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(71) Applicant: **Gunnar Prefab AB**
795 32 Rättvik (SE)

(72) Inventor: **Kivistö, Daniel**
725 96 Västerås (SE)

(74) Representative: **AWA Sweden AB**
Box 5117
200 71 Malmö (SE)

(54) COUPLING ELEMENT, BARRIER ELEMENT, AND BARRIER

(57) The disclosure relates to a coupling element (10) comprising a coupling portion (30) having a cross-section which comprises a first longitudinal protrusion (40) and a second longitudinal protrusion (50) between them forming an open recess (60) which has a transversely wide bottom portion (61) and a transversely narrow mouth portion (62) and which is configured to receive, by a relative vertical movement between the first and second barrier elements (1, 2), a first protrusion (240) of the corresponding coupling element (210) of the second barrier element (2), wherein the first protrusion (40) has a first portion (41) and a second portion (42) arranged one after the other along the longitudinal direction (L), wherein the first portion (41) has on an inner side a first inclined abutment surface (41a) and the second portion (42) has on an inner side a second inclined abutment surface (42a). Also disclosed is a barrier element (1, 2) and a barrier (300).

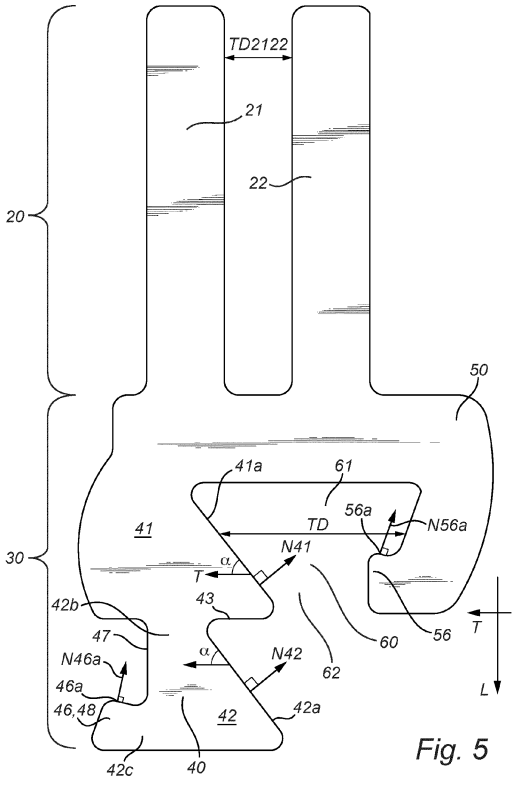

Fig. 5

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Description

Field of invention

[0001] The invention relates to a coupling element configured to form part of a first barrier element and to form part of a connection between the first barrier element and a second barrier element.

[0002] The invention also relates to a barrier element comprising a first and a second coupling element being arranged at a respective end of the barrier element.

[0003] The invention also relates to a barrier comprising a plurality of barrier elements.

Technical Background

[0004] In order to improve road safety, it is common practice to separate different traffic areas from each other by some kind of barrier or separator. Different traffic areas may e.g., be on one side one more lanes of traffic travelling in a first direction and on the other side one or more lanes of traffic travelling in a second, opposite, direction. Barriers may of course be used for various other reasons, such as protecting road vehicles from hazards just outside the road, protecting surrounding environment from the hazard of vehicles leaving the intended lane, providing a safety separation between neighboring lanes, etc. The barrier may be in the form of metal rails, wire rails, or concrete barriers. Concrete barriers are typically formed of elongated barrier elements which are positioned one after the other. The barrier elements of concrete are heavy, and they are typically also interconnected to each other, whereby they form a strong barrier capable of sustaining heavy impacts from vehicles being heavy and/or traveling at high speed.

[0005] One example of such a concrete barrier is disclosed in US 8,388,257 B2. Each barrier element is provided with a respective connecting element at each end face of the barrier element. Each connecting element comprises one leg having hook portions on both transverse sides thereof and one leg having an inwardly facing hook portion. The leg having two hook portions will interact with one hook with a corresponding leg of another connecting element and one hook with the single hook leg of the other connecting element.

[0006] When designing such a connecting element, the designer should preferably take into account several design criteria, such as that the connecting element should be strong, it should be easy to produce, it should be easy to interconnect with similar connecting elements of neighboring barrier elements, and that there should be provided a strong connection between the connecting elements at the opposing ends of the respective barrier element.

[0007] As will be apparent from the following, there is still room for improvements of the design compared to prior art designs.

Summary of invention

[0008] It is an object of the invention to provide a coupling element addressing at least some of the above-mentioned design criteria relating to that the coupling element should be strong, it should be easy to produce, it should be easy to interconnect with similar connecting elements of neighboring barrier elements, and that there should be provided a strong connection between the connecting elements at the opposing ends of the respective barrier element.

[0009] This object has been achieved by a coupling element configured to form part of a first barrier element and to form part of a connection between the first barrier element and a second barrier element, the coupling element being configured to extend along a longitudinal direction from the first barrier element to a free end of the coupling element, the coupling element comprising as seen along the longitudinal direction :

an attachment portion by which the coupling element is configured to be attached to the barrier element, and

a coupling portion by which the coupling element is configured to couple with a corresponding coupling element of the second barrier element,

wherein the coupling portion has as seen from above a cross-section which comprises:

a first longitudinal protrusion and a second longitudinal protrusion being arranged at a mutual transverse distance from each other and between them forming an open recess which has a transversely wide bottom portion and a transversely narrow mouth portion and which is configured to receive, by a relative vertical movement between the first and second barrier elements, a first protrusion of the corresponding coupling element of the second barrier element,

wherein the first protrusion has a first portion and a second portion arranged one after the other along the longitudinal direction, wherein the first portion has on an inner side a first inclined abutment surface and the second portion has on an inner side a second inclined abutment surface, the first and second inclined abutment surfaces each facing in a respective normal direction which has a component along the transverse direction being directed towards the second protrusion and a component along the longitudinal direction being directed towards the attachment portion, the first inclined abutment surface being configured to abut a second abutment surface of the coupling element of the second barrier element and the second inclined abutment surface being configured to abut a first abutment surface of the coupling element of the second barrier element,

wherein the first inclined abutment surface forms part of one side of the recess having the transversely wide bottom portion and the transversely narrow mouth portion,

wherein the second portion has a transversely narrow root portion and a transversely wide end portion allowing the second portion to be received, by a vertical relative movement between the first and second barrier elements, in an open recess of the coupling element of the second barrier element having a transversely wide bottom portion and a transversely narrow mouth portion and preventing the second portion from being removed from said recess of the coupling element of the second barrier element in a longitudinal relative movement.

[0010] One advantage with this design is that the two inclined abutment surfaces are capable of transferring high loads between interconnected coupling elements. Moreover, the two inclined abutment surfaces will transfer load both by the inclined surfaces of the respective coupling element blocking each other's paths and by frictionally engaging each other whereby there will be a smooth load build-up. Moreover, the concept of having inclined abutment surfaces also makes the design comparably insensitive to deviations in shape. This makes it possible to have comparably wide tolerances, which in turn facilitates and reduces costs associated with manufacture. Moreover, the comparable insensitivity to deviations also makes the system robust in the sense that it is capable of providing the intended function although the barriers are misaligned due to misplacement and/or due to the fact that they accommodate a curve or the like in the road where they are positioned. Moreover, the comparably insensitivity also makes the system robust in the sense that it is capable of withstanding high loads also when being deformed by e.g., a vehicle having crashed into the barriers.

[0011] It may in this context be noted that the coupling element should be able to withstand transversely directed forces but that typically the dimensioning force will be a longitudinally acting force since any impact onto the barrier will tend to lead to a slightly transversal displacement of the barrier which in turn will basically be transformed into a tendency of a longitudinal separation of neighboring barrier elements.

[0012] In this context, longitudinal refers to the direction along which the barrier element extends between the coupling elements at each end of the barrier element. The longitudinal direction typically extends along the ground. The transversal direction is transverse to the longitudinal direction and typically extends along the ground. From above refers to a direction directed downwardly along the normal to the ground. If the barrier element is positioned on a flat horizontal surface, the longitudinal and the transverse directions will typically be horizontal and the direction from above will typically be downwardly along vertical. In the description below, reference to directions will for clarity reason typically be referred to as if the barrier element is positioned on a flat horizontal surface.

[0013] The inner side of the first protrusion refers in this context to the side facing the recess of said coupling element. The inner side of the first protrusion of a first coupling element will in installed state face an inner side of a first protrusion of a coupling element of another barrier element. Outer side is the other side of the first protrusion compared to the inner side. The outer side of the second portion of the first protrusion of a first coupling element will in installed state face a second protrusion of a coupling element of another barrier element.

[0014] The coupling elements of the two neighboring barrier elements are configured to be coupled together by one of the barrier elements, such as the second barrier element, being moved vertically relative to the other barrier element. Typically, the barrier elements are moved into the intended position one after the other by a crane or the like. The barrier elements are lifted up from a trailer or the like and are lowered into position such that the coupling element of the second barrier element becomes coupled with the coupling element of the first barrier element. As mentioned above, the cross-section disclosed is as seen from above, i.e., typically downwardly along vertical. The coupling elements have essentially uniform cross-section along vertical. In the preferred embodiment, they have uniform cross-section along vertical. However, it is conceivable that there is a slight variation of the cross-section along vertical, e.g., such that there is a larger play when the lower portion of the coupling element of the second barrier element is initially engaging the upper portion of the coupling element of the first barrier element compared to the play being present when the barriers assume their intended positions at about the same height. Also, the first barrier may have a coupling element being provided with a bottom portion forming a floor or the like below the portion interacting with the coupling element of the second barrier. Correspondingly or alternatively, the second barrier element may have a coupling element being provided with a top portion forming a lid or the like above the portion interacting with the coupling element of the first barrier. However, any such additional parts or portions will typically make the barrier elements asymmetric such that they have one coupling element of each kind in respective end which makes it necessary to always interconnect this specific combination of coupling elements with each other, which in turn means that every barrier element can only be oriented in one correct direction. In the preferred embodiment, the coupling elements and respective barrier element are symmetrical and preferably also identical in the sense that a second barrier element can be coupled to a first barrier element irrespective of which ends of the first barrier element and second barrier element are combined with each other. It may in this context be noted that the different features, portions, parts, details, etc. of the coupling element disclosed above and, in the follow-

ing, typically refers to the design of the cross-section as seen from above.

[0015] With this design with an open recess which has a transversely wide bottom portion and a transversely narrow mouth portion in combination with the second portion has a transversely narrow root portion and a transversely wide end portion allowing the second portion to be received, by a vertical relative movement between the first and second barrier elements, in an open recess of the coupling element of the second barrier element having a transversely wide bottom portion and a transversely narrow mouth portion and preventing the second portion from being removed from said recess of the coupling element of the second barrier element in a longitudinal relative movement it is secured that the barriers elements are maintained in the correct position and there is also provided a locking functionality such that the inclined abutment surfaces at kept in contact with each other in case there is a vehicle crashing into the barrier.

[0016] It may be noted that it is preferred that the first and second inclined abutment surfaces are as seen in the cross-sectional view formed of a straight line. Thereby, the first and second inclined abutment surfaces will form planar surfaces. Preferably, the planar surfaces extends along vertical.

[0017] The second protrusion may have on a side forming part of the recess a hook portion with an abutment surface which faces in a direction which has a component along the transverse direction being directed away from the first protrusion and a component along the longitudinal direction being directed towards the attachment portion. With this design there is provided a hook functionality whereby an increased force pulling the two interconnected coupling elements apart along the longitudinal direction will tend to make the engagement even firmer, and it will maintain its contact until there is a force and associated deformation sufficient to release the hook functionality. Thereby, the second protrusion will firmly maintain the second portion of the first protrusion inside the recess, which in turn will securely keep the inclined abutment surfaces of the two interconnected coupling elements in contact with each other.

[0018] Preferably, the first protrusion has on an outer side of the second portion a hook portion with an abutment surface which faces in a direction which has a component along the transverse direction being directed towards the second protrusion and a component along the longitudinal direction being directed towards the attachment portion, the hook portion of the second portion being configured to interact with a hook portion of the second protrusion of the coupling element of the second barrier element. It is advantageous that also the first protrusion has a corresponding hook functionality. Thereby, the advantage provided by the hook functionality of the second protrusion is even more pronounced.

[0019] It may in this context be noted that a hook portion of any of the first and second portion may alternatively interact with a transversally extending abutment surface of the other member. It may in this context also be noted that the hook portions may altogether be replaced with transversally extending abutment surfaces on both the first and second protrusion. However, it is preferred that at least one of the first and/or second protrusion is provided with a hook portion interacting with a transversally extending surface and it is most preferred that both the first and second protrusion are provided with a respective hook portion.

[0020] Preferably, the transversely narrow root portion of the second portion is formed by the second portion being provided with a recess on an outer side of the second portion and by the second inclined abutment surface on an inner side of the second portion. The recess allows a portion of the second protrusion of the other coupling element to extend around the transversely wide end portion of the first protrusion. Moreover, there is made efficient use of available space to provide a strong coupling element.

[0021] Preferably, the transversely wide end portion of the second portion is formed by a transversely extending protrusion on an outer side of the second portion and by the second inclined abutment surface on an inner side of the second portion. With this design there is made efficient use of available space to provide a strong coupling element. It may in this context be noted that in the preferred embodiment, the protrusion may also be said to form the basis of the hook portion or that the hook portion forms part of the protrusion. It may also be noted that the abutment surface of the hook portion forms part of the recess.

[0022] The first and second inclined abutment surfaces may each form an angle α relative to the transversal direction, the angle α being between 40-65°, preferably between 45-60°. It may be noted that the angle α of the first inclined abutment surface may be the same or may be different from the angle α of the second inclined abutment surface. It is preferred that if the inclined abutment surfaces have different angles α the difference between them is less than 5°. As indicated, it is preferred that the inclined surfaces are inclined such that their respective angle is about 45°; slightly below or a bit larger than 45°, preferably between 40-65°. It is more preferred that the angle α is between 45-60°. It may in this context be noted that it is more preferred that the angle α is greater than 45° but not too large, i.e., greater than 45° but only up to 65°, preferably only up to 60°.

[0023] Most preferably, the first inclined abutment surface is angled an angle α between 50-55° and the second inclined abutment surface is angled an angle α between 51-56°, preferably with the second inclined abutment surface being angled about 0-2° more than the first inclined abutment surface. The reason for the angles preferably being slightly different is that when a vehicle hits the side of the barrier, the barrier elements and thereby the two coupling elements are typically slightly pivoted relative to each other and the preferred slight difference in

angles allows the inclined surfaces to be oriented close to parallel also in such a scenario, whereby a strong interconnection will be accomplished independently of the different incident scenarios.

[0024] The attachment portion may, as seen from above, have a cross-section which comprises a first and a second longitudinally extending leg. The provision of legs provides anchor points by which the coupling element may by secured to the barrier element. Preferably, the longitudinally extending legs arranged at a mutual transverse distance from each other. Thereby, the capability of taking up a transversely directed force to the coupling element is improved.

[0025] The above-mentioned object has also been achieved by a barrier element comprising a first coupling element and a second coupling element, each being of a kind disclosed above, wherein the first and second coupling elements are arranged at a respective end of the barrier element.

[0026] Advantages associated with the various features have been discussed above with reference to the coupling element, and those are equally applicable to the barrier element. The various embodiments disclosed with reference to the coupling element are equally applicable to the barrier element.

[0027] Preferably, the barrier element is designed such that the first coupling element is positioned and oriented as viewed towards a first end of the barrier equal to a position and orientation of the second coupling element as viewed towards a second end of the barrier such that the barrier element presents a coupling element of the same position and orientation independently of if the first end or the second end is presented to another barrier element.

[0028] The barrier element may further comprise one or more interconnecting rods extending between and being fixed to the first and second coupling elements. Thereby, a strong connection between the first and second coupling elements may be achieved.

[0029] Preferably, said one or more interconnecting rods includes at least two interconnecting rods extending along each other and at a mutual distance from each other along the transverse direction and/or along a height direction. Preferably, the barrier element comprises four interconnecting rods extending along each other with a first pair of rods extending along each other at a mutual distance from each other along the transverse direction and a second pair of rods extending along each other at a mutual distance from each other along the transverse direction where the first pair of rods extends at a first height and the second pair of rods extends at a second height such that there is along the height direction formed a distance between the rods of the first pair and the rods of the second pair. Thereby, a strong interconnection between the first and second coupling elements is accomplished both with respect to transversally directed forces and with respect to vertically directed forces.

[0030] Preferably, the barrier element further comprises a body of concrete, wherein the first and second coupling elements are preferably interconnected via one or more interconnecting rods extending within said body of concrete. Thereby, it is possible to provide a barrier element which provides the intended barrier effect both due to the barrier element being heavy and due to the barrier element having a strong internal force distribution from coupling element to coupling element.

[0031] The above-mentioned object has also been achieved by a barrier comprising a plurality of barrier elements of the kind disclosed above, wherein the barrier elements are arranged one after the other along the longitudinal direction and being interconnected with neighboring barrier elements via the respective coupling elements.

[0032] Advantages associated with the various features have been discussed above with reference to the coupling element, and those are equally applicable to the barrier. The various embodiments disclosed with reference to the coupling element are equally applicable to the barrier.

[0033] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

[0034] The invention may also in short be said to relate to a coupling element comprising a coupling portion having a cross-section which comprises a first longitudinal protrusion and a second longitudinal protrusion between them forming an open recess which has a transversely wide bottom portion and a transversely narrow mouth portion and which is configured to receive, by a relative vertical movement between first and second barrier elements, a first protrusion of a corresponding coupling element of the second barrier element, wherein the first protrusion has a first portion and a second portion arranged one after the other along the longitudinal direction, wherein the first portion has on an inner side a first inclined abutment surface and the second portion has on an inner side a second inclined abutment surface. Also disclosed is a barrier element and a barrier.

Brief description of the drawings

[0035] The invention will by way of example be described in more detail with reference to the appended schematic drawings, which shows a presently preferred embodiment of the invention.

Figure 1 discloses a road with a barrier formed of two barrier elements positioned along a side of the road.
Figure 2 is a view from above of an end of a barrier

element and discloses a coupling element.

Figure 3 is a perspective view and discloses an interconnecting system by which two coupling elements at each end of a barrier element are interconnected.

Figures 4a-c discloses different views of a coupling element and connection rods attached thereto.

Figure 5 is a planar view and discloses a coupling element as viewed from above.

Figure 6 discloses two coupling elements each connected to a respective barrier element being in a coupled state as viewed from above.

Detailed description of preferred embodiments

[0036] With reference to Fig. 1, there is disclosed a barrier 300 comprising a plurality of barrier elements 1, 2. The barrier elements 1, 2 are arranged one after the other along a longitudinal direction L. The barrier elements 1, 2 are interconnected via respective coupling elements 10, 110, 210. Respective barrier element 1, 2 is provided with a coupling element 1, 110, 210 at both respective ends thereof.

[0037] The respective barrier element 1 is designed such that the first coupling element 10 is positioned and oriented as viewed towards a first end of the barrier 1, 2 equal to a position and orientation of the second coupling element 110 as viewed towards a second end of the barrier 1 such that the barrier element 1 presents a coupling element 10, 110 of the same position and orientation independently of if the first end or the second end is presented to another barrier element 2.

[0038] In the following, a coupling element 10 provided at an end of a first barrier element 1 will be disclosed in detail. In the preferred embodiment, there is an identical coupling element 110 at the opposite end of the barrier element 1. In the preferred embodiment, the barrier 300 is formed of a plurality of such barrier elements 1 arranged one after the other. Thus, the disclosure related to the coupling element 10 is equally applicable to the other coupling element 110 of the first barrier element 1 and is also applicable to the other barrier elements 2 forming the barrier 300. In practice, the barrier 300 may extend several kilometers formed of such barrier elements 1, 2 arranged one after the other. It may also be noted that the barrier 300 may be provided with other kind barrier elements e.g., at ends of the barrier.

[0039] As is best shown in Figs. 2 and 3, the coupling element 10 is preferably partially embedded in the body of the barrier element 1. The body of the barrier element 1, 2 is typically formed of concrete. The body of the barrier element 1 is elongated and has an essentially triangularly shaped cross-section with one side forming the base resting on the road or ground and one pointy end forming an upper edge of the barrier element 1. Typically, the upper end has a cross-section shaped with an at least partly rectangular shape on top of the triangle rather than just ending as a corner of the triangle. The first and second coupling elements 10, 110 are preferably interconnected via one or more interconnecting rods 90a-d extending within said body of concrete. The interconnecting rods 90a-d are fixed to the respective coupling element 10, 110, such as by welding. The coupling elements 10, 110 and the interconnecting rods 90a-d are located in an upper portion of the cross-section of the barrier element 1. The coupling elements 10, 110 and the interconnecting rods 90a-d are located in the upper most 50%, preferably upper most 30%, of the height H of the barrier element 1.

[0040] In the embodiment shown in detail in Fig. 2, the end of the body of the barrier element 1 is provided with a recess 1a and the coupling element 10 is slightly withdrawn backwardly into the body of the barrier element 1. In the preferred embodiment, it is withdrawn such that the coupling element 210 of the other barrier element 2 will extend slightly past the end face of the barrier element 1.

[0041] The coupling element 10 has, as seen along the longitudinal direction L, an attachment portion 20 by which the coupling element 10 is configured to be attached to the barrier element 1, and a coupling portion 30 by which the coupling element 10 is configured to couple with a corresponding coupling element 210 of the second barrier element 2. As indicated in Fig. 2, the coupling element 10 may be positioned such that a rear most part of the coupling portion 30 is partially embedded in the body of the barrier element 1. The attachment portion 20 is preferably fully embedded in the body of the barrier element 1.

[0042] As is best shown in Figs. 4a-c, the attachment portion 20 preferably has, as seen from above V, a cross-section which comprises a first and a second longitudinally extending leg 21, 22. Preferably, the longitudinally extending legs 21, 22 arranged at a mutual transverse distance TD2122 from each other. It may in this context be noted that in the preferred embodiment, the coupling element 10 has a uniform cross-section along the height direction HD or alternatively expressed along the vertical direction V. Thus, the legs 21, 22 are basically shaped as two plates extending along the complete height of the coupling element 10.

[0043] As is best shown in Figs. 3, and 4a-c, there are four interconnecting rods 90a-d extending along each other. A first pair of rods 90a-b extend along each other at a mutual distance from each other along the transverse direction T and a second pair of rods 90c-d extend along each other at a mutual distance from each other along the transverse direction T. The first pair of rods 90a-b extends at a first height H90a and the second pair of rods 90c-d extends at a second height H90c such that there is along the height direction formed a distance between the rods 90a-b of the first pair and the rods 90c-d of the second pair. The interconnecting rods 90a-d are positioned on top of and beneath the respective leg 21, 22, respectively, such that there is an overlap in extension between the interconnecting rods 90a-d and the respective leg 21, 22. This facilitates provision of a strong connection, such as a

strong weld.

[0044] In the following the cross-section of the coupling portion 30 as seen from above V will be disclosed in detail with reference to Fig. 5.

[0045] The coupling portion 30 has a cross-section which comprises a first longitudinal protrusion 40 and a second longitudinal protrusion 50 being arranged at a mutual transverse distance TD from each other. The first protrusion 40 may also be referred to as a leg or shank, especially considering that it has an extension along the longitudinal direction L being greater than its extension along a transverse direction T. In view of its position in the coupling it may also be labelled as inner or central. Thus, it may e.g., be referred to as central longitudinal protrusion 40, central leg 40, or the like. The second protrusion 50 may also be referred to as hook 50 considering its basic shape. In view of its position in the coupling it may also be labelled as outer. Thus, it may e.g., be referred to as outer longitudinal protrusion 50, outer hook 50, outer longitudinal hook 50, or the like.

[0046] The first and second longitudinal protrusions 40, 50 form between them an open recess 60. The open recess 60 has a transversely wide bottom portion 61 and a transversely narrow mouth portion 62. The open recess 60 is configured to receive, by a relative vertical movement between the first and second barrier elements 1, 2, a first protrusion 240 of the corresponding coupling element 210 of the second barrier element 2.

[0047] The first protrusion 40 has a first portion 41 and a second portion 42 arranged one after the other along the longitudinal direction L. The first portion 41 has on an inner side a first inclined abutment surface 41a. The first inclined abutment surface 41a faces in a normal direction N41 which has a component along the transverse direction T being directed towards the second protrusion 50 and a component along the longitudinal direction L being directed towards the attachment portion 20. The second portion 42 has on an inner side a second inclined abutment surface 42a. The second inclined abutment surface 42a faces in a normal direction N42 which has a component along the transverse direction T being directed towards the second protrusion 50 and a component along the longitudinal direction L being directed towards the attachment portion 20. As is best shown in Fig. 6, the first inclined abutment surface 41a is configured to abut a second abutment surface 242a of the coupling element 210 of the second barrier element 2 and the second inclined abutment surface 42a is configured to abut a first abutment surface 241a of the coupling element 210 of the second barrier element 2.

[0048] The first and second inclined abutment surfaces 41a, 42a each form an angle α relative to the transversal direction T. Preferably, the angle α is between 40-65°, more preferably between 45-60°. In the preferred embodiment, the first inclined abutment surface 41a is angled an angle α between 50-55° and the second inclined abutment surface 42a is angled an angle α between 51-56°, preferably with the second inclined abutment surface 42a being angled about 0-2° more than the first inclined abutment surface 41a. On the inner side of the first longitudinal protrusion 40, first and second inclined abutment surfaces 41a, 42a are interconnected by a surface 43, which preferably is a transversally extending surface. In the preferred embodiment, the first and second inclined abutment surfaces 41a, 42a have essentially the same transversal extension, but they are located at two different longitudinal positions. It may also be expressed as that the first and second inclined abutment surfaces 41a, 42a form, as seen along the longitudinal direction, a first slope from a first transversal position at the wide bottom portion 61 of the recess 60 to a second transversal position at the narrow mouth portion 62 of the recess followed by a step back to the first transversal position formed by the surface 43, and then a second slope once again from the first transversal position to the second transversal position.

[0049] As is best shown in Fig. 5, the first inclined abutment surface 41 forms part of one side of the recess 60 having the transversely wide bottom portion 61 and the transversely narrow mouth portion 62.

[0050] The second portion 42 has a transversely narrow root portion 42b and a transversely wide end portion 42c allowing the second portion 42 to be received, by a vertical relative movement between the first and second barrier elements 1, 2, in an open recess 260 of the coupling element 210 of the second barrier element 2 having a transversely wide bottom portion 261 and a transversely narrow mouth portion 262 and preventing the second portion 42 from being removed from said recess 260 of the coupling element 210 of the second barrier element 2 in a longitudinal relative movement.

[0051] The coupling elements 10, 210 of the two neighboring barrier elements 1, 2 are configured to be coupled together by one of the barrier elements, such as the second barrier element 2, being moved vertically relative to the other barrier element 1. Typically, the barrier elements 1, 2 are moved into the intended position one after the other by a crane or the like. The barrier elements 1, 2 are lifted up from a trailer or the like and are lowered into position such that the coupling element 210 of the second barrier element 2 becomes coupled with the coupling element 10 of the first barrier element 1. As mentioned above, the cross-section disclosed is as seen from above, i.e., typically downwardly along vertical.

[0052] Preferably, the second protrusion 50 has on a side forming part of the recess 60 a hook portion 56. The hook portion 56 has an abutment surface 56a which faces in a direction N56a which has a component along the transverse direction T being directed away from the first protrusion 40 and a component along the longitudinal direction L being directed towards the attachment portion 20.

[0053] Preferably, the first protrusion 40 has on an outer side of the second portion 42 a hook portion 46. The hook portion 46 has an abutment surface 46a which faces in a direction N46a which has a component along

the transverse direction T being directed towards the second protrusion 50 and a component along the longitudinal direction L being directed towards the attachment portion 20. As shown in Fig. 6, the hook portion 46 of the second portion 42 is configured to interact with a hook portion 256 of the second protrusion 250 of the coupling element 210 of the second barrier element 2, and vice versa.

[0054] In the preferred embodiment, the transversely narrow root portion 42b of the second portion 42 is formed by the second portion 42 being provided with a recess 47 on an outer side of the second portion 42 and by the second inclined abutment surface 42 on an inner side of the second portion 42. The recess 47 allows a portion 256 of the second protrusion 250 of the other coupling element 210 to extend around the transversely wide end portion 42c of the first protrusion 40.

[0055] In the preferred embodiment, the transversely wide end portion 42c of the second portion 42 is formed by a transversely extending protrusion 48 on an outer side of the second portion 42 and by the second inclined abutment surface 42 on an inner side of the second portion 42. It may in this context be noted that in the preferred embodiment, the protrusion 48 may also be said to form the basis of the hook portion 46 or that the hook portion 46 forms part of the protrusion 48. It may also be noted that the abutment surface 46a of the hook portion 46 forms part of the recess 47.

[0056] It is contemplated that there are numerous modifications of the embodiments described herein, which are still within the scope of the invention as defined by the appended claims.

[0057] The angle α of the first and second inclined abutment surfaces 41a, 42a relative to the transversal direction T may e.g., be between 40-65°, preferably between 45-60°. The angle α of the first inclined abutment surface 41a may be the same or may be different from the angle α of the second inclined abutment surface 42a. It is preferred that if the inclined abutment surfaces 41a, 42a have different angles α the difference between them is less than 5°. As indicated, it is preferred that the inclined surfaces 41a, 42a are inclined such that their respective angle is in the neighborhood of about 45°; slightly below or a bit larger than 45°, preferably between 40-65°. It is more preferred that the angle α is between 45-60°. It may in this context be noted that it is more preferred that the angle α is greater than 45° but not too large, i.e., greater than 45° but only up to 65°, preferably only up to 60°.

[0058] Additionally, variations to the disclosed embodiments can be understood and effected by the skilled person in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage.

Claims

1. Coupling element (10) configured to form part of a first barrier element (1) and to form part of a connection between the first barrier element (1) and a second barrier element (2), the coupling element (10) being configured to extend along a longitudinal direction (L) from the first barrier element (1) to a free end of the coupling element (10), the coupling element (10) comprising as seen along the longitudinal direction (L):

an attachment portion (20) by which the coupling element (10) is configured to be attached to the barrier element (1), and
a coupling portion (30) by which the coupling element (10) is configured to couple with a corresponding coupling element (210) of the second barrier element (2),
wherein the coupling portion (30) has as seen from above (V) a cross-section which comprises:

a first longitudinal protrusion (40) and a second longitudinal protrusion (50) being arranged at a mutual transverse distance (TD) from each other and between them forming an open recess (60) which has a transversely wide bottom portion (61) and a transversely narrow mouth portion (62) and which is configured to receive, by a relative vertical movement between the first and second barrier elements (1, 2), a first protrusion (240) of the corresponding coupling element (210) of the second barrier element (2),
wherein the first protrusion (40) has a first portion (41) and a second portion (42) arranged one after the other along the longitudinal direction (L), wherein the first portion (41) has on an inner side a first inclined abutment surface (41a) and the second portion (42) has on an inner side a second inclined abutment surface (42a), the first and second inclined abutment surfaces (41a, 42a) each facing in a respective normal direction (N41, N42) which has a component along the transverse direction (T) being directed towards the second protrusion (50) and a component along the longitudinal direction (L) being directed towards the attachment portion (20), the first inclined abutment surface (41a) being configured to abut a second abutment surface (242a) of the coupling element (210) of the second

barrier element (2) and the second inclined abutment surface (42a) being configured to abut a first abutment surface (241a) of the coupling element (210) of the second barrier element (2),
wherein the first inclined abutment surface (41) forms part of one side of the recess (60) having the transversely wide bottom portion (61) and the transversely narrow mouth portion (62),
wherein the second portion (42) has a transversely narrow root portion (42b) and a transversely wide end portion (42c) allowing the second portion (42) to be received, by a vertical relative movement between the first and second barrier elements (1, 2), in an open recess (260) of the coupling element (210) of the second barrier element (2) having a transversely wide bottom portion (261) and a transversely narrow mouth portion (262) and preventing the second portion (42) from being removed from said recess (260) of the coupling element (210) of the second barrier element (2) in a longitudinal relative movement.

2. Coupling element (10) according to claim 1, wherein the second protrusion (50) has on a side forming part of the recess (60) a hook portion (56) with an abutment surface (56a) which faces in a direction (N56a) which has a component along the transverse direction (T) being directed away from the first protrusion (40) and a component along the longitudinal direction (L) being directed towards the attachment portion (20).

3. Coupling element (10) according to claim 2, wherein the first protrusion (40) has on an outer side of the second portion (42) a hook portion (46) with an abutment surface (46a) which faces in a direction (N46a) which has a component along the transverse direction (T) being directed towards the second protrusion (50) and a component along the longitudinal direction (L) being directed towards the attachment portion (20), the hook portion (46) of the second portion (42) being configured to interact with a hook portion (256) of the second protrusion (250) of the coupling element (210) of the second barrier element (2).

4. Coupling element (10) according to any one of claims 1-3, wherein the transversely narrow root portion (42b) of the second portion (42) is formed by the second portion (42) being provided with a recess (47) on an outer side of the second portion (42) and by the second inclined abutment surface (42) on an inner side of the second portion (42).

5. Coupling element (10) according to any one of claims 1-4, wherein the transversely wide end portion (42c) of the second portion (42) is formed by a transversely extending protrusion (48) on an outer side of the second portion (42) and by the second inclined abutment surface (42) on an inner side of the second portion (42).

6. Coupling element (10) according to any one of claims 1-5, wherein the first and second inclined abutment surfaces (41a, 42a) each forms an angle α relative to the transversal direction (T), the angle α being between 40-65°, preferably between 45-60°.

7. Coupling element (10) according to any one of claims 1-6, wherein the attachment portion (20) has as seen from above (V) a cross-section which comprises:
a first and a second longitudinally extending leg (21, 22) being arranged at a mutual transverse distance (TD2122) from each other.

8. Barrier element (1, 2) comprising

a first coupling element (10) according to any one of claims 1-7, and
a second coupling element (110) according to any one of claims 1-7,
wherein the first and second coupling elements (10, 110) are arranged at a respective end of the barrier element (1, 2).

9. Barrier element (1, 2) according to claim 8, wherein the first coupling element (10) is positioned and oriented as viewed towards a first end of the barrier (1, 2) equal to a position and orientation of the second coupling element (110) as viewed towards a second end of the barrier (1, 2) such that the barrier element (1, 2) presents a coupling element (10, 110) of the same position and orientation independently of if the first end or the second end is presented to another barrier element (2).

10. Barrier element (1, 2) according to claim 8 or 9, further comprising one or more interconnecting rods (90a-d) extending between and being fixed to the first and second coupling elements (10, 110).

11. Barrier element (1, 2) according to claim 10, wherein said one or more interconnecting rods (90a-d) includes at least two interconnecting rods (90a-d) extending along each other and at a mutual distance from each other along the transverse direction (T) and/or along a height direction (HD), wherein preferably the barrier element (1, 2) comprises four interconnecting rods (90a-d) extending along each other with a first pair of rods (90a-b) extending along each other at a mutual distance from each other

along the transverse direction (T) and a second pair of rods (90c-d) extending along each other at a mutual distance from each other along the transverse direction (T) where the first pair of rods (90a-b) extends at a first height (H90a) and the second pair of rods (90c-d) extends at a second height (H90c) such that there is along the height direction formed a distance between the rods (90a-b) of the first pair and the rods (90c-d) of the second pair.

12. Barrier element (1, 2) according to any one of claims 8-11, further comprising a body of concrete, wherein the first and second coupling elements (10, 110) are preferably interconnected via one or more interconnecting rods (90a-d) extending within said body of concrete.

13. Barrier (300) comprising a plurality of barrier elements (1, 2) according to any one of claims 8-12, the barrier elements (1, 2) being arranged one after the other along the longitudinal direction (L) and being interconnected with neighboring barrier elements (1, 2) via the respective coupling elements (10, 110, 210).

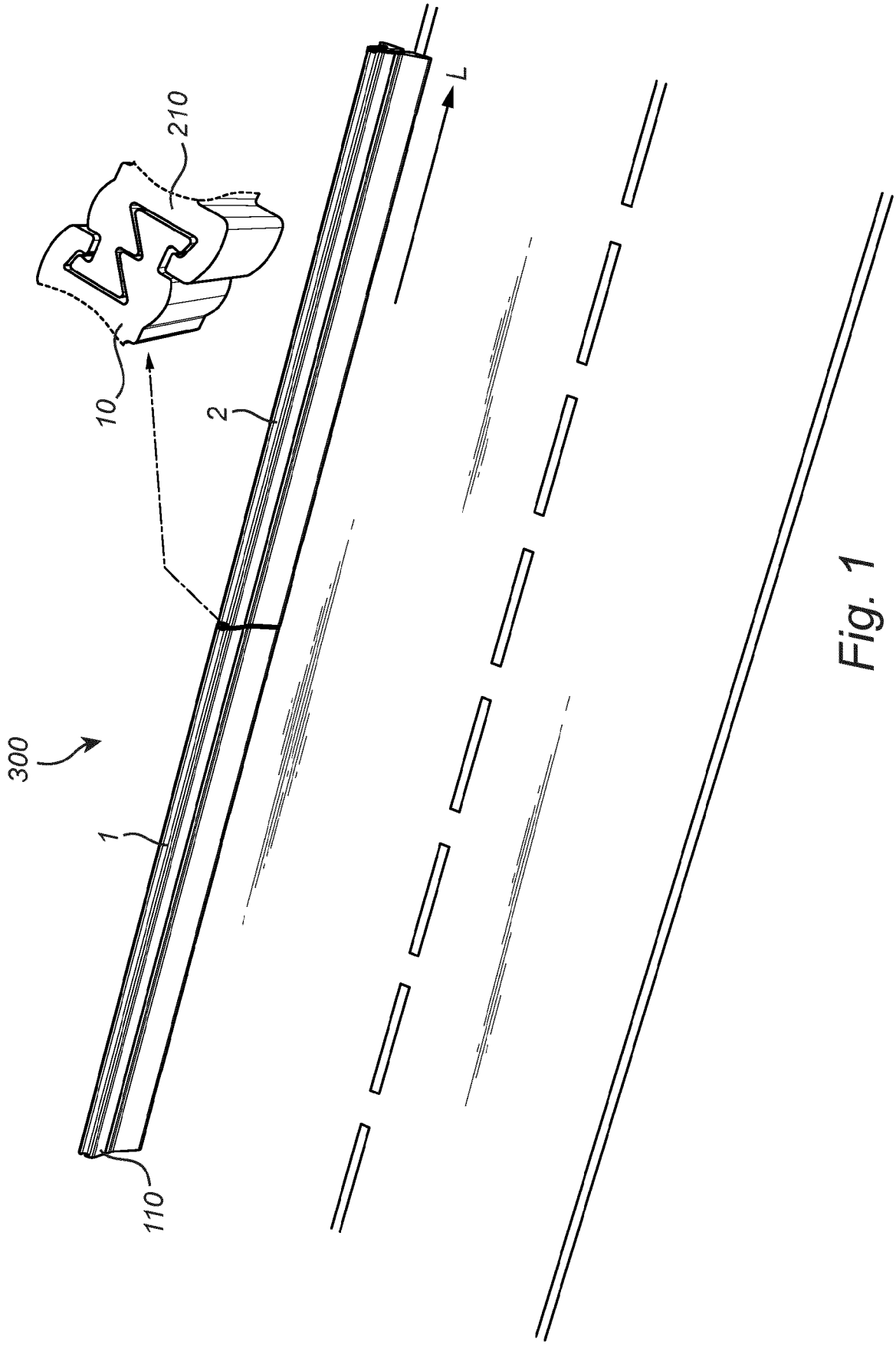

Fig. 1

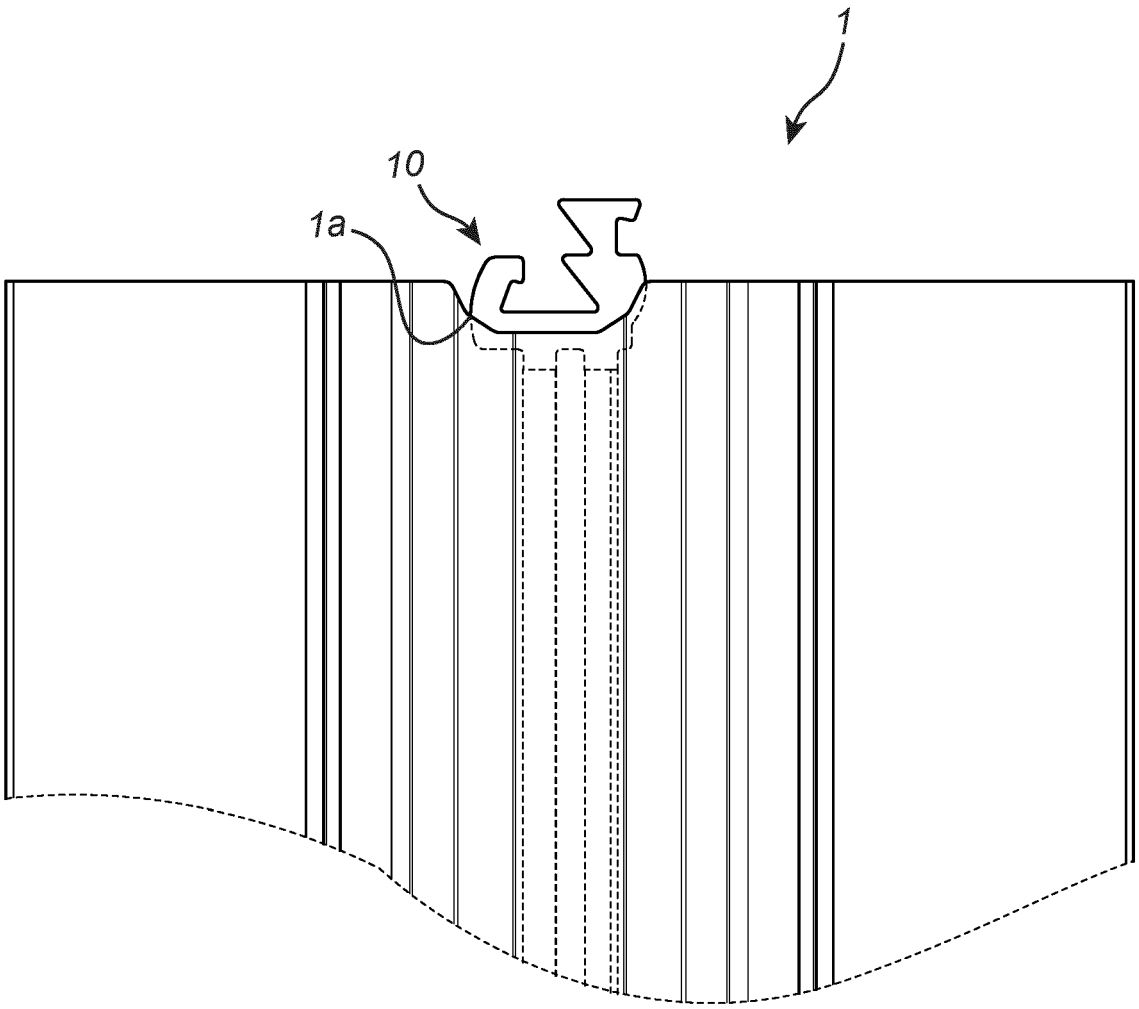

Fig. 2

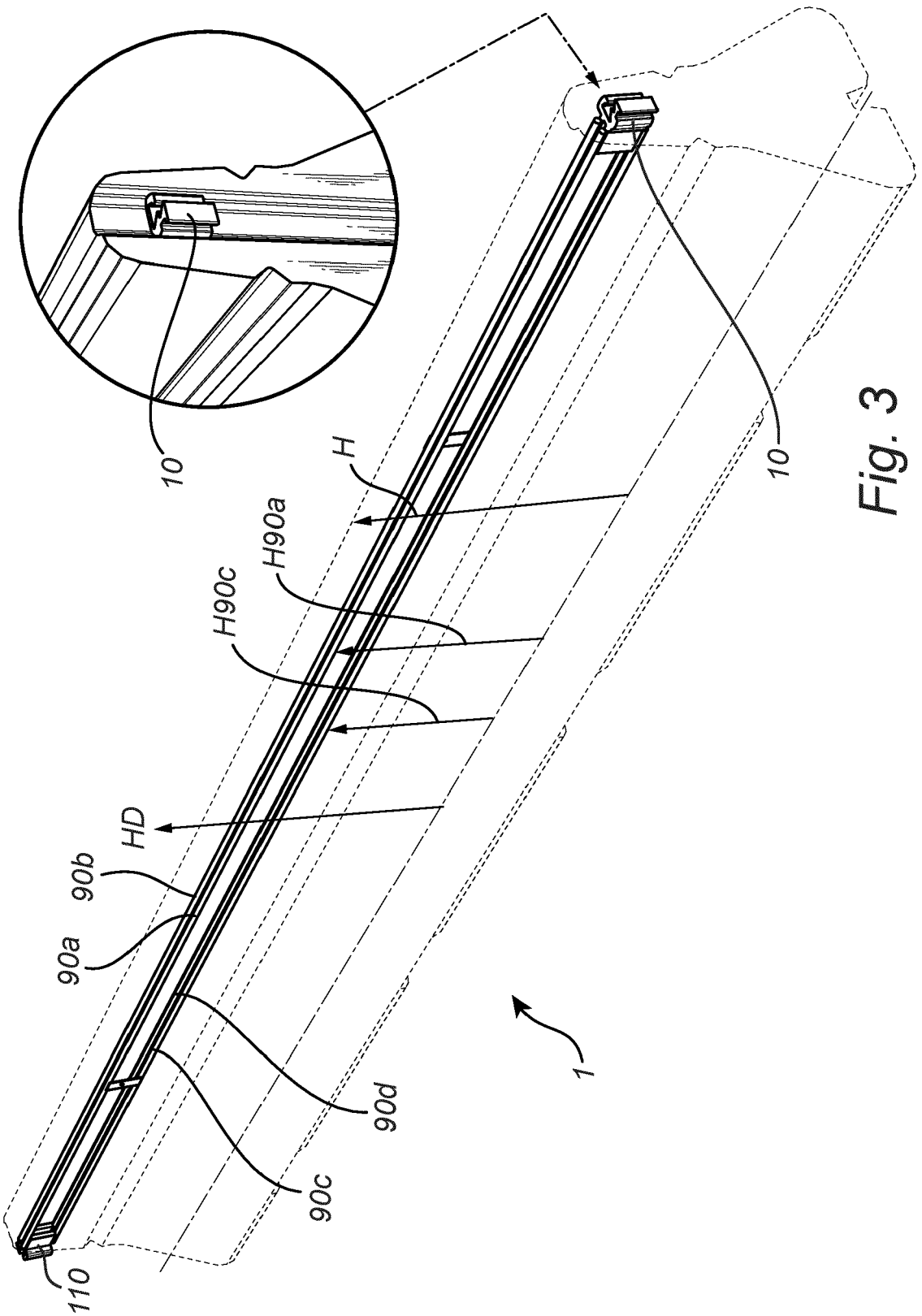

Fig. 3

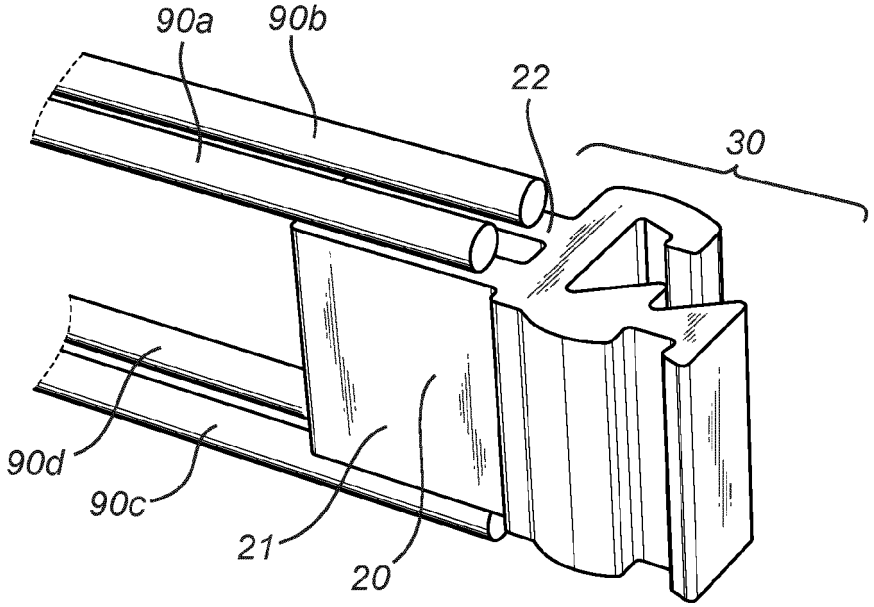

Fig. 4a

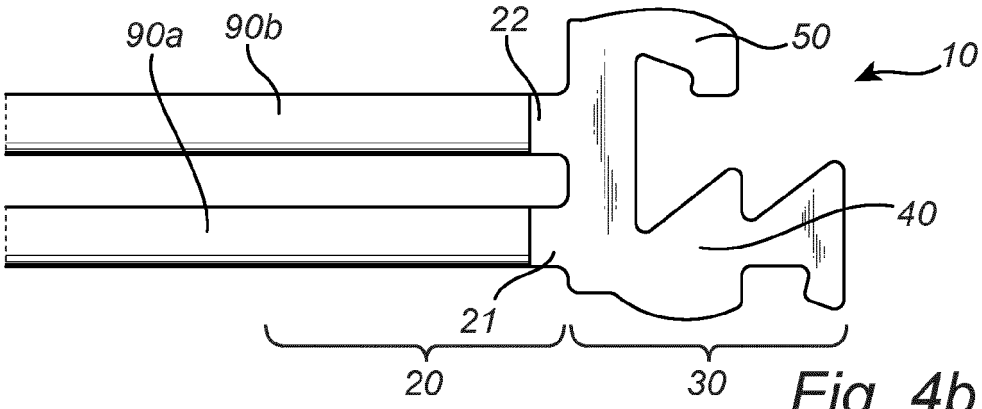

Fig. 4b

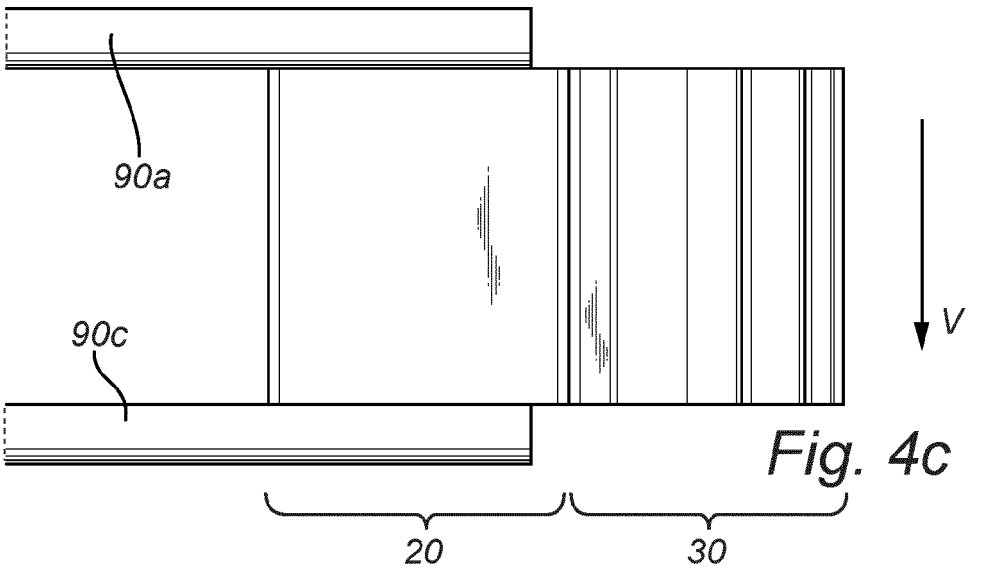

Fig. 4c

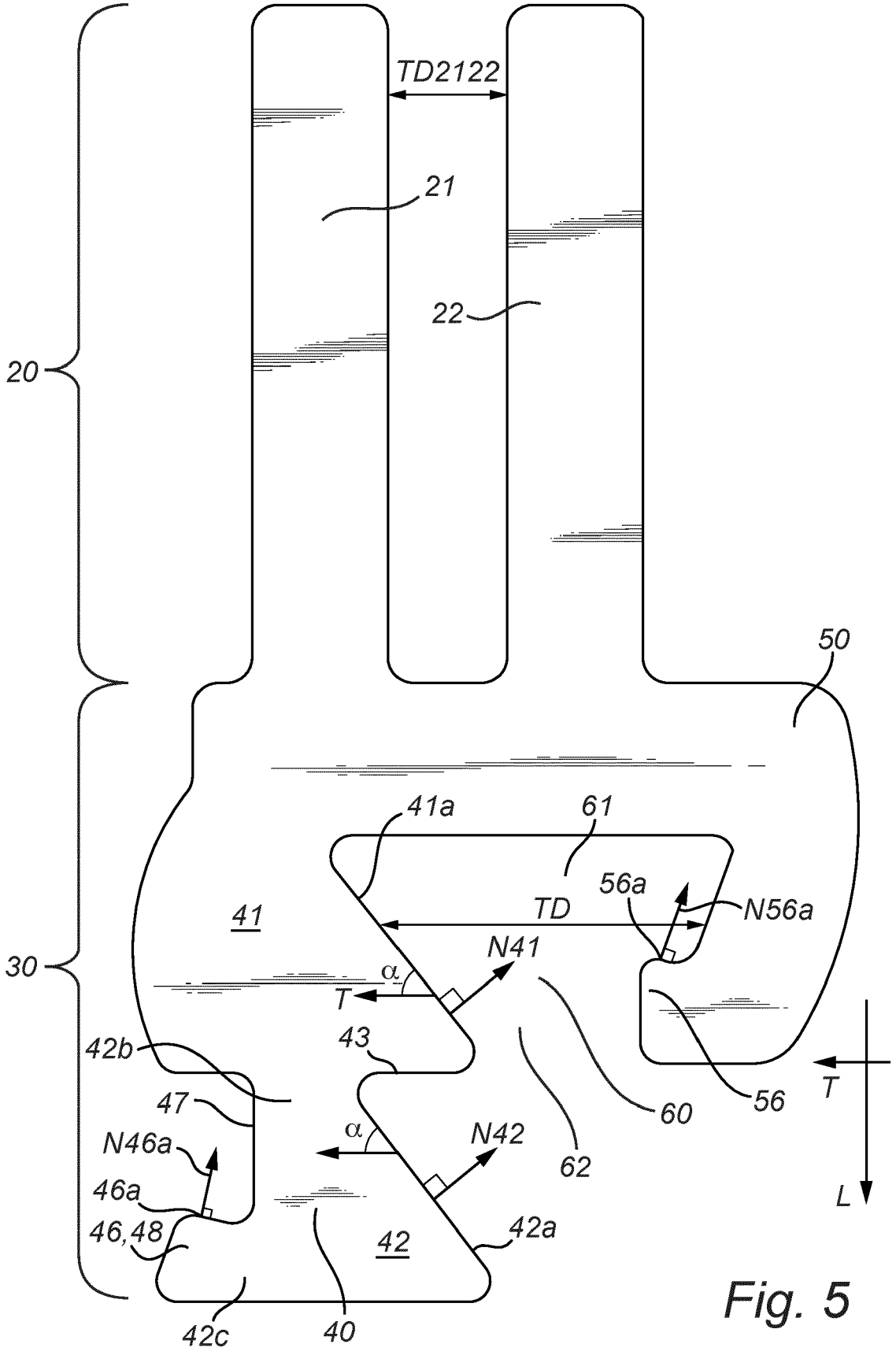
TD2122
21
22
20
50
41a
61
56a
N56a
TD
41
N41
α
T
30
42b
43
47
60
56
T
α
N42
N46a
62
46a
L
46,48
42
42a
42c
40

Fig. 5

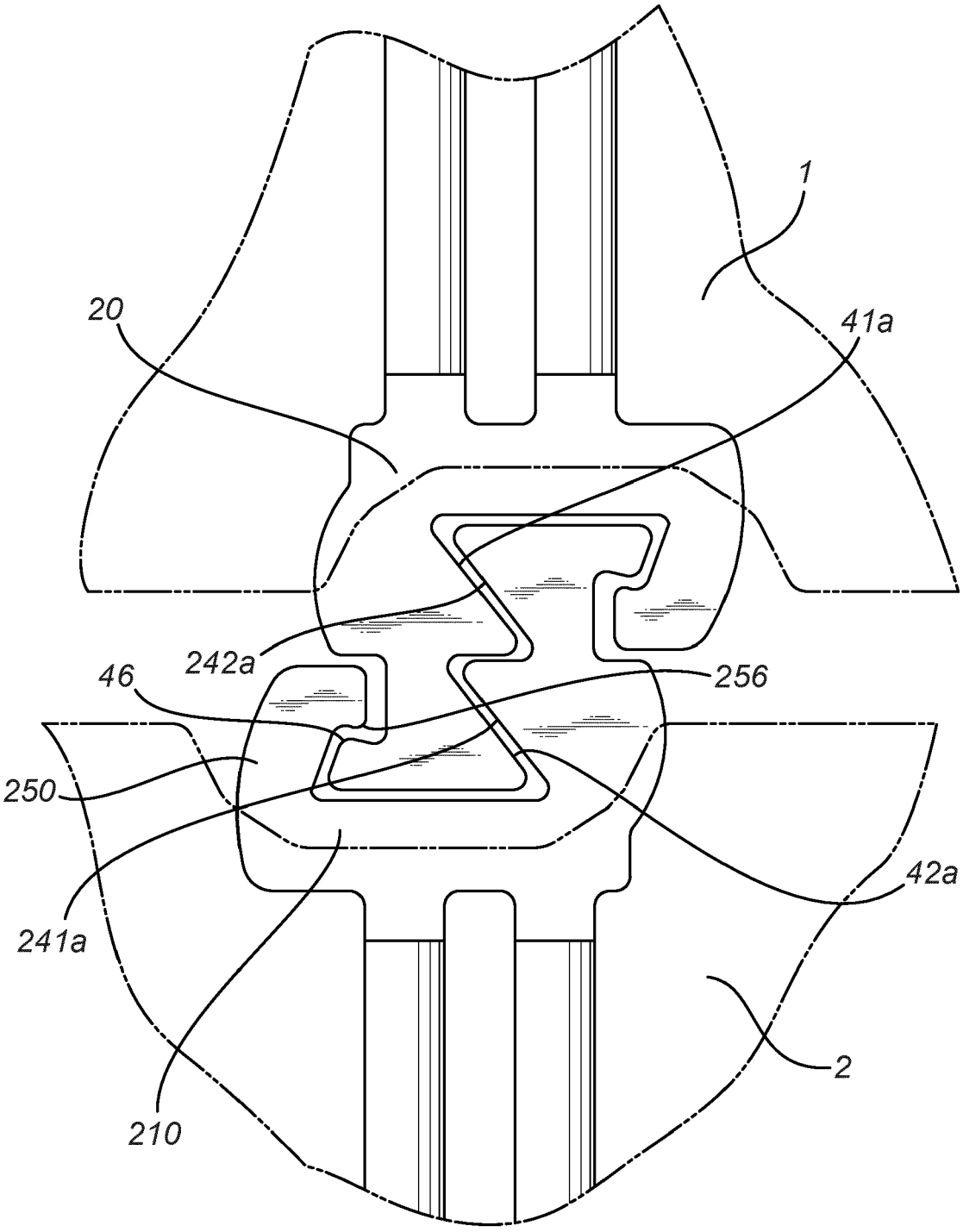

Fig. 6

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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 March 2024	Flores Hokkanen, P

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