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(54) TRANSITION DEVICE FOR THE CONNECTION OF ROAD BARRIERS

(57) The present invention relates to a transition device (1) for functionally continuous connection of a concrete road barrier (2) to a metal road barrier (3), comprising:

- a main body (10) configured to be rigidly connected, at a first terminal portion (10a), to an end of said concrete barrier (2);
- at least one connection adapter (12) fixed at a second terminal portion (10b) of the main body (10) and comprising a first portion (12a) having an anchoring axis (A), configured to be connected to said second terminal portion (10b) of the main body (10), and a second portion (12b) extending along a longitudinal axis (B) and configured to constrain, at least laterally, at least a portion of said metal barrier (3),

in which said main body (10) comprises at least one outer surface (11), having a curvilinear profile.

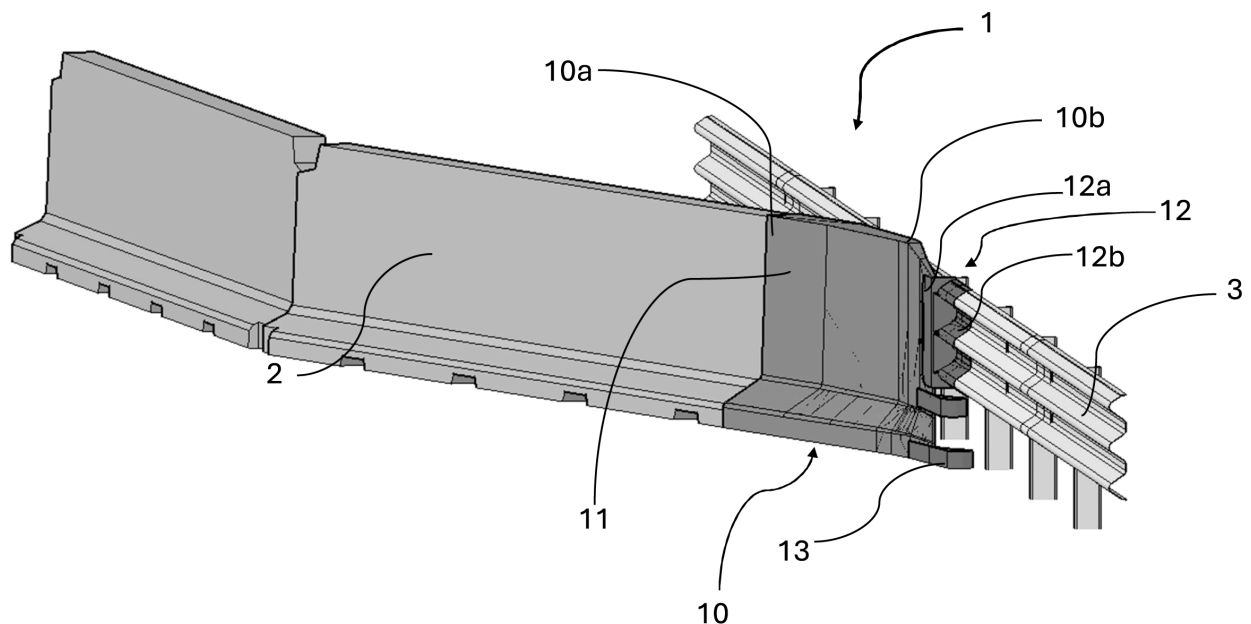


Fig. 1A

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a transition device for the connection between road safety barriers of different type, in particular between a prefabricated concrete barrier and a continuous metal barrier.

BACKGROUND ART

[0002] In recent years, the introduction of type-approved safety barriers has made it possible to significantly increase passive protection along road infrastructure, both in urban and extra-urban contexts, in particular through the introduction of type-approved safety barriers compliant with European standards.

[0003] These barriers may assume different configurations depending on the application context, and are generally divided into two broad categories: prefabricated concrete barriers, often of the New Jersey type, and continuous metal barriers with a wavy profile.

[0004] However, in many operational scenarios, including temporary work zones, road maintenance segments, new installations or interfaces to existing infrastructure, there is a frequent need to connect two barriers of different nature to each other, e.g., a concrete barrier and a metal barrier. This design requirement does not currently find a univocal and standardized answer in the background art.

[0005] In the background art, the connection between these two types of barriers is often solved empirically, by means of improvised or adapted fixing systems.

[0006] The currently adopted solutions are generally designed for a specific configuration and do not offer application flexibility.

[0007] Furthermore, the known systems do not guarantee either mechanical continuity or functional continuity of the containment system, because they do not guarantee a homogeneous behavior in the event of an impact, with potential discontinuities in vehicle deflection or rigid points liable to generate localized damage.

[0008] Devices designed to absorb the kinetic energy of a frontal collision are also known in the art, used to close the free ends of the barriers or to attenuate the impact in cases of lane departure.

[0009] However, these devices prevalently address longitudinal energy dissipation and not the lateral connection function between different barriers. Their geometry and function do not make them suitable to form an intermediate structural element between two diverse systems.

[0010] The configurations currently provided for transitions are generally rectilinear, preventing the possibility of utilizing a transition device, e.g., in work zone end treatments which involve an angled configuration.

[0011] Furthermore, as mentioned above, the known technical solutions are based on components specifi-

cally designed for a determined requirement and a determined barrier profile. This implies limited versatility, with a consequent increase in operational complexity, logistics and intervention times in the work zone.

[0012] Some devices provide a transition function by means of rounded terminals or variable angle connectors, but are typically designed as frontal-impact energy-dissipating terminals and not as veritable lateral redirection connection modules. These shortcomings determine a greater logistical difficulty in the work zones and the impossibility of ensuring reliable, certifiable and repeatable performance in emergency installations or structurally critical connectors.

[0013] It is the object of the present invention to overcome the limitations highlighted above, making possible a safe and functional connection between barriers of different type. It is a further object to provide a transition device usable both in a rectilinear configuration, for layout continuity, and in an inclined configuration, as in the case of work zone end treatments.

[0014] It is another object to allow the connection between a concrete barrier and different types of metal barriers, with no need for redesign or structural customization.

[0015] It is a further object of the invention to reduce the logistical complexity and the intervention times by offering a system compatible with multiple installation configurations.

[0016] It is yet another object to ensure a functional continuity between the connected barriers, i.e., ensure the maintenance of the redirection function also at the connection point, without creating geometric discontinuities or unpredictable behaviors in the event of impact.

SUMMARY OF THE INVENTION

[0017] These and other objects are achieved by the transition device according to claim 1. The present invention relates to a transition device for functionally continuous connection of a concrete road barrier to a metal road barrier, comprising:

- a main body configured to be fixedly connected, at a first terminal portion, to an end of said concrete barrier;
- at least one connection adapter fixed at a second terminal portion of the main body and comprising a first portion having an anchoring axis, configured to be connected to said second terminal portion of the main body, and a second portion extending along a longitudinal axis and configured to at least laterally constrain at least a portion of said metal barrier,

wherein said main body comprises at least one outer surface, having a curvilinear profile.

[0018] Advantageously, the curvilinear profile of the outer surface of the main body is adapted to laterally

deflect an impacting vehicle, and the device is configured to ensure functional continuity between the concrete barrier and the metal barrier in the event of a vehicle impact.

[0019] Advantageously, this configuration makes it possible to obtain an effective structural connection between heterogeneous systems (i.e., between barriers of different conformation and material), by virtue of the presence of a main body with a blended redirecting profile and a connection adapter which is fixedly constrained to both the main body and the metal barrier.

[0020] This architecture makes it possible to avoid geometric misalignments and ensures coherent transmission of stresses between the two systems, thus contributing to reducing the possibility of critical collision points.

[0021] Unlike the known solutions, in which structural discontinuity may cause abnormal vehicle behavior at the moment of impact, the device makes it possible to maintain mechanical-functional continuity between the connected segments, preserving the overall redirection effect even under complex dynamic conditions, such as angled collisions or impacts on inclined surfaces.

[0022] According to an aspect, the first portion of the connection adapter is preferably reversibly constrained and preferably adjustable in position with respect to the second terminal portion of the main body, while the second portion of the connection adapter has a conformation which is complementary to the profile of said metal barrier.

[0023] It is worth noting that here and hereafter the wording "adjustable in position" means that the first portion of the connection adapter may be moved and fixed in different positions with respect to the main body, in particular may be moved and fixed in different positions and at different heights along the terminal portion of the main body to which it is constrained, e.g. by means of systems with multiple holes, slots or guided slides, which allow the position to be adjusted in height, in inclination, and/or along the longitudinal axis of the device.

[0024] This adjustability makes it possible to compensate for level differences, misalignments, or irregular geometries between the barriers to be connected, ensuring a precise and functional coupling independently of the conditions of the installation site.

[0025] Advantageously, this solution ensures a high degree of adaptability during assembly, allowing the installation of the device in geometrically different contexts, including situations of curvilinear layout, level differences or misalignments, without the need for specific customizations.

[0026] According to an aspect, the connection adapter can be formed in one piece, or said first portion and said second portion of the adapter can be formed as separate parts, connected to each other by mechanical assembly.

[0027] Advantageously, the adoption of modular,

combinable elements allows individual elements to be replaced or adapted as a function of the desired configuration, reducing production and maintenance costs, simplifying logistics, and improving system flexibility.

[0028] Furthermore, the possibility of varying the composition of the modular elements makes it possible to obtain a progressive curvature of the device, adapting it with precision to the geometry of the road layout.

[0029] This may contribute to absorbing the impact more effectively because a distributed curvature allows a gradual deflection of the vehicle and reduces concentrated stresses, thus improving the capacity of the system to dissipate kinetic energy in the event of a collision.

[0030] According to an aspect, the connection adapter can be selected from a plurality of adapters having different geometric configurations, in which, in each configuration, the longitudinal axis of the second portion is aligned with or vertically offset from the anchoring axis of the first portion, with reference to a laying plane of the device.

[0031] In other words, the connection adapter is selectable from a plurality of interchangeable adapters, each configured for connecting to a different type of road barrier.

[0032] Advantageously, the possibility of selecting the adapter from a plurality of geometric configurations allows the second portion, in particular the longitudinal axis of the second portion, to be arranged at different heights with respect to the main body, in particular with respect to the axis of the anchoring plane between the first portion of the adapter and the main body, precisely adapting the connection to the actual elevation of the metal barrier to be blended.

[0033] This makes it possible to compensate for level differences or elevation differences between the connected barriers, simplifying installation and ensuring the geometric and functional continuity of the existing device and of the device which is the object of invention.

[0034] In particular, according to an aspect, the second portion of said connection adapter is selectable from a plurality of interchangeable second portions, each configured for connecting to a different type of road barrier.

[0035] Advantageously, this makes it possible to prepare a kit system, as will be better described hereinafter, which reduces intervention times in the work zone and allows the use of the same base device in different contexts, increasing the universality and scalability of the invention.

[0036] According to an aspect, the first portion of said connection adapter comprises a first shaped plate, having a conformation complementary to said second terminal portion of the main body, preferably an L-shaped conformation or a U-shaped conformation. According to an aspect, the second portion of said connection adapter comprises a second shaped plate, hav-

ing a conformation complementary to the profile of said metal barrier, preferably a wavy conformation.

[0037] It is worth noting that "complementary conformation" means that the first and the second portion geometrically conform to the surface of the main body or the metal barrier to which they are respectively connected, ensuring a stable coupling, free of play and capable of transmitting loads uniformly.

[0038] In particular, in the case of the first portion of the adapter, said L- or U-shaped conformation is specifically designed to enfold at least one lateral surface of the main body, allowing a stable and enveloping grip. This lateral coupling improves the distribution of mechanical stresses, facilitates the alignment of the components in the assembly step and contributes to the overall robustness of the joint. Advantageously, this conformation allows precise assembly, the reduction of local vibrations, and an increase in the mechanical efficiency of the connection during the dynamic operation of the system.

[0039] According to an aspect, the connection adapter is selectable from a plurality of interchangeable adapters, each arranged for connecting to a different type of road barrier.

[0040] In particular, according to an aspect, the second portion of said connection adapter is selectable from a plurality of interchangeable second portions, each configured for connecting to a different type of road barrier.

[0041] As mentioned above, this makes it possible to provide a kit system, which reduces intervention times at the work zones site and allows the use of the same base device in different contexts, increasing the universality and the scalability of the invention. According to an aspect, the main body is made in one piece or can be obtained assembling a plurality of modular elements, preferably made of metal, joined or blended to one another.

[0042] Preferably, the said modular elements consist of shaped structural portions which, once assembled, compose the main body along its longitudinal extension.

[0043] Each element may have a slight curvature, an inclination, or a predetermined angle, and the successive abutment of multiple elements with variable geometry makes it possible to obtain an overall blended profile, also curved or arched.

[0044] This modularity makes it possible to achieve a smooth transition between offset barriers, road curves or end treatment configurations, without the need for customized single block elements.

[0045] Advantageously, the modular solution allows greater flexibility in production, transport and installation operations, and make it possible to adapt the device to the geometry of the site without sacrificing high mechanical performance.

[0046] According to an aspect, the outer surface of the main body has a blended, curvilinear profile free of

sharp edges, and preferably has a radius of curvature comprised between 100 mm and 500 mm, configured to laterally deflect an impacting vehicle. This configuration promotes a progressive deflection of the impacting vehicle along a tangential trajectory, avoiding direct frontal impacts and contributing to dissipating the kinetic energy in a distributed manner along the body of the device. Advantageously, this geometry increases the redirection effect and contributes to reducing the acceleration peaks experienced by the passengers in the event of a collision, improving the system performance in terms of passive safety.

[0047] A device according to the foregoing description, which, when used to connect a concrete road barrier to a metal road barrier, may be positioned in a first configuration, in which the main body extends parallel to said metal barrier, or in a second configuration, in which the main body extends in a longitudinal direction forming an angle comprised between 5° and 45°, preferably between 10° and 20°, with respect to the longitudinal axis of the metal barrier.

[0048] Advantageously, the possibility of installation both in a rectilinear configuration and in an inclined configuration allows the device to operate effectively both as a linear connecting element between pre-existing barriers and as a terminal portion for work zone end treatments, thereby considerably broadening the range of applications.

[0049] Unlike the known solutions, which provide fixed transitions designed for a single configuration, the possibility of inclining the device allows adapting it also to angled entries or provisional segments, such as those typical of temporary work zones. This allows more versatile management of the installation and reduces the need for specific components for each type of geometry. Furthermore, the inclined installation allows a progressive entry of the vehicle into the line of barriers, contributing to impact mitigation and improving the overall redirection effect of the system.

[0050] A device according to the foregoing description, which comprises a wheel guard accessory fixed to the second end of the main body, preferably near the base of the main body, configured to prevent the passage of the vehicle under the device in the event of an impact.

[0051] Advantageously, the wheel guard accessory contributes to increasing system safety in the presence of light vehicles, reducing the risk of intrusion under the barrier and preventing vertical instability of the vehicle in the event of a tangential or frontal collision.

[0052] It is worth noting that the present invention is also directed to an adapter for the connection between a concrete road barrier and a metal road barrier, i.e., to an adapter that may be utilized independently or in combination with a transition device according to the invention, also being suitable for retrofit interventions, adaptation on existing systems, or custom work zone connections.

[0053] Indeed, the invention further relates to an adapter for the connection between a concrete road barrier and a metal road barrier, comprising a first portion having an anchoring axis, configured to be connected to a surface integral with the concrete barrier, and a second portion which extends along a longitudinal axis and it is configured to constrain at least laterally at least one portion of the metal barrier, in which the second portion has a conformation which is complementary with respect to the profile of the metal barrier, preferably a wavy or substantially flat conformation. According to an embodiment, the longitudinal axis of the second portion is aligned or arranged at a vertical distance with respect to the anchoring axis of the first portion, with reference to a laying plane.

[0054] Advantageously, the adapter makes it possible to achieve a geometrically efficient and functional connection between two diverse types of barriers, ensuring mechanical coupling even in the presence of level offsets, irregularities, or elevation differences between the connected structures.

[0055] The possibility of making adapters with portions shaped at different elevations with respect to the anchoring plane makes it possible to cover a wide range of applications, without modifying the interface of the receiving barrier.

[0056] The adapter may be employed in an independent manner or in combination with a transition device according to the invention.

[0057] According to an aspect, the invention is further directed to a kit for making a transition system between a concrete road barrier and a metal road barrier, comprising a main body and a plurality of connection adapters, each comprising a first portion configured to be connected to the main body and a second portion configured to at least laterally constrain a portion of the metal barrier, in which said adapters have different geometric configurations, in particular as regards the arrangement of the longitudinal axis of the second portion with respect to the anchoring axis of the first portion, with reference to a laying plane. Advantageously, the kit allows the device to be adapted to the different types of installable metal barriers, without the need for structural modifications of the main body or of the receiving barrier.

[0058] Furthermore, the availability of a plurality of adapters in a single solution makes it possible to simplify logistics and reduce work zone intervention times, improving installation efficiency and ensuring compatibility with a wide range of profiles and configurations of road barriers.

[0059] The kit is particularly suitable for use in contexts of temporary installation, retrofit interventions, mobile work zones, or situations in which it is not possible to know *a priori* the type of metal barrier to be blended.

BRIEF DESCRIPTION OF THE FIGURES

[0060] Further objects, features, and advantages of the present invention will be more apparent from the following detailed description provided by way of non-limiting example and illustrated in the accompanying figures, in which:

Fig. 1A shows a perspective view of the transition device in use according to a preferred embodiment of the invention;

Fig. 1B shows a detailed view of the transition device in figure 1A, in particular of the connection adapter in an embodiment of the invention;

Fig. 2 shows a perspective view of the transition device in use according to an embodiment of the invention;

Figs. 3A - 3C show the connection adapter 12 in a triple wave configuration according to different embodiments of the invention;

Figs. 4A - 4C show the connection adapter 12 in a double wave configuration according to different embodiments of the invention;

Figs. 5A - 5C show the connection adapter 12 in a flat configuration according to different embodiments of the invention;

Fig. 6 shows the wheel guard accessory in an embodiment of the invention.

[0061] The following description of exemplary embodiments relates to the accompanying figures. The same reference numbers in the various figures identify the same elements or similar elements. The following detailed description does not limit the invention. The scope of the invention is defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

[0062] With reference to the accompanying figures, the present invention relates to a transition device 1 to connect a concrete road barrier 2 to a metal road barrier 3. With reference to figures 1A, 1B and 2, the device 1 comprises a main body 10, preferably made of metal, configured to be fixedly connected, at a first terminal portion 10a to an end of the concrete barrier 2.

[0063] Preferably, the main body 10 is made of a metal material with high mechanical strength, preferably structural steel, galvanized or painted to resist corrosion in outdoor environments. In an embodiment, the material employed shows features of ductility and resilience such as to ensure a good capacity for impact absorption and for redistribution of stresses along its extension. The use of structural steel allows the main body 10 to maintain its integrity even in the event of repeated collisions, and is compatible with the welding or bolting operations required for assembling the device. Alternatively, light metal alloys or reinforced com-

posite materials may be used, as a function of weight, transport, or installation context requirements.

[0064] In an embodiment, the main body 10 may be formed in one piece, i.e., as a single block piece, or may be obtained by assembling multiple modular elements, preferably metal, joined or blended ones, to one another.

[0065] In an embodiment, the modular elements consist of shaped structural portions which, once assembled, form the main body 10 along its longitudinal extension. Each modular element may show a slight curvature, an inclination, or a predetermined angle, and the successive abutment of multiple elements with variable geometry makes it possible to obtain an overall blended profile, also curved or arched.

[0066] This modularity makes it possible to achieve a smooth transition between offset barriers, road curves or end treatment configurations, without the need for customized single block elements.

[0067] Preferably the modular elements are coupled or blended to each other by mechanical assembly.

[0068] This possibility allows the device to be adapted to different installation configurations and facilitates its transport and installation on site. The modular solution, in particular, makes it possible to achieve progressive curvatures along the longitudinal axis of the main body 10, contributing to the creation of an optimal interface between the connected barriers.

[0069] With reference to figure 1B, the main metal body 10 comprises at least one outer surface 11 configured with a curvilinear profile adapted to laterally deflect an impacting vehicle, and the device 1 is configured to ensure functional continuity between the concrete barrier 2 and the metal barrier 3 in the event of a vehicle impact.

[0070] It is worth noting that, according to a preferred embodiment, the main body 10 preferably extends along a main longitudinal direction, which corresponds to the direction of traffic or to the layout of the concrete barrier 2 to which it is fixedly connected.

[0071] In this configuration, the main body has a cross-section designed to ensure geometric and functional continuity with the profile of the concrete barrier 2, reducing discontinuities or level differences which could interfere with the trajectory of the vehicle in the event of an impact.

[0072] The shape of the section may vary as a function of the type of receiving barrier, but is preferably tapered or blended so as to avoid misalignments, while ensuring the smooth transmission of collision forces between the connected components.

[0073] The surface 11 of the main body 10 has a blended, curvilinear profile free of sharp edges, and preferably has a radius of curvature comprised between 50 mm and 700 mm, preferably comprised between 100 mm and 500 mm, configured to laterally deflect an impacting vehicle.

[0074] In other words, this configuration allows the

lateral deflection of a vehicle that impacts against the device 1, preventing a stop and an abrupt collision, and significantly reducing the risk of injury to the passengers.

[0075] The blended, curvilinear redirection geometry of the surface 11 is designed to facilitate a controlled deflected movement of the vehicle toward the center of the carriageway, avoiding the impact resulting in a lane crossover beyond the barrier, i.e., a hazard for the other road users.

[0076] The device further comprises at least one connection adapter 12 fixed at a second terminal portion 10b of the main body 10, to connect it to the metal barrier 3.

[0077] Figures 3A - 3C, 4A - 4C and 5A - 5C show some embodiments of the connection adapter 12 according to the invention.

[0078] Like the main body 10, the adapter 12 may also be made of high-strength steel, surface-treated by hot-dip galvanizing, epoxy painting, or other anti-corrosion coatings, so as to ensure its durability even under severe environmental conditions. Alternatively, the adapter may be made of light alloys, such as reinforced aluminum, or structural composite materials, if it is desired to reduce the weight of the system without compromising the rigidity of the assembly. The selected materials must be compatible with the utilized fixing means (bolting, welding, or mechanical interlocks) and ensure adequate resistance to the stresses transmitted during a collision, contributing to the structural integrity of the device as a whole.

[0079] With reference to figures 3A - 3C, 4A - 4C and 5A - 5C, the connection adapter 12 comprises a first portion 12a having an anchoring axis A, configured to be connected to the second terminal portion 10b of the main body 10, and a second portion 12b extending along a longitudinal axis B and configured to at least laterally constrain at least one portion of the metal barrier 3 (figures 3A - 3C, 4A - 4C), or configured for a wall attachment (figures 5A - 5C).

[0080] In this manner, the adapter ensures a rigid and structurally efficient connection between two heterogeneous entities.

[0081] It is worth noting that the present invention further relates to the adapter 12 as such, independently of the presence of the main body 10 or of the device 1 as a whole.

[0082] The adapter 12 according to the invention is configured to achieve a structurally effective connection between a concrete barrier 2 and a metal barrier 3, and comprises a first portion 12a having an anchoring axis A, and is configured to be connected to at least one surface, preferably metal, integral with the concrete barrier 2, and a second portion 12b extending along a longitudinal axis B and is configured to constrain at least laterally at least a portion of the metal barrier 3.

[0083] The second portion 12b has a conformation complementary with respect to the profile of the metal

barrier 3, e.g., a wavy shape for double or triple wave profiles, or a substantially flat shape for connectors with continuous surfaces or abutment walls. In an embodiment, the longitudinal axis B of the second portion 12b may be aligned or arranged at a vertical distance d with respect to the anchoring axis A of the first portion 12a, with reference to a laying plane.

[0084] This configuration makes it possible to adapt the adapter 12 to different interface heights, facilitating installation with barriers of different geometry and contributing to the versatility and modularity of the system also when utilized as an independent element.

[0085] With reference to figure 1B, the main body 10 and the adapter 12 are configured so as to ensure functional continuity between the concrete barrier 2 and the metal barrier 3.

[0086] As mentioned above, "functional continuity" means that, in the event of a vehicular impact, there are no interruptions or discontinuities between the two barriers in the vehicle containment and lateral guidance function and the function is transmitted in a smooth manner through device 1, without generating critical collision points or misalignment of the restraint geometries.

[0087] The redirection effect is ensured by the curvilinear profile of the outer surface 11 of the main body 10 and by the complementary geometry of the second portion 12b with respect to the metal barrier 3.

[0088] Furthermore, the redirection function is also guaranteed in the case in which the vehicle impacts the interface between the metal barrier and the main body 10, by virtue of the structural integration between these elements.

[0089] In an embodiment, shown by way of example in figures 1A and 1B, the first portion 12a of the adapter 12 is reversibly constrained to the main body 10 and preferably adjustable in position.

[0090] It is worth noting that in a preferred embodiment, the connection adapter 12 is selectable from a plurality of interchangeable adapters, as shown for illustrative purposes in figures 3A - 3C, 4A - 4C and 5A - 5C, each designed to connect to a specific type of metal barrier, and the device 1 is made as a modular kit, comprising a plurality of interchangeable adapters 12, depending on the metal barrier 3 to be connected.

[0091] In a preferred embodiment, the same adapter 12 may be made modular, comprising a plurality of interchangeable second portions 12b, to be associated with the same first portion 12a, depending on the metal barrier 3 to be connected. This solution simplifies logistics management and allows high flexibility at the work zone.

[0092] The connection adapter 12 may be selected from a plurality of adapters 12 having different geometric configurations, in which, in each configuration, the longitudinal axis B of the second portion 12b is aligned or arranged at a vertical distance d with respect to the anchoring axis A of the first portion 12a, with

reference to a laying plane of the device 1.

[0093] The modularity of the transition device 1 makes it possible to select the most suitable adapter 12, based on the height and the specific geometry of the barrier to be connected.

[0094] In particular, the possibility of selecting an adapter as a function of the height positioning of the second portion 12b makes it possible to align the contact point between the metal barrier 3 and the adapter 12 in a precise manner, while the angular adjustment also allows installation in inclined configurations, e.g., at work zone end treatments.

[0095] The adapter 12 may be made as a single piece or, alternatively, the first portion 12a and the second portion 12b may be made as separate components, connected to each other by means of mechanical assembly, e.g., by means of bolting or guide interlocks. This solution makes it possible to increase installation flexibility and adapt the system to different road barrier standards.

[0096] In an embodiment, the first portion 12a comprises a shaped plate which has a complementary conformation with respect to the geometry of the terminal portion 10b of the main body 10, preferably with an L-shaped or U-shaped conformation. For example, as shown in figure 1B, the plate 12a has an L shape, allowing it to be constrained laterally to a wall of the main body 10, forming a geometric coupling that improves the mechanical resistance and the correct positioning in the step of installation. The shape may further facilitate the absorption of vibrations and the overall redirection behavior.

[0097] In an embodiment, the second portion 12b of the connection adapter 12, which extends along a longitudinal axis B, or central longitudinal axis B, comprises a second shaped plate having a conformation complementary with respect to the profile of the metal barrier portion 3, preferably a wavy conformation.

[0098] In particular, as shown in the accompanying figures 3A - 3C, 4A - 4C and 5A - 5C, the second portion 12b has a complementary conformation with respect to at least part of the outer surface of the metal barrier portion 3 to which it is connected.

[0099] For example, the second portion 12b may have a triple wave profile (figure 3A - 3C), or a double wave profile (figure 4A - 4C), for metal barriers type H1, H2, H3 or H4 or for light or medium metal barriers, or a flat profile (figure 5A - 5C), for direct connection to other flat elements or to masonry structures, such as bridge abutments or concrete barriers of the New Jersey type.

[0100] With reference to figures 3A, 3B and 3C, different embodiment variants of the adapter 12 are shown, in which the second portion 12b, which extends along a longitudinal axis B, or central longitudinal axis B, is shaped with a triple wave profile. In these configurations, the adapter 12 is designed to blend to metal barriers 3 with high containment capacity, conventionally classified as H3 or higher, which have three over-

lapping or offset waves, and has a configuration such as to ensure a rigid and functional coupling even in the presence of level differences.

[0101] The three figures 3A, 3B and 3C show possible construction differences in the geometry of the portion 12a, in the positioning of the holes, and in the mutual positioning of the two portions 12a and 12b of the adapter 12, to adapt both to barriers installed on a regular road surface, and to barriers installed on grounds having slopes or irregularities, such as those that may be encountered in temporary work zones.

[0102] In particular, in figure 3A, a connection adapter 12 is shown in which the longitudinal axis B of the second portion 12b is aligned with respect to the anchoring axis A of the first portion 12a, with reference to a laying plane of the device 1, while in figure 3B and 3C a connection adapter 12 is shown in which the longitudinal axis B of the second portion 12b is arranged at a vertical distance d with respect to the anchoring axis A of the first portion 12a, with reference to a laying plane of the device 1.

[0103] The three configurations show geometric variants, in particular of the portion 12a of the adapter 12, which may be shaped with a transition portion 12c having a raised, gradual, or inclined geometry, so that the second portion 12b (in particular with reference to its longitudinal axis B) is positioned at different heights with respect to the main body 10.

[0104] This configuration makes it possible to compensate for differences in elevation between the concrete barrier 2 and the metal barrier 3, and therefore compensate for differences in elevation between the fixing point of the adapter 12 on the main body 10 and that on the metal barrier 3, facilitating the blending even in the presence of barriers installed at variable elevations with respect to the road surface.

[0105] With reference to the figures 4A, 4B and 4C, further configurations of the adapter 12 are shown, in which the second portion 12b has a double wave shape.

[0106] Such a double wave configuration is particularly adapted for connection with metal barriers 3 of medium capacity (e.g., H1 or H2), which adopt a simpler and more widespread wavy profile.

[0107] In particular, in figures 4A - 4C, a connection adapter 12 is shown in which the longitudinal axis B of the second portion 12b is arranged at a vertical distance d with respect to the anchoring axis A of the first portion 12a, with reference to a laying plane of the device 1.

[0108] Also in this case, the figures 4A, 4B and 4C show variants of the adapter 12 which allow precise adaptation to the profile of the receiving barrier and facilitate alignment between the concrete or cement barrier 2 and the metal barrier 3 to be connected, so that the second portion 12b can be at different heights with respect to the main body 10, by virtue of the inclined or stepped geometry of the transition portion

12c. In particular, these shapes make it possible to adapt to different installation configurations of the metal barrier 3, without the need to modify the structure of the device, nor to employ shims or additional spacers.

[0109] In both series of figures (3A-3C and 4A - 4C), the geometry of the shaped plates 12b is designed to ensure efficient and distributed contact with the lateral surface of the metal barrier 3, contributing to maintaining a uniform transmission of forces in the event of a lateral impact, and, simultaneously, to compensate for height tolerances between the fixing points.

[0110] Figures 5A, 5B and 5C show a further variant of the adapter 12 in which the second portion 12b has a flat conformation, designed to be constrained not to a wavy metal barrier, but rather to a masonry or prefabricated concrete structure, e.g., a bridge abutment, an existing New Jersey barrier or a prefabricated smooth-face barrier.

[0111] This configuration allows the use of device 1 also in contexts in which the receiving barrier does not have a wavy profile, but consists of flat surfaces or rigid containment structures.

[0112] The second portion 12b may in this case comprise a flat metal plate, provided with through holes arranged for direct fixing to the receiving structure, by bolting or chemical-mechanical anchors, compatibly with the type of material and with the regulations in force regarding restraint devices.

[0113] In particular, in figure 5A, a connection adapter 12 is shown in which the longitudinal axis B of the second portion 12b is aligned with respect to the anchoring axis A of the first portion 12a, with reference to an installation plane of the device 1, while in figure 5B and 5C a connection adapter 12 is shown in which the longitudinal axis B of the second portion 12b is arranged at a vertical distance d with respect to the anchoring axis A of the first portion 12a, with reference to a laying plane of the device 1.

[0114] In an embodiment of the three variants shown in figures 5A, 5B and 5C, the first portion 12a of the adapter 12 may include a transition portion 12c, inclined or stepped, such as to position the second portion 12b at different heights with respect to the main body 10, so as to compensate for the differences in height between the attachment point on the device 1 (on the body 10 of the device 1) and the attachment point of the barrier or receiving structure.

[0115] This solution, compatible with the modular device 1 provided by the invention, further increases the versatility of the transition device 1, making it adapted also to hybrid applications or on existing flat infrastructures, without the need for modification or structural adaptation of the preinstalled barriers.

[0116] Therefore, the adoption of the flat adapter 12 allows a certifiable redirection connection also to masonry-type surfaces, while keeping the features of functional continuity and passive safety of the device unchanged.

[0117] The device 1 thus allows precise adaptation to different installation conditions, thus maintaining a structural continuity between the two barrier systems.

[0118] The connection between the second portion 12b and the metal barrier 3 preferably occurs by means of direct bolting, using the standard holes already present on the junction section of the metal barrier 3.

[0119] In an embodiment, the plate 12b has a series of aligned through-holes according to the same center distance provided for fixing the barriers according to EN 1317 standard, so as to ensure the mechanical compatibility with type-approved road devices.

[0120] This configuration makes it possible to avoid structural modifications to the existing barrier 3, maintaining the integrity of the original system and ensuring a reversible, safe and certifiable connection.

[0121] This arrangement meets the interoperability and compatibility requirements prescribed by the European legislation in force concerning road containment devices, and is compliant with the technical indications provided by the manufacturers of the installed barriers.

[0122] The device 1, in use for connecting a concrete road barrier 2 to a metal road barrier 3, may be positioned according to at least two main configurations: in a first configuration, the main body 10 extends in the longitudinal direction parallel to the metal barrier 3.

[0123] This configuration makes it possible to form a rectilinear continuation; it is used as a compensatory barrier, e.g., if a temporary barrier must be blended to a system already installed in a permanent location.

[0124] In a second configuration, the device 1, in use for connecting a concrete road barrier 2 to a metal road barrier 3, may be positioned so that the main body 10 extends in the longitudinal direction at an angle between 5° and 45°, preferably between 10° and 20°, with respect to the axis of the metal road barrier 3, assuming the function of a work zone end treatment, i.e., of an initial element of a sequence of barriers. In this position, the inclination makes it possible to guide the vehicle transiting toward the protected lane, reducing the frontal collision with the end of the barrier. According to a preferred embodiment, the device 1 may be made in two mirror-image versions, namely a right-hand version and a left-hand version, depending on the installation side with respect to the carriageway.

[0125] In particular, the device 1 may be configured to be installed on the right margin or on the left margin of the roadway, ensuring in both cases the same redirection function and structural continuity between the connected barriers.

[0126] This design symmetry allows a wider work zone operational flexibility and reduces the need for geometric adjustments or rotations of the device during installation.

[0127] In an embodiment, the device 1 may be provided with a wheel guard accessory 13, positioned close to the second end 10b of the main body 10, preferably at the base, and configured to prevent the vehi-

cle from passing under the structure in the event of a frontal or lateral impact, contributing to the overall safety of the system.

[0128] A preferred embodiment of the wheel guard accessory 13 is shown in figure 6.

[0129] This accessory is positioned close to the base of the main body 10, in particular at the terminal portion 10b, and extends transversally with respect to the longitudinal direction of the device. The wheel guard 13 is shaped to intercept the lower part of the impacting vehicle, in particular the front or rear wheels in the case of light vehicles, and to deflect its trajectory, preventing intrusion beneath the device. Figure 6 shows a configuration arched and inclined with respect to the road surface, allowing the wheel to be deflected laterally or upwards. This geometry promotes the redirection function and prevents the vehicle from lifting or becoming destabilized in the event of a low-elevation tangential impact.

[0130] The accessory may be made of structural steel or composite material with high energy absorption capacity, and may be fixed by welding, bolting, or by structural interlocks integrated into the main body.

[0131] This element is particularly effective in counteracting the lifting of the vehicle or its vertical instability in the event of tangential impacts at low elevation, contributing to the passive safety of the system.

[0132] It is worth noting that the present invention is also directed to a kit for the manufacture of a transition device 1 for the connection between a concrete barrier and a metal barrier.

[0133] This kit comprises a transition device 1 as described above, with a main body 10 and a plurality of connection adapters 12, configured to be selected as a function of the geometry of the metal barrier 3 to be blended.

[0134] Each adapter 12 as described above, with a first portion 12a having an anchoring axis A, configured to be connected to the second terminal portion 10b of the main body 10, and a second portion 12b extending along a longitudinal axis B and configured to constrain at least laterally at least one portion of the metal barrier 3. The adapters 12 have different geometric configurations, in particular with regard to the position of the longitudinal axis B of the second portion 12b with respect to the anchoring axis A of the first portion 12a, with reference to a laying plane.

[0135] This modular configuration allows the same main body 10 to be used with different adapters depending on the installation conditions, ensuring compatibility with metal barriers having different profiles, elevations, or assembly angles.

[0136] Therefore, the kit is particularly adapted to work zone contexts in which operational flexibility is required, simplifying logistics and ensuring the functional continuity of the road containment system.

Claims

1. A transition device (1) for functionally continuous connection of a concrete road barrier (2) to a metal road barrier (3), comprising:
 - a main body (10) configured to be rigidly connected, at a first terminal portion (10a), to an end of said concrete barrier (2);
 - at least one connection adapter (12) fixed at a second terminal portion (10b) of the main body (10) and comprising a first portion (12a) having an anchoring axis (A), configured to be connected to said second terminal portion (10b) of the main body (10), and a second portion (12b) extending along a longitudinal axis (B) and configured to constrain, at least laterally, at least a portion of said metal barrier (3), wherein said main body (10) comprises at least one outer surface (11), having a curvilinear profile.
2. A device according to claim 1, wherein said second portion (12b) has a conformation which is complementary to the profile of said metal barrier (3), preferably a wavy conformation, or a substantially flat conformation for a wall mounting.
3. A device according to claim 1 or 2, wherein said connection adapter (12) can be formed in one piece, or said first portion (12a) and said second portion (12b) can be formed as separate parts, connected to each other by mechanical assembly.
4. A device according to one of the preceding claims, wherein said first portion (12a) of said connection adapter (12) comprises a shaped plate, having a conformation complementary to said second terminal portion (10b) of the main body (10), preferably an L-shaped conformation or a U-shaped conformation.
5. A device according to one of the preceding claims, wherein said second portion (12b) of said connection adapter (12) comprises a shaped plate, having a conformation complementary to the profile of said metal barrier portion (3), preferably a wavy conformation, or a flat conformation complementary to a flat surface, preferably a masonry surface.
6. A device according to one of the preceding claims, wherein the connection adapter (12) can be selected from a plurality of adapters (12) having different geometric configurations, wherein, in each configuration, the longitudinal axis (B) of the second portion (12b) is aligned with or vertically offset (d) from the anchoring axis (A) of the first portion (12a), with reference to a laying plane of the device
- (1).
7. A device according to one of the preceding claims, wherein the main body (10) is either formed in one piece or obtained by assembling multiple modular elements joined together.
8. A device according to one of the preceding claims, wherein the outer surface (11) of the main body (10) has a blended, curvilinear profile free of sharp edges, and preferably has a radius of curvature comprised between 50mm and 700mm, preferably between 100mm and 500mm, configured to laterally deflect an impacting vehicle.
9. A device according to one of the preceding claims, which, when used to connect a concrete road barrier (2) to a metal road barrier (3), can be positioned in a first configuration in which the main body (10) extends in a longitudinal direction parallel to said metal barrier (3), or in a second configuration in which the main body (10) extends in a longitudinal direction forming an angle comprised between 5° and 45°, preferably between 10° and 20°, with respect to the longitudinal axis of the metal barrier (3).
10. A device according to one of the preceding claims, comprising a wheel guard accessory (13) fixed at the second terminal portion (10b) of the main body (10), preferably near the base of the main body (10), configured to prevent the passage of the vehicle under the device (1) in the event of a collision.
11. An adapter (12) for connecting a concrete road barrier (2) to a metal road barrier (3), comprising:
 - a first portion (12a) having an anchoring axis (A), configured to be connected to at least one surface integrally fixed with the concrete barrier (2);
 - a second portion (12b), extending along a longitudinal axis (B) and configured to at least laterally constrain at least one portion of said metal barrier (3); wherein the conformation of the second portion (12b) is complementary to the profile of said metal barrier (3), preferably a wavy conformation, or a substantially flat conformation.
12. An adapter (12) according to claim 11, wherein the longitudinal axis (B) of the second portion (12b) is aligned with or vertically offset (d) from the anchoring axis (A) of the first portion (12a), with reference to a laying plane.
13. A kit for making a transition device (1) according to one of claims 1 - 11, for functionally continuous

connection of a concrete road barrier (2) to a metal road barrier (3), comprising:

- a main body (10) configured to be fixedly connected, at a first terminal portion (10a), to an end of said concrete barrier (2); 5
- a plurality of connection adapters (12), each comprising a first portion (12a) having an anchoring axis (A) and configured to be connected to a second terminal portion (10b) of the main body (10), and a second portion (12b), which extends along a longitudinal axis (B) and is configured to at least laterally constrain at least one portion of said metal barrier (3), 10 15

wherein said adapters (12) have different geometric configurations, in which the longitudinal axis (B) of the second portion (12b) is aligned with or arranged at a vertical distance (d) from the anchoring axis (A) of the first portion (12a), with reference to a laying plane. 20

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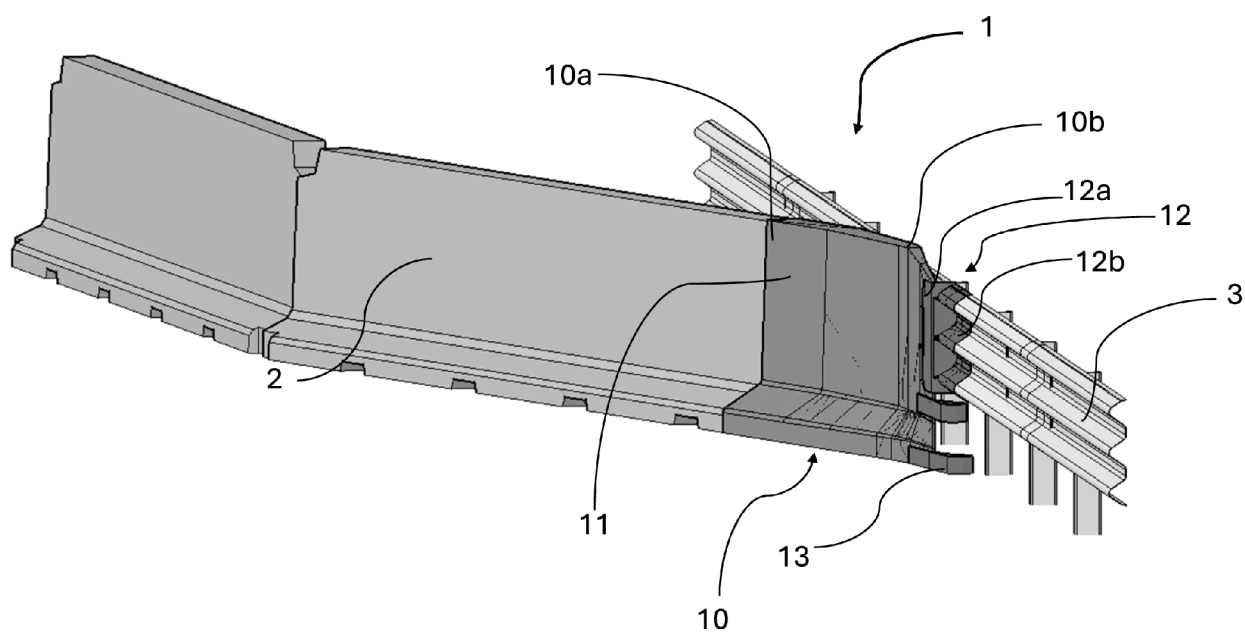
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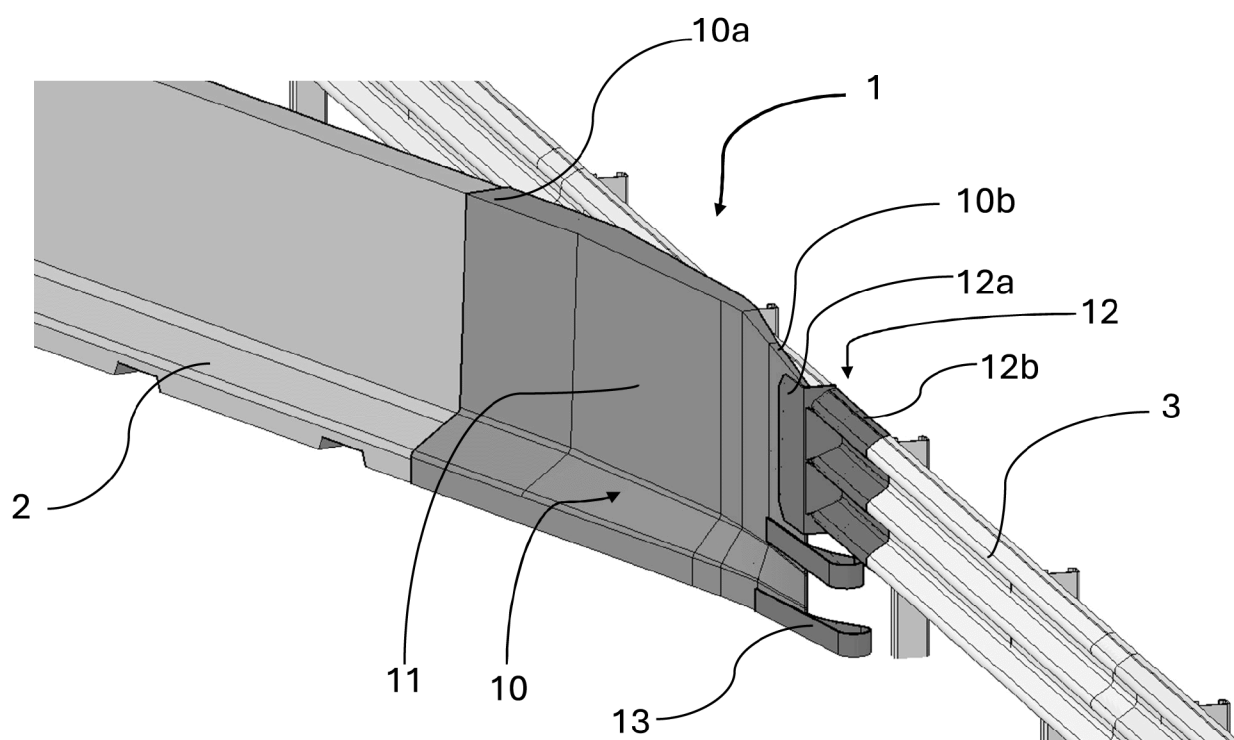


Fig. 1B

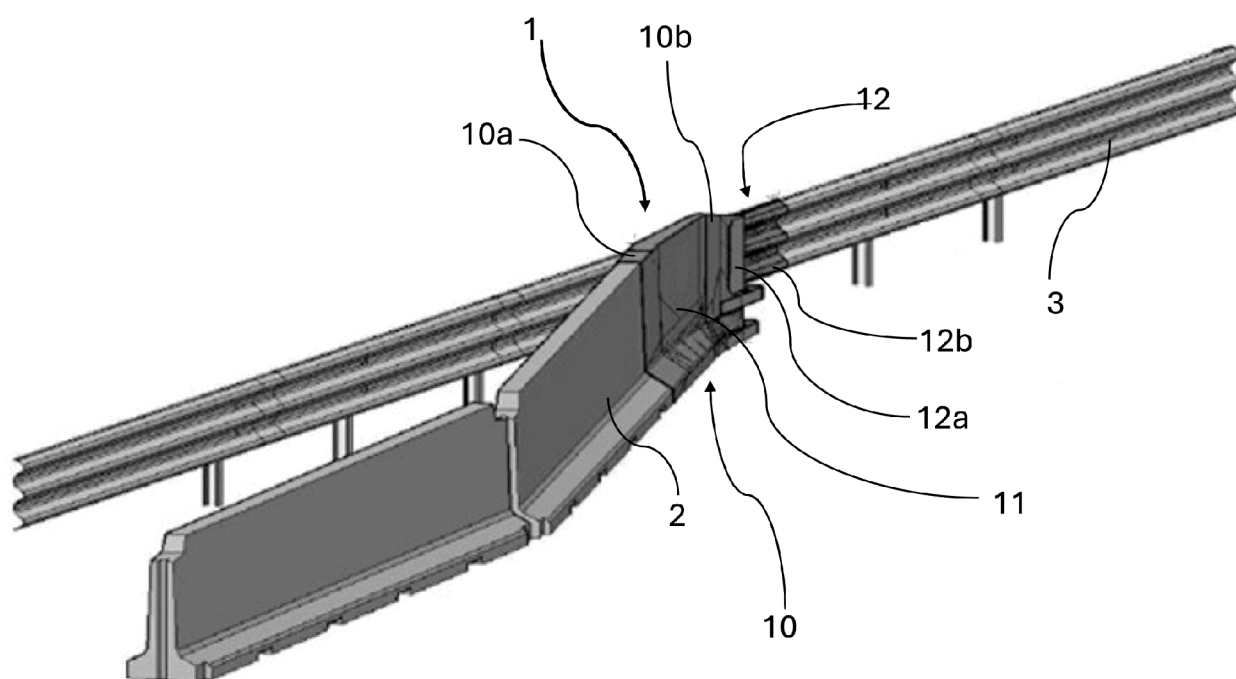


Fig. 2

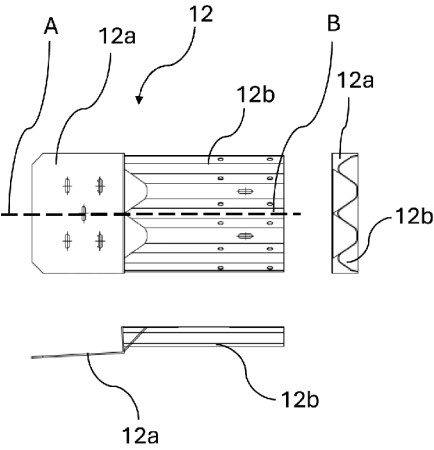


Fig. 3A

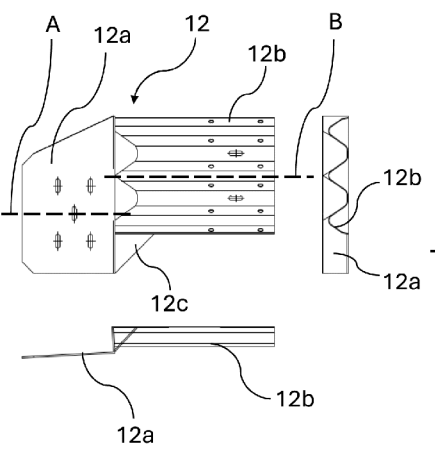


Fig. 3B

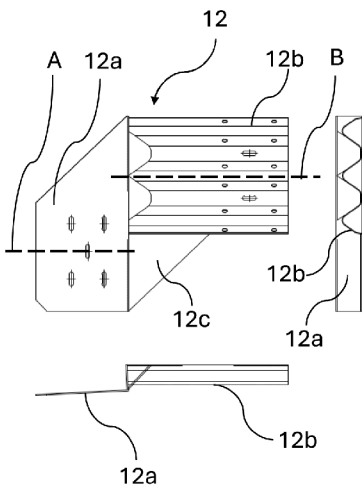


Fig. 3C

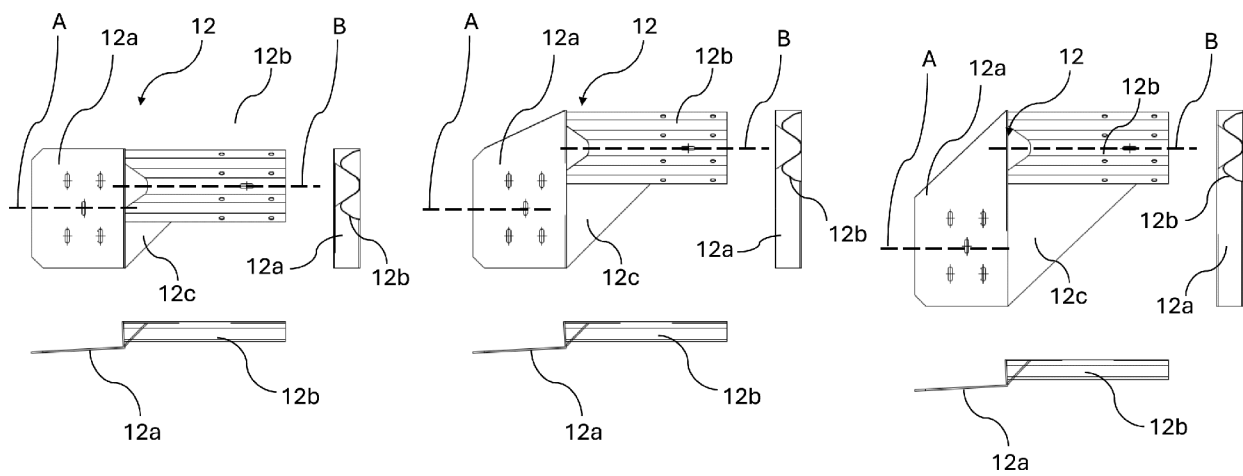


Fig. 4A

Fig. 4B

Fig. 4C

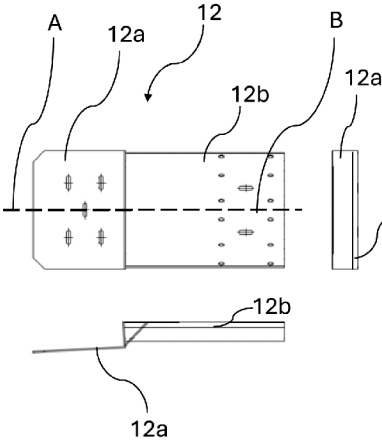


Fig. 5A

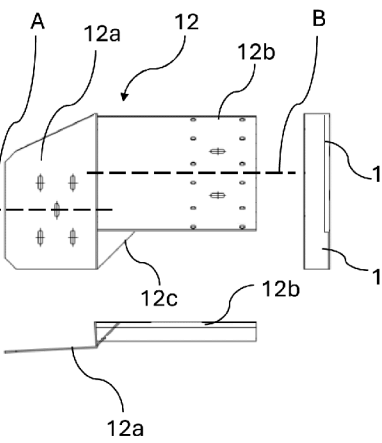


Fig. 5B

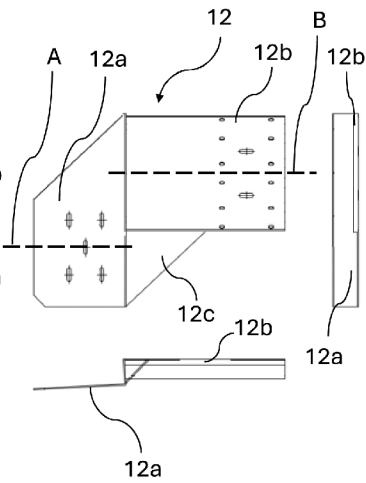


Fig. 5C

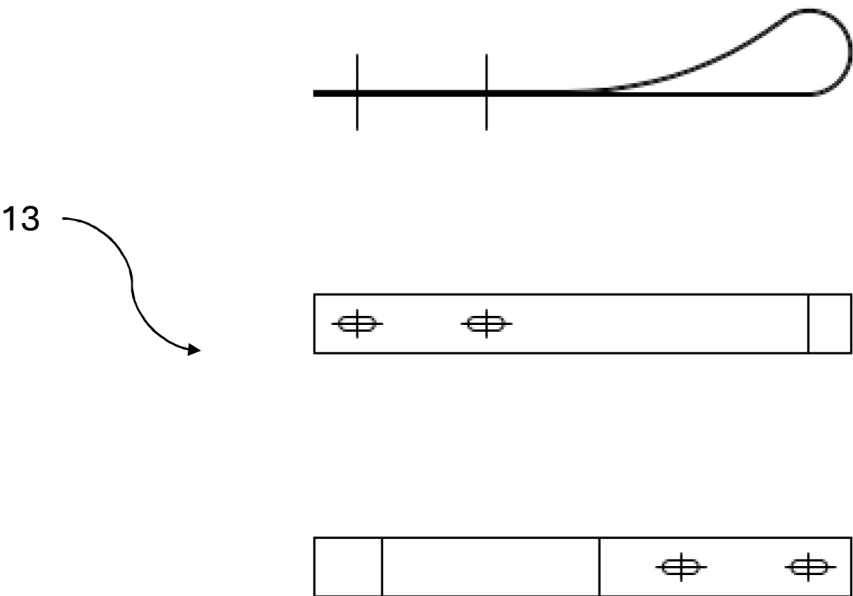


Fig. 6



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Y	* paragraphs [0002], [0006] - [0013], [0022] - [0028] *	9,10	E01F15/08
	* figures 1-6 *		E01F15/04
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Y	* paragraphs [0001], [0005] - [0011], [0016] - [0018], [0027] - [0029], [0040] - [0052] *	9,10	
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	* column 1, lines 17-25 *		
	* column 2, lines 10-14 *		
	* column 2, line 52 - column 3, line 18 *		
	* column 6, line 6 - column 8, line 13 *		

The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 31 July 2026	Examiner Kremsler, Stefan
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