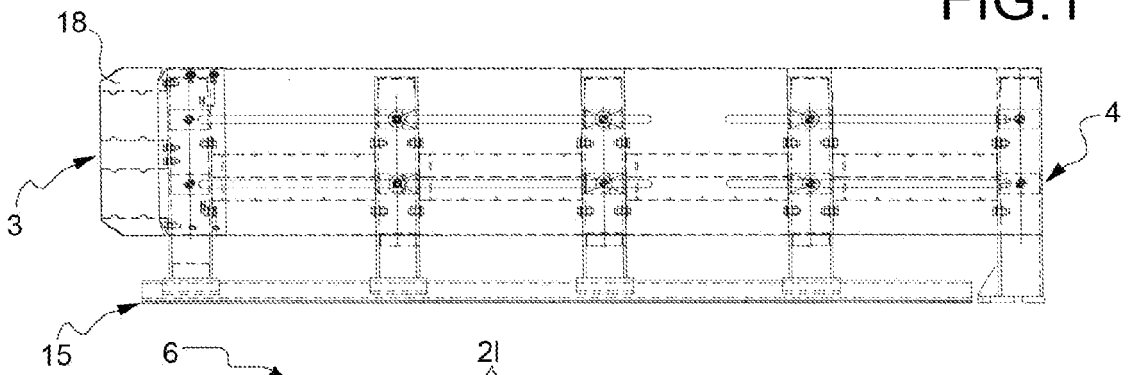
12. Road safety device (1) according to one or more of the preceding claims, **characterized by** having a plate (18) which surrounds the front side (3) of the device (1) for uniform distribution, over the device (1), of the kinetic energy released by said frontal impacts.

13. Road safety device (1) according to one or more of the preceding claims, **characterized in that** means for redirection in the event of lateral impacts are present along at least one of the lateral sides (5, 6) of the device (1).

14. Road safety device (1) according to the preceding claim, **characterized in that** said redirection means comprise corrugated sheets (19) supported by the lateral uprights (2, 2').

15. Road safety device (1) according to one or more of the preceding claims, **characterized by** being made of steel.

FIG.1



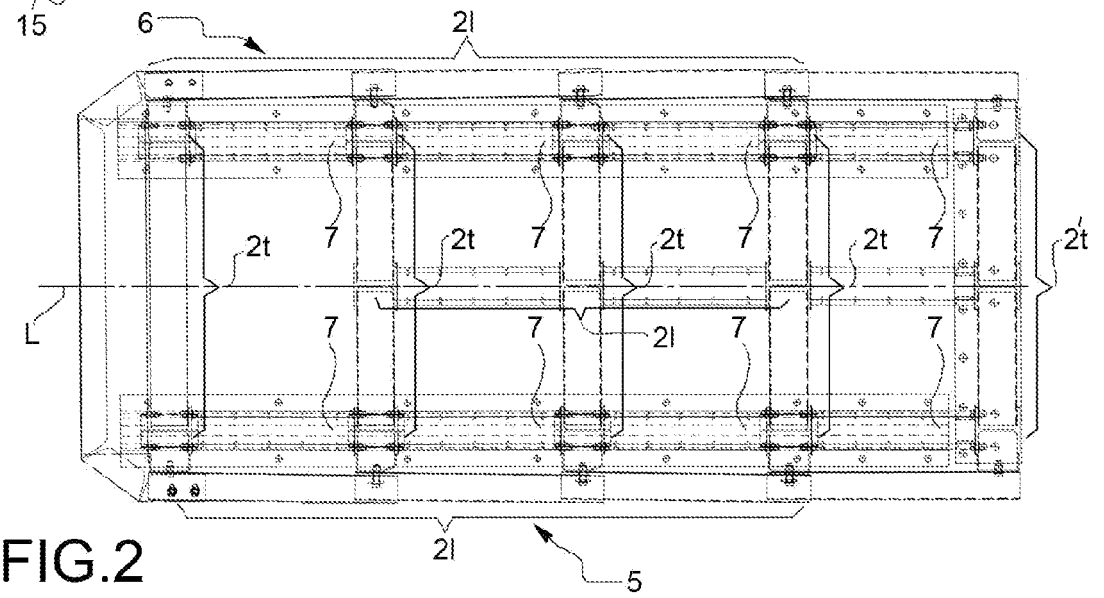


FIG.2

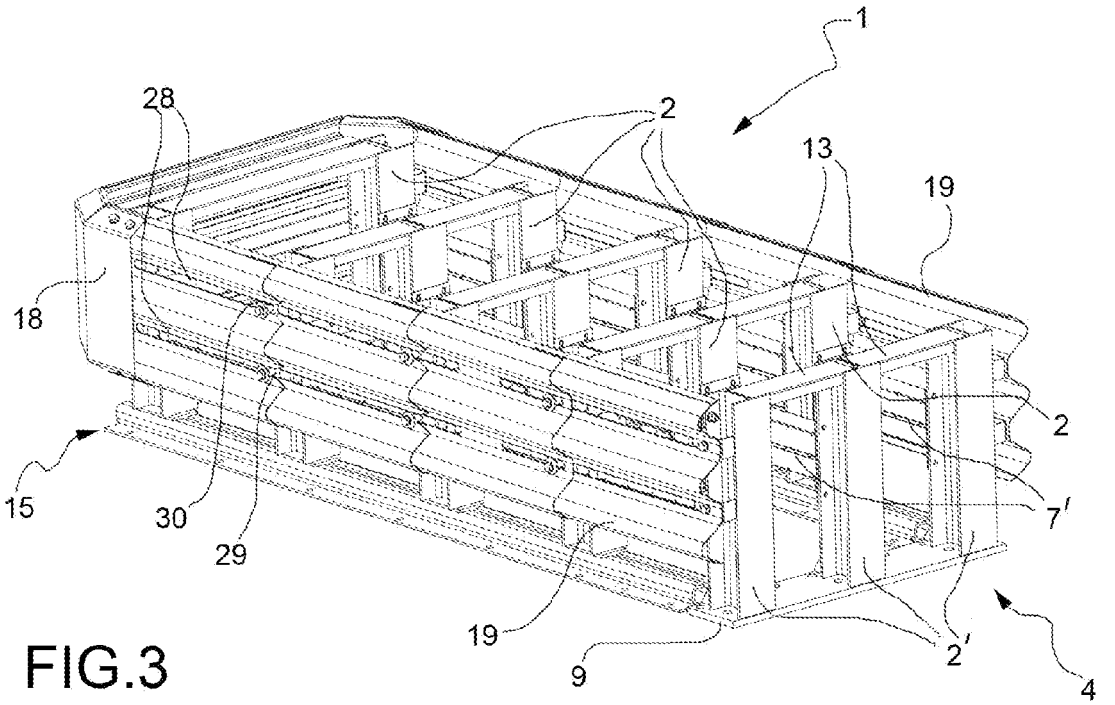


FIG.3

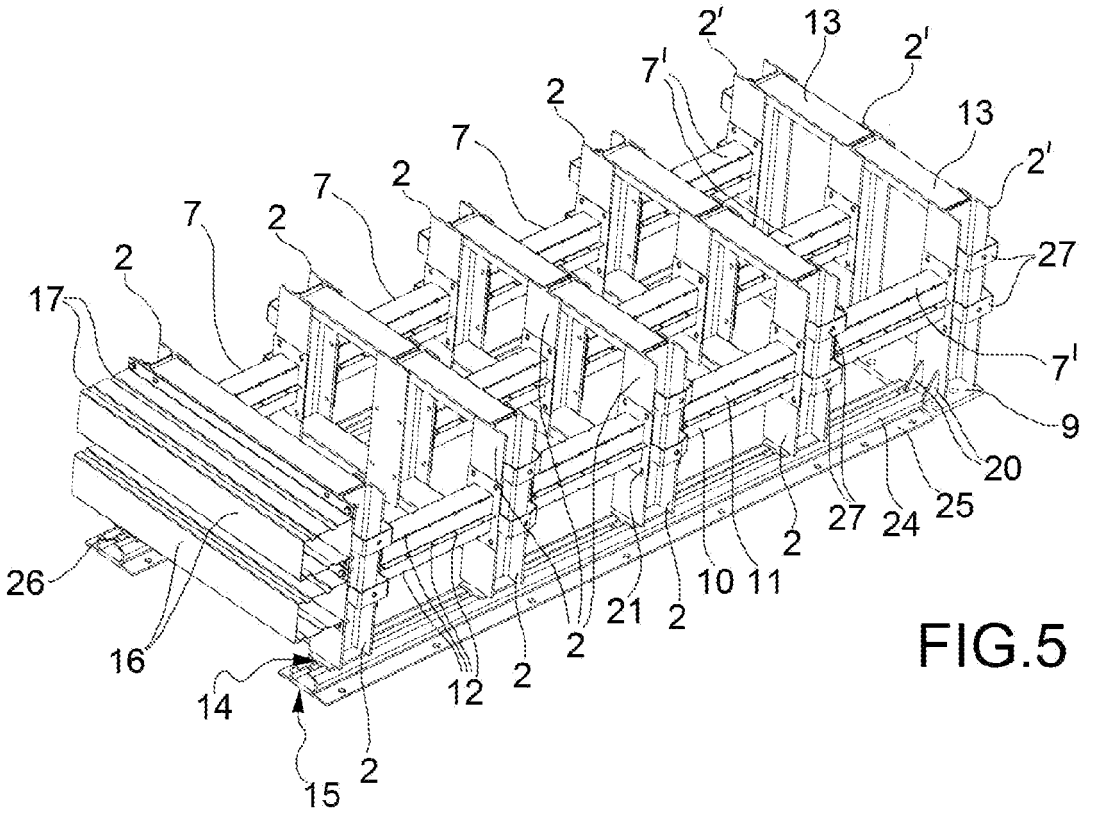

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FIG.5

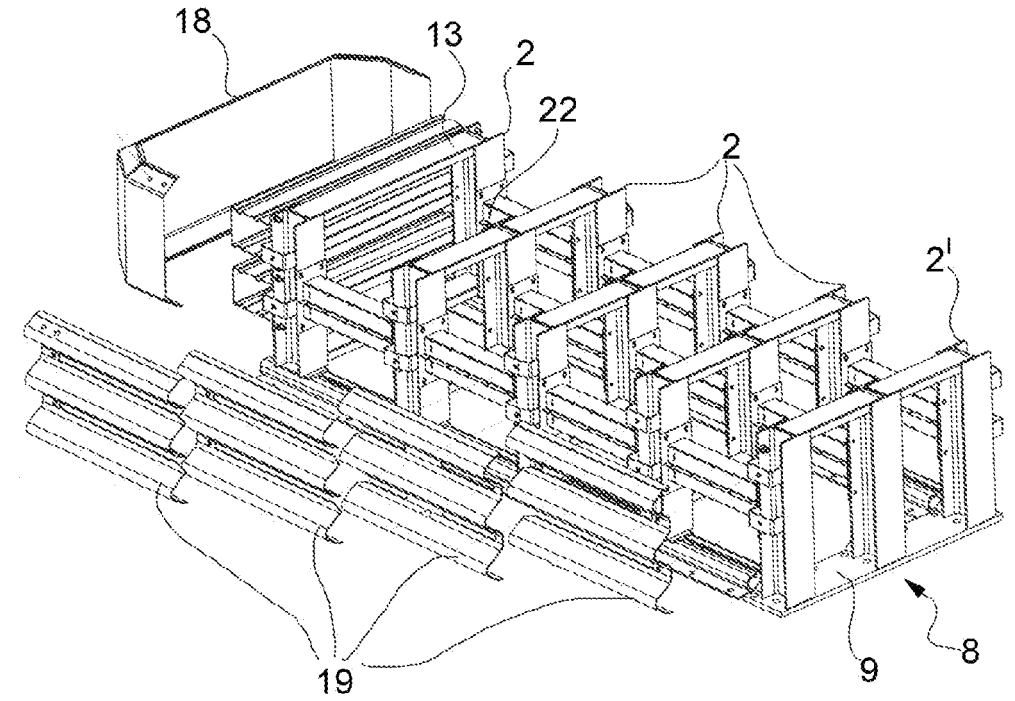
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FIG.4