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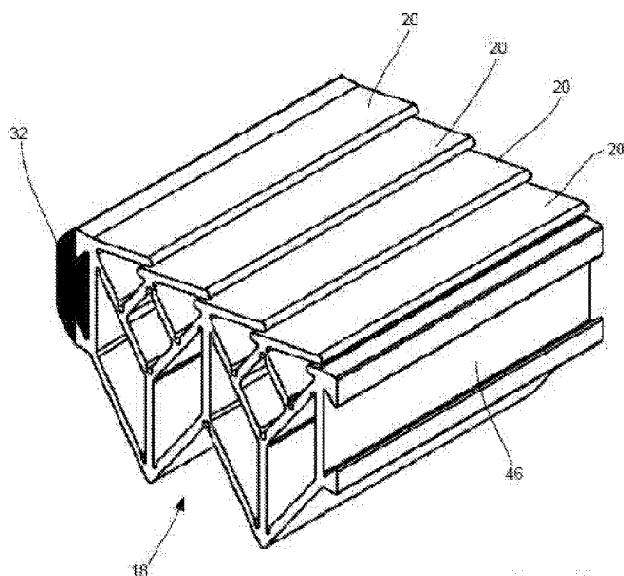


Figure 5

(57) Abstract: A system for bridging a gap between a platform having an elevated surface, and a transport vehicle that has an internal floor and a side door. The system includes a device mounted beneath the doorway of the side door such that an upper edge of the device that is adjacent the first elongate side is approximately level with the internal floor. The device has a longitudinal support body that is resiliently compressible and includes a plurality of overlapping leaf members. When the support body is in an uncompressed state, the device projects outwardly from the side of the vehicle whereby, when the transport vehicle is suitably positioned beside the platform, the device engages the platform such that the support body is compressed and the overlapping leaf members provide a bridging surface between the elevated surface and the internal floor.

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Bridging Device and System**Field of the invention**

The present invention relates to a bridging device and system. In particular, the
5 present invention relates to bridging a gap between two spaced apart surfaces.

Background

There are many instances where two surfaces are brought together, and people,
10 animals, and/or equipment are to move from one surface to the other. A gap between the surfaces can be problematic, as the discontinuity can inhibit the movement between the two surfaces.

By way of example, in a public transport network, passengers must board and
15 alight the vehicle. To make the network safer and more accessible for passengers, platforms are installed at designated stops. While the platform reduces the separation between the natural ground level, and the internal floor of the vehicle, a gap often remains between the platform and the internal floor. This gap presents a variety of risks, including people or belongings falling through the gap and/or being trapped within the gap.

20

The gap size can vary due to specifications of the vehicle, the platform construction, and vehicle load. Where a gap between the vehicle and the platform is too big (laterally and/or vertically), mobility aids, such as wheel chairs and wheeled walking frames, are unable to move safely across the gap. The size of the gap can also vary at
25 different locations within the same platform due to variations in construction. Consequently, passengers with mobility aids may be unable to board and alight the vehicle independently.

There have been previous attempts to solve this problem, and these have limited
30 success for various reasons. Access ramps have been used to provide access to the carriage. Although an access ramp can very effectively cover the gap, these can cause significant timing disruptions to the vehicle. In addition, ramps that are manually deployed by the vehicle driver limit the access points, and may present health and safety problems

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to the driver and/or passengers. The passenger must also directly communicate their destination to the driver so that the ramp is deployed when and where required.

Passive devices that fill the gap have been proposed and trialled. These devices
5 are fitted to one of the platform edge or the side of the vehicle beneath the doorway, and have vertically oriented fingers that deflect on contact with the other of the vehicle or platform. While these can reduce the gap size, they are unable to compensate for variation in the gap height that may arise due to vehicle load. There is also the risk of narrow wheels being trapped between the fingers.

10 Accordingly, there is a need to address the above, and/or at least provide a useful alternative.

15 Summary of the invention

The present invention provides a device for bridging a gap between two spaced apart surfaces that are movable relative to one another, the device comprising:

a first elongate side that is to be mounted on a first structure associated with a first one of the spaced apart surfaces;

20 a second elongate side that is opposite the first elongate side;

a longitudinal support body that is between the first and second elongate sides, the support body being resiliently compressible such that the second elongate side can be deflected in a first direction that is towards the first elongate side; and

one or more leaf members that extend longitudinally along the support body and
25 are disposed on the top of the device, and are each interconnected to an upper side of the support body, the leaf members being arranged such that:

the leaf members overlap one another, and/or

at least some of the leaf members are deflectable by application of
a vertical load so as to overlap and contact an adjacent leaf member,

30 wherein the device has an uncompressed state in which the first and second elongate sides have a maximum separation,

and wherein the overlap of the leaf members increases as the separation of the first and second elongate sides reduces from the maximum separation.

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The support body can also be configured such that at least a portion of the second elongate side can be deflected so as to rotate relative to the first elongate side. Alternatively or additionally, the support body can also be configured such that at least a portion of the second elongate side can be deflected relative to the first elongate side in a second direction that is perpendicular to the first direction.

The device is constructed to accommodate varying deflections at different points along the length of the device.

In at least one embodiment, the support body further has one or more elongate rib formations that extend longitudinally along the device and are disposed between the first and second elongate sides, wherein each leaf member is interconnected with a respective one of the elongate rib formations. Preferably, the support body and the leaf members are contiguous. The support body and the leaf members can be formed simultaneously with one another.

The support body has a plurality of cell walls, and the support body has a plurality of cells with internal spaces that are each defined by one or more of the cell walls. Preferably, the cell walls also form at least some of the rib formations.

The cells have a vertical cross sectional shape, in a direction perpendicular to the first elongate side, that enables each cell to be compressed in the first direction.

The plurality of cells can include primary cells that, in a vertical cross section perpendicular to the first elongate side, have a generally parallelogram shape when the support body is in its uncompressed state. In some embodiments, the cell walls include vertical cell walls between adjacent primary cells, wherein the separation of adjacent vertical cell walls reduces in the first direction with deflection of the second elongate side towards the first elongate side.

The plurality of cells can also include secondary cells that, in a vertical cross section perpendicular to the first elongate side, have a generally diamond shape when the

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support body is in its uncompressed state. In some embodiments, the cell walls include minor cell walls that at least partially define the minor cells, wherein the angle minor cell walls of each minor cell reduces with deflection of the second elongate side towards the first elongate side.

5

Preferably, the internal space of each cell is hollow.

At least some of the rib formations can be defined by the cell walls.

10

The support body can include stress relieving formations at intersections between at least some of the cell walls. Preferably, the stress relieving formations are formed between cell walls that intersect at an acute angle when the support body is in its uncompressed state. Each stress relieving formation can comprise a channel formation that extends in the longitudinal direction of the support body.

15

Preferably, the device has a mount on the first elongate side for mounting the device on the first structure. In some embodiments, the mount includes a profiled formation that interlocks with a complementary formation on the first structure. In some alternative embodiments, the mount includes an interface plate with a formation that interlocks with a complementary formation on the first elongate side of the support body, whereby the interface plate is mountable on the first structure.

20

In some applications, the first structure is a transport vehicle, and the device is to be mounted beneath a doorway of that vehicle, with the second elongate side of the device to contact a second structure, such as for example, a loading or passenger platform. In such applications, the interface plate is attachable to the vehicle beneath the doorway. In some embodiments, the device further comprises a tread plate that is to be installed at the threshold of the doorway, and the interface plate is attached to the tread plate. In some alternative embodiments, the interface plate is integral with a tread plate that is to be installed at the threshold of the doorway.

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In some other applications, the first structure is a platform having an elevated surface, with the second elongate side of the device to contact a second structure, such

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as for example, a transport vehicle. In these applications, the second of the surfaces may be, for example, an internal floor of the vehicle. In such applications, the interface plate may form a nosing that is to be attached to the platform beneath the elevated surface. The device can extend along the entire length of the platform, or a part of the length of the platform.

The device can further comprise an elongate contact element that is attached to the support body on the second elongate side of the device, the contact element being flexible along its length, whereby in use of the device the contact element is to contact a second structure that is associated with a second one of the spaced apart surfaces. Preferably, the contact element is a strip that extends along the entire length of the second elongate side. The support body has a formation to facilitate interconnection of the contact element with the support body.

In some embodiments, the contact element and support body have complementary interlocking formations. The contact element may be removably connected with the support body. In some alternative embodiments, the contact element is integrally formed with the support body. In some cases, the contact element can be co-extruded with the support body.

The contact element can be made of a material has higher abrasion resistance than the support body. Alternatively or additionally, the contact element can be made of a material that is self lubricating.

In some embodiments, the device has:
a primary portion in which the support body can adopt the uncompressed state in which the first and second elongate sides have a maximum separation; and
one or more secondary portions that are each disposed between the primary portion and a respective longitudinal end of the device, wherein in each secondary portion has a maximum width adjacent the primary portion that corresponds with the maximum separation,

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wherein each secondary portion tapers in width towards the respective longitudinal end of the device, and wherein each secondary portion is at least partially compressible in the first direction.

5 In some embodiments, each secondary portion is a continuation of the primary portion, and within each secondary portion the support body transitions from an uncompressed state adjacent the primary portion, to a fully compressed state adjacent the longitudinal end of the device.

10 Preferably, the device has a secondary portion at each opposing end of the device.

In embodiments in which the device is to be mounted beneath a doorway, the primary portion has a length that is at least equal to the width of the doorway.

15

In some embodiments, the leaf members are configured such that, when the support body is in its uncompressed state, at least some of the leaf members overlie an adjacent leaf member and the rib formation that is interconnected with that adjacent leaf member.

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Alternatively or additionally, each leaf member has a width that is greater than the separation of rib formations when the support body is in its uncompressed state.

25 Preferably, the leaf members and/or support body are configured such that, when the support body is in its uncompressed state and the leaf members are not subjected to any vertical loads, the leaf members lie at an oblique angle to the first direction. More preferably, the oblique angle is in the range of 1° to 40°. Even more preferably, the oblique angle is in the range of 10° to 30°.

30 The device can be mounted to the first structure such that the upper edge of the second elongate side is vertically below the upper edge of the first elongate side. Preferably, the first elongate side can be mounted such that first direction is at an angle in the range of 0° to 15° to a horizontal plane.

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In some embodiments, the device includes an overhang formation on an underside and adjacent the second elongate side, such that the second elongate side can be vertically supported by a portion of the first structure that is positioned underneath the overhang formation. The overhang formation can be formed in the support body, or the contact element.

The present invention also provides a system for bridging a gap between a platform having an elevated surface, and a transport vehicle that has an internal floor and a side door, the system comprising:

a device as previously described, the device being mounted beneath the doorway of the side door such that an upper edge of the device that is adjacent the first elongate side is approximately level with the internal floor and, when the support body is in its uncompressed state, the device projects outwardly from the side of the vehicle, whereby, when the transport vehicle is suitably positioned beside the platform with the device engaging the platform such that the support body is compressed, the overlapping leaf members provide a bridging surface between the elevated surface and the internal floor.

The system can comprise a platform nosing that is to be attached to an upright surface of the platform, whereby the nosing has a shoulder that provides vertical support to second elongate side of the support body. Alternatively or additionally, the nosing has a profiled surface to deflect the second elongate side in the second direction.

The nosing can be made of a material that is self lubricating.

The system can comprise a ramp structure that is secured to the platform, the ramp structure having:

an outer shell that provides a raised surface that is above the elevated surface of the platform; and

an inner core that provides rigidity to the ramp structure.

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The ramp structure can include the nosing on an outer edge of the outer shell and/or inner core.

5 Brief description of the drawings

In order that the invention may be more easily understood, embodiments will now be described, by way of example only, with reference to the accompanying drawings, in which:

- 10 Figure 1: is a schematic view of a platform and train carriage with a bridging device and system according to a first embodiment of the present invention;
- Figure 2: is a schematic front elevation view of a platform and train carriage, with the bridging device and system of Figure 1;
- Figure 3: is an enlarged view of Region III in Figure 2;
- 15 Figure 4: is a plan view of the bridging device of Figure 1;
- Figure 5: is a partial left rear perspective view of the bridging device of Figure 4;
- Figure 6: is a vertical cross section view of a bridging device of Figure 4 shown in a relaxed state;
- 20 Figure 7: is a vertical cross section view of the bridging device of Figure 4 shown in a fully compressed state;
- Figure 8: is an enlarged view of Region VIII in Figure 7;
- Figure 9: is a schematic vertical cross section of a platform, and train carriage with the bridging device of Figure 4, showing the bridging device in a relaxed state;
- 25 Figure 10: is a schematic vertical cross section of a platform, and train carriage with the bridging device of Figure 4, showing the bridging device in a fully compressed state;
- Figure 11: is a schematic vertical cross section of the platform and train carriage with a bridging device and system of Figure 1;
- 30 Figure 12: is a vertical cross section view of a bridging device according to a second embodiment of the present invention;

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- Figure 13: is a vertical cross section view of a bridging device according to a third embodiment of the present invention;
- Figure 14: is a schematic perspective view of a bridging device according to a fourth embodiment of the present invention, the bridging device being mounted to a train carriage;
- Figure 15: is a vertical cross section view of a bridging device of Figure 14 shown in a relaxed state;
- Figure 16: is an enlarged schematic perspective view of the bridging device of Figure 14;
- Figure 17: is a schematic plan view of a linear platform, and the bridging device of Figure 14;
- Figure 18: is a schematic plan view of a curved platform, and the bridging device of Figure 14;
- Figure 19: is a vertical cross section view of a platform and train carriage with a bridging device and system having a modified contact element;
- Figure 20: is a vertical cross section view of a platform and train carriage with a system comprising two bridging devices according to embodiments of the invention; and
- Figure 21: is a vertical cross section view of a platform and train carriage with the system of Figure 20 including modified contact elements.

Detailed description

Figures 1 to 3 shows a carriage of a train T that has an internal floor F and side doors S. Beside the train T is a platform P that has a surface E on which passengers move prior to, or after, travelling on the train. The surface E is elevated above the level of the tracks on which the train travels. As will be appreciated, the train travels in a direction parallel to the outer, upright surface of the platform P, such that when the train T is at rest at the platform P, a gap exists between the internal floor F at the doorway of the side doors S, and the surface E. Passengers must cross the gap when boarding or alighting the train T. The gap almost invariably includes a horizontal component between the floor F and the surface E, and depending on various factors there can also be a vertical component.

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Figures 1 to 3, and 11 also show a system 10 for bridging the gap between a platform surface E, and the internal floor F of the train T. The system 10 includes a device 12 that is suitable for bridging the gap, and which is mounted beneath the doorway
5 of the side door S. As will be evident from Figures 2 and 3, the device 12 projects outwardly from the side of the train T.

The device 12 is shown in further detail in Figures 4 to 10. The device 12 has a first elongate side 14 that is to be mounted on a first structure, such as the side of the
10 train T, a second elongate side 16 that is opposite the first elongate side 14, and a longitudinal support body 18 that is between the first and second elongate sides 14, 16. The support body 18 is resiliently compressible such that the second elongate side 16 can be deflected in a first direction that is towards the first elongate side 14. Throughout the
Figures, the first direction is indicated by arrow D_1 .

On the top of the device 12, there are leaf members 20 that extend longitudinally along the support body 18. In the embodiment illustrated in Figures 4 to 9, the device 12 has four leaf members 20. Each leaf member 20 is interconnected to an upper side of the support body 12. In this embodiment, the leaf members 20 are arranged so as to overlap
20 one another.

The device 12 has an uncompressed state in which the first and second elongate sides 14, 16 have a maximum separation. Figures 6 and 7 show vertical cross sections through the device 12 that are perpendicular to the first elongate side 14. In Figure 6, the
25 device 12 is illustrated with the support body 18 in an uncompressed state. Consequently, the first and second elongate sides 14, 16 are at their maximum separation. In Figure 7, a lateral load L is applied to the second elongate side 16 of the device 12, which has caused the second elongate side 16 to move in the first direction (which is parallel to the direction of the load L) towards the first elongate side 14. By
30 virtue of the load L applied to the device 12, the support body 18 is in its fully compressed state, at least within a region at which the load L is applied. As is evident from a comparison of Figures 6 and 7, the overlap of the leaf members 20 increases as the

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separation of the first and second elongate sides 14, 16 reduces from the maximum separation.

5 The device 12 is able to bridge a gap with a width that is at least equal to the maximum separation of the first and second sides 14, 16. When bridging a gap between two spaced apart surfaces (such as between an internal floor of a train T and a surface at a platform), the leaf members 20 provide a consistent surface along the length of the device 12. Of considerable advantage is that there are no opportunity for wheels (such as castor wheels of a mobility aid) to become entrapped in the device 12 when rolling across
10 the top surface. Further, having regard to the typical diameters of wheels of mobility aids, there can be negligible vertical ledges that inhibit a wheel rolling across the device 12 from one of the two surfaces to the other.

15 Although not shown in the Figures, the device 12 is able to be manipulated such that the second elongate side 16 is rotated relative to the first elongate side 14. In other words, at least a portion of the second elongate side 16 can be deflected so as to rotate relative to the first elongate side 14, and this movement is accommodated by resilient deflection of the support body 18. In Figure 6, the direction of this rotation is indicated by double-headed arrow R . Furthermore, in this embodiment, the device 12 can also be
20 manipulated such that at least a portion of the second elongate side 16 is displaced relative to the first elongate side 14 in a second direction D_2 that is perpendicular to the first direction D_1 .

25 The construction of the device 12 is such that varying deflections at different points along the length of the device 12 can be accommodated. For example, the size of the gap may vary along the length of the device 12, such that the extent of deflection of the second elongate side 16 towards the first elongate side 14 varies. In some instances, only a part of the length of the device 12 is compressed, there may be a localized deflection, a step change in the deflection, or the deflection may vary along part or all of
30 the device in a linear or non-linear manner. Further, the nature of the deflection may vary in any one or more of the first direction D_1 , the second direction D_2 , and the rotation R .

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In the embodiment of Figures 4 to 10, the support body 18 has elongate rib formations 22 that extend longitudinally along the device 12 and are disposed between the first and second elongate sides 14, 16. Each leaf member 20 is interconnected with a respective one of the elongate rib formations 22.

5

Each leaf member 20 has a width that is greater than the separation of adjacent rib formations 22 when the support body 18 is in its uncompressed state. The leaf members 20 are also configured such that, when the support body 18 is in its uncompressed state, each leaf member 20 overlies one of the two adjacent leaf members 20 and also the rib formation 22 that is interconnected with that adjacent leaf member 20. In this way, each leaf member 20 supports vertical loads by the rib formation 22 to which it is attached, and also by the rib formation 22 of the adjacent leaf member 20.

The support body 18 also has cell walls that define cells with internal spaces. To this end, the support body 18 has cell walls that, in this embodiment, define four primary cells 26. Each of the primary cells 26 has a generally parallelogram shape when the support body 18 is in its uncompressed state, as illustrated in Figure 6. The cell walls include five vertical cell walls: two laterally outer vertical cell walls 24a, 24b are at the first and second elongate sides 14, 16, respectively, of the support body 18, and three vertical cell walls 24b that are between adjacent primary cells 26. In addition, there are two sets of four inclined cell walls 24c; one set on each of the top and bottom of the support body 18. The sets of inclined cell walls 24c are arranged in a concertina formation, so that each set is able to concertina as the vertical cell walls 24a, 24b move towards or away from one another.

25

The separation of adjacent vertical cell walls 24a, 24b, in the first direction D_1 , reduces with deflection of the second elongate side 18 towards the first elongate side 14. As will also be evident from Figure 7, the relative vertical position of the vertical cell walls 24a, 24b actually increases with deflection of the second elongate side 18 towards the first elongate side 14.

30

The cell walls also define two secondary cells 28. Each of the cells 28 has a generally diamond shape when the support body 18 is in its uncompressed state, as

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illustrated in Figure 6. The cell walls include four secondary inclined cell walls 24d that are arranged in pairs, with each pair being connected to two adjacent inclined cell walls 24c. The cell walls 24a, 24b, 24c, 24d are hereinafter referred to collectively as "cell walls 24".

5

The rib formations 22 are formed at the intersection of cell walls 24. As is evident from Figure 6, when the support body 18 is in its uncompressed state, the rib formations 22 lie in a common plane.

10

In this embodiment, the internal space of each cell 26, 28 is hollow. However, in alternative embodiments, the internal space may be filled with a compressible material that increases the rigidity of the support body.

15

The support body 18 and leaf members 20 can be contiguous. For example, the support body 18 and leaf members 20 can be formed simultaneously. To this end, the support body 18 and leaf members 20 can be of unitary construction. To this end, the support body and leaf members 20 can be an extrusion.

20

The support body 18 includes stress relieving formations 30 where interconnected cell walls 24 intersect at an acute angle when the support body is in its uncompressed state. Each stress relieving formation can comprise a channel formation that extends in the longitudinal direction of the support body 18. The stress relieving formations reduce the internal stresses within the support body 18; for instance, in regions in which cell walls 24 meet at an obtuse angle. By reducing these internal stresses, cracking by cyclic loading and unloading may be mitigated and/or even avoided.

25

30

The device 12 has elongate contact element 32 that is attached to the support body 18 on the second elongate side 16 of the device 12. The contact element 32 is flexible along its length such that, in use of the device 12, the contact element 32 is to contact a second structure (for instance, a platform P). As shown in Figures 4 to 7, the contact element 32 is a strip that extends along the entire length of the second elongate side 16. The contact element 32 and support body 18 have complementary interlocking formations. In this embodiment, the contact element has a dove-tail shaped key

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formation 34, and the support body 18 has a complementary dove-tail shaped keyway formation 36.

5 The contact element 32 provides a sacrificial wearing surface, that is to minimize wear on the support body 18. The key and keyway formations 34, 36 enable the contact element 32 to be removed from the support body 18 and replaced in the event that the contact element 32 is damaged or worn excessively. The resilient nature of the support body 18 facilitates this removal and replacement.

10 In this example, the contact element 32 is made of a material has higher abrasion resistance than the support body 18, and is also self lubricating. The contact element 32 may be made of a rubber, or synthetic rubber/polymer product that has a higher durometer when compared with the support body 18. The contact element 32 may include wear indicators as a visual signal for timely replacement of the contact element at a
15 certain stage of wear. The contact element may incorporate, at a certain depth from the contact surface, features such as voids or coloured materials, for example, that are visible to a maintenance worker when the contact element has been abraded to that depth.

As shown in Figure 4, the device has a primary portion (indicated by brace 38 in
20 Figure 4), and two secondary portions (indicated by braces 40 in Figure 4). The primary portion 38 is located centrally of the two secondary portions 40. In other words, each secondary portion 40 is located between the primary portion 38 and a respective longitudinal end of the device 12. Within the primary portion 38, the support body 18 can adopt its uncompressed state in which the first and second elongate sides 14, 16 have
25 the maximum separation. Within the secondary portions, the support body 18 transitions from an uncompressed state adjacent the primary portion 38, to a fully compressed state adjacent the longitudinal end of the device 12. In other words, each secondary portion 40 tapers in width towards the respective longitudinal end of the device 12, and in the region adjacent the primary portion 38 each secondary portion 40 is compressible in the first
30 direction D_1 . In this way, as the train T meets the approach end of the platform P, the device 12 is progressively compressed along its length.

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As is evident from Figure 1, in which the device 12 is to be mounted beneath the doorway of the side door S, the primary portion 38 has a length that is at least equal to, if not greater than, the width of the doorway. Consequently, in the region in which passengers will cross over the device 12, the maximum width of the device 12 is available to bridge gaps, by providing a bridging surface between the internal floor F of the train, and the elevated surface E of the platform P. It is envisaged that the embodiment of the device 12 that is illustrated in Figure 1 would have a primary portion 38 that has a length of at least 1,100mm, so as to at least match the width of the doorway S. However, in some other embodiments, the device, or at least the primary portion of the device, may have a minimal length necessary to accommodate mobility devices in the intended installation location.

The device 12 has a mount on the first elongate side 14 that is to be used for mounting the device onto a structure, such as the side of a train T. In the embodiment illustrated in Figures 9 and 10, the mount includes an interface plate 42 with a dove-tail shaped formation 44 that interlocks with a complementary keyway formation 46 on the first elongate side of the support body 18. On an opposing side of the interface plate 42 to the formation 44, the interface plate 42 is profiled to mate with a tread plate 48. By attachment of the interface plate 42 with the tread plate 48, the device 12 is readily installed in the doorway of a door S of the train T.

Figures 9 and 10 show the manner in which the device 12 is able to bridge the gap between the internal floor F of the train T, and the elevated surface E of the platform P. In Figure 9, the horizontal width of the gap is slightly larger than the maximum separation of the first and second sides 14, 16 of the device 12. Consequently, within the region that includes the section of Figure 9, the device 12 is not in contact with the platform P. However, the device 12 has sufficient rigidity that some vertical loads on the leaf members 20 can be supported.

As shown in Figures 1 to 3, and 11, the system 10 also includes a ramp structure 50 that is secured to the platform P. The ramp 50 provides a raised surface 52 that is above the elevated surface E of the platform P. The raised surface 52 of the ramp 50 is inclined relative to the elevated surface E in the direction of the platform edge. In this

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way, the ramp 50 can reduce the step height that must be crossed when boarding or alighting the carriage of the train T.

Figure 11 shows the ramp 50 in further detail. The ramp 50 includes a platform
5 nosing 54 that is to be attached to an upright surface of the platform P. The nosing 54 has a shoulder 56 that provides vertical support to second elongate side 16 of the support body 18. In this way, the nosing 54 can engage and deflect the second elongate side 16 of the support body 18 upwardly with respect to the platform P (and thus in the second direction D_2). This enables the vertical position of the second elongate side 16 to be
10 adjusted relative to the raised surface 52 as the train T approaches its stop.

The ramp 50 also includes an outer shell 58, and an inner core 60 that provides rigidity to the outer shell 58. At least part of the outer shell 58 forms at least a substantial part of the raised surface 52.

15 The nosing 54 can be made of a material that is self lubricating. In this way, wear between the ramp 50 and device 12 can be minimized. The portion of the outer shell 58 that provides the raised surface 52 can be made of a light-weight material, with non-slip properties and/or features. The inner core 60 can be made of a light-weight material that
20 provides rigidity to the outer shell 58. For example, the inner core 60 can be made of an aerated concrete, a hard-setting, closed cell foam, an expanded foam, or other suitable materials.

The bottom surface of the ramp 50 that rests on the elevated surface E of the
25 platform P may be machined to closely follow the contour of the elevated surface. In this regard, it will be appreciated that platforms that have been constructed using older constructions techniques may have a very uneven elevated surface. Machining the bottom surface of the ramp 50 can ensure that the raise surface 52 is well supported, and does not move in an unsettling manner for passengers.

30 Figure 12 is a vertical cross section view of a bridging device 112 according to a second embodiment of the present invention. The bridging device 112 is substantially similar to the bridging device 12 of Figures 4 to 9. In Figure 12, the features of the

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bridging device 112 that are substantially similar to those of the bridging device 12 have the same reference numeral with the prefix "1".

The bridging device 112 is arranged such that, when the support body 118 is in its uncompressed state and the leaf members 120 are not subjected to any vertical loads, the leaf members 120 lie at an oblique angle to the first direction. The oblique angle is approximately 30° . In Figure 12, the relaxed position of the leaf members 120 is shown in broken lines, and the oblique angle is indicated by pronomeral α . Further, in this state, the edge of each leaf member 120 that is remote from the rib formation 122 of that leaf member 120 is spaced vertically from the adjacent leaf member 120 over which that leaf member overlaps.

When a vertical load is applied to one of the leaf members 120, that leaf member 120 is deflected so as to overlap and contact the adjacent leaf member 120. In Figure 12, the leaf members 120 in their deflected positions are shown by solid lines.

Figure 13 is a vertical cross section view of a bridging device 212 according to a third embodiment of the present invention. The bridging device 212 is substantially similar to the bridging device 12 of Figures 4 to 9. In Figure 12, the features of the bridging device 212 that are substantially similar to those of the bridging device 12 have the same reference numeral with the prefix "2".

The device 212 includes an interface plate 242 that is configured such that the upper edge of the second elongate side 216 is vertically below the upper edge of the first elongate side 214. In particular, the interface plate 242 orientates the support body 218 such that first direction D_1 is at angle in the range of approximately 15° to a horizontal plane. In Figure 13, the inclination of the support body 218 is indicated by pronomeral β .

Figures 14 to 16 show a bridging device 312 according to a fourth embodiment of the present invention. The bridging device 312 is substantially similar to the bridging device 12 of Figures 4 to 9. In Figures 14 to 16, the features of the bridging device 312 that are substantially similar to those of the bridging device 12 have the same reference numeral with the prefix "3".

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In the embodiment of Figures 14 to 16, the contact element 332 is integrally formed with the support body 318. To this end, the contact element 332 and support body 318 can be co-extruded. As is evident from Figure 15, the contact element 332 is a substantially planar strip that extends along the second elongate side 316 of the support body 318.

The device 312 includes a mount on the first elongate side 314 for mounting the device 312 at the threshold of a doorway on the side of a train T. In this embodiment, the mount includes a tread plate 348 that has a dove-tail shaped formation 344 that interlocks with a complementary keyway formation 346 on the first elongate side 314 of the support body 318. The device 312 can readily be retrofitted to a train by removing the original tread plate, and installing the tread plate 348 of the device 312 in the doorway of a door S of the train.

The support body 318 of the device 312 may be co-moulded onto the tread plate 348, or may be permanent adhered to the tread plate 348. In either case, the device 312, including the tread plate 348 is to be installed / removed in its entirety from the train T.

Figures 17 and 18 exemplify the ability of a device (for example, the device 12 of Figures 4 to 10) to accommodate varying deflections at different points along the length of the device. In Figure 17, the outer edge of the platform P is substantially linear, and the entire length of the primary portion 38 is compressed.

As will be appreciated, the side of a train carriage T is linear, but in some instances the outer edge of the platform P is curved, as is the case in Figure 18. In such instances, the width of the gap between the internal floor F of the train carriage and the platform P varies along the width of the doorway of the door S. The device 12 is able to compensate for this variation, by varying the extent to which the support body 18 is compressed.

Figure 19 is a vertical cross section view of a platform and train carriage with a bridging device and system having a modified contact element 432. The device 12 is

– 19 –

shown mounted on the side of a train T for bridging a gap between the internal floor F of the train carriage and the raised surface 52 of a ramp 50 located on the platform P. In this case the contact element 432 is constructed with a profile having a downwardly angled contact surface 433. The angled face profile of the contact element is designed to support
5 alignment and downward stability of the device 12, and may be assisted in that by use of a complementary contact element 455 fitted to the nosing 54 of the ramp 50 (or the opposing face of the platform coping, as the case may be). The complementary contact element 455 has an upwardly angled contact surface 456. As previously mentioned, the contact element(s) may incorporate wear indication features as illustrated (without
10 reference numeral) in this view as well as in Figures 20 and 21. It will be appreciated that the illustrated embodiments merely provide examples of the installation of the device and system. Many modifications and variations may be made thereto without departing from the spirit and scope of the invention. For instance, in some applications of systems of the present invention there may be need to provide two devices; one mounted to each of the
15 first and second structures, such that the two devices are brought together and co-operate to bridge the gap between the associated surfaces.

Figures 20 and 21 are vertical cross section views of a platform and train carriage with a system comprising two bridging devices according to an alternative embodiment of
20 the invention. In the embodiments described hereinabove the bridging device 12 in the system 10 is mounted to a train carriage T, for example, to bridge across the gap to a platform structure. However, it is also possible for the device 12 to be mounted on the platform structure. Moreover, it is possible to utilise two bridging devices extending in opposite directions that meet one another in the gap. A system 500 constructed in this
25 manner is shown in Figures 20 and 21.

The system 500 includes a first device 12A mounted to the train T and having a contact element 32A projecting, in use, toward the platform P. A second device 12B is mounted to the edge of the platform P with a contact element 32B facing the train T. As
30 shown the two elements 32A and 32B make contact with one another within the gap between the train T and platform P, and together the devices 12A and 12B provide a supportive bridge across the gap. The use of two devices in this way may effectively span a greater distance between train and platform than a single device only.

– 20 –

Figure 21 shows the system 500 having two devices 12A and 12B although in this case with angled profile contact elements 432A and 432B. The contact elements 432A and 432B are respectively angled downward and upward in complementary fashion in a similar way as described in connection with Figure 19.

The illustrated embodiments are shown in the context of one of the surfaces being part of a structure that is in a fixed position and the other surface being part of a structure that moves. However, it will be understood that the device and system may be applied to scenarios in which both structures move.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word “comprise”, and variations such as “comprises” and “comprising”, will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

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CLAIMS:

1. A device for bridging a gap between two spaced apart surfaces that are movable relative to one another, the device comprising:

5 a first elongate side that is to be mounted on a first structure associated with a first one of the spaced apart surfaces;

a second elongate side that is opposite the first elongate side;

a longitudinal support body that is between the first and second elongate sides, the support body being resiliently compressible such that the second elongate side can be
10 deflected in a first direction that is towards the first elongate side; and

one or more leaf members that extend longitudinally along the support body and are disposed on the top of the device, and are each interconnected to an upper side of the support body, the leaf members being arranged such that:

the leaf members overlap one another, and/or

15 at least some of the leaf members are deflectable by application of a vertical load so as to overlap and contact an adjacent leaf member,

wherein the device has an uncompressed state in which the first and second elongate sides have a maximum separation,

and wherein the overlap of the leaf members increases as the separation of the
20 first and second elongate sides reduces from the maximum separation.

2. A device according to claim 1, wherein the support body is configured such that at least a portion of the second elongate side can be deflected so as to rotate relative to the first elongate side.

25

3. A device according to either claim 1 or 2, wherein the support body is configured such that at least a portion of the second elongate side can be deflected relative to the first elongate side in a second direction that is perpendicular to the first direction.

30 4. A device according to any one of claims 1 to 3, wherein the support body further has one or more elongate rib formations that extend longitudinally along the device and are disposed between the first and second elongate sides, wherein each leaf member is interconnected with a respective one of the elongate rib formations.

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5. A device according to any one of claims 1 to 4, wherein the support body has a plurality of cell walls, and the support body has a plurality of cells with internal spaces that are each defined by one or more the cell walls.

5

6. A device according to claim 5, wherein the cells have a vertical cross sectional shape, in a direction perpendicular to the first elongate side, that enables each cell to be compressed in the first direction.

10 7. A device according to any one of claims 1 to 6, wherein the device has a mount on the first elongate side for mounting the device on the first structure.

8. A device according to claim 7, wherein the mount includes a profiled formation that interlocks with a complementary formation on the first structure.

15

9. A device according to either claim 7 or 8, wherein the mount includes an interface plate with a formation that interlocks with a complementary formation on the first elongate side of the support body, whereby the interface plate is mountable on the first structure.

20 10. A device according to claim 9 in which the first structure is a transport vehicle, and the device is to be mounted beneath a doorway of that vehicle, with the second elongate side of the device disposed to contact a second structure, and wherein the interface plate is integral with a tread plate that is to be installed at the threshold of the doorway.

25 11. A device according to any one of claims 1 to 10, further comprising an elongate contact element that is attached to the support body on the second elongate side of the device, the contact element being flexible along its length, whereby in use of the device the contact element is to contact a second structure that is associated with a second one of the spaced apart surfaces.

30

12. A device according to claim 11, wherein the contact element is a strip that extends along the entire length of the second elongate side.

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13. A device according to either claim 11 or 12, wherein the contact element is removably connected with the support body.

14. A device according to either claim 11 or 12, wherein the contact element is
5 integrally formed with the support body.

15. A device according to any one of claims 11 to 14, wherein the contact element is made of a material has higher abrasion resistance than the support body, and/or a material that is self lubricating.

10

16. A device according to any one of claims 1 to 15, wherein the device has:
a primary portion in which the support body can adopt the uncompressed state in which the first and second elongate sides have a maximum separation; and
one or more secondary portions that are each disposed between the primary
15 portion and a respective longitudinal end of the device, wherein in each secondary portion has a maximum width adjacent the primary portion that corresponds with the maximum separation,

20

wherein each secondary portion tapers in width towards the respective longitudinal end of the device, and wherein each secondary portion is at least partially compressible in the first direction.

25

17. A device according to claim 16, wherein each secondary portion is a continuation of the primary portion, and within each secondary portion the support body transitions from an uncompressed state adjacent the primary portion, to a fully compressed state adjacent the longitudinal end of the device.

30

18. A device according to any one of claims 1 to 17, wherein the leaf members are configured such that, when the support body is in its uncompressed state, at least some of the leaf members overlie an adjacent leaf member and the rib formation that is interconnected with that adjacent leaf member.

19. A system for bridging a gap between a platform having an elevated surface, and a transport vehicle that has an internal floor and a side door, the system comprising:

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a device according to any one of claims 1 to 18, the device being mounted beneath the doorway of the side door such that an upper edge of the device that is adjacent the first elongate side is approximately level with the internal floor and, when the support body is in its uncompressed state, the device projects outwardly from the side of the vehicle,

whereby, when the transport vehicle is suitably positioned beside the platform with the device engaging the platform such that the support body is compressed, the overlapping leaf members provide a bridging surface between the elevated surface and the internal floor.

20. A system according to claim 19, further comprising a platform nosing that is to be attached to an upright surface of the platform, whereby the nosing has a shoulder that provides vertical support to second elongate side of the support body.

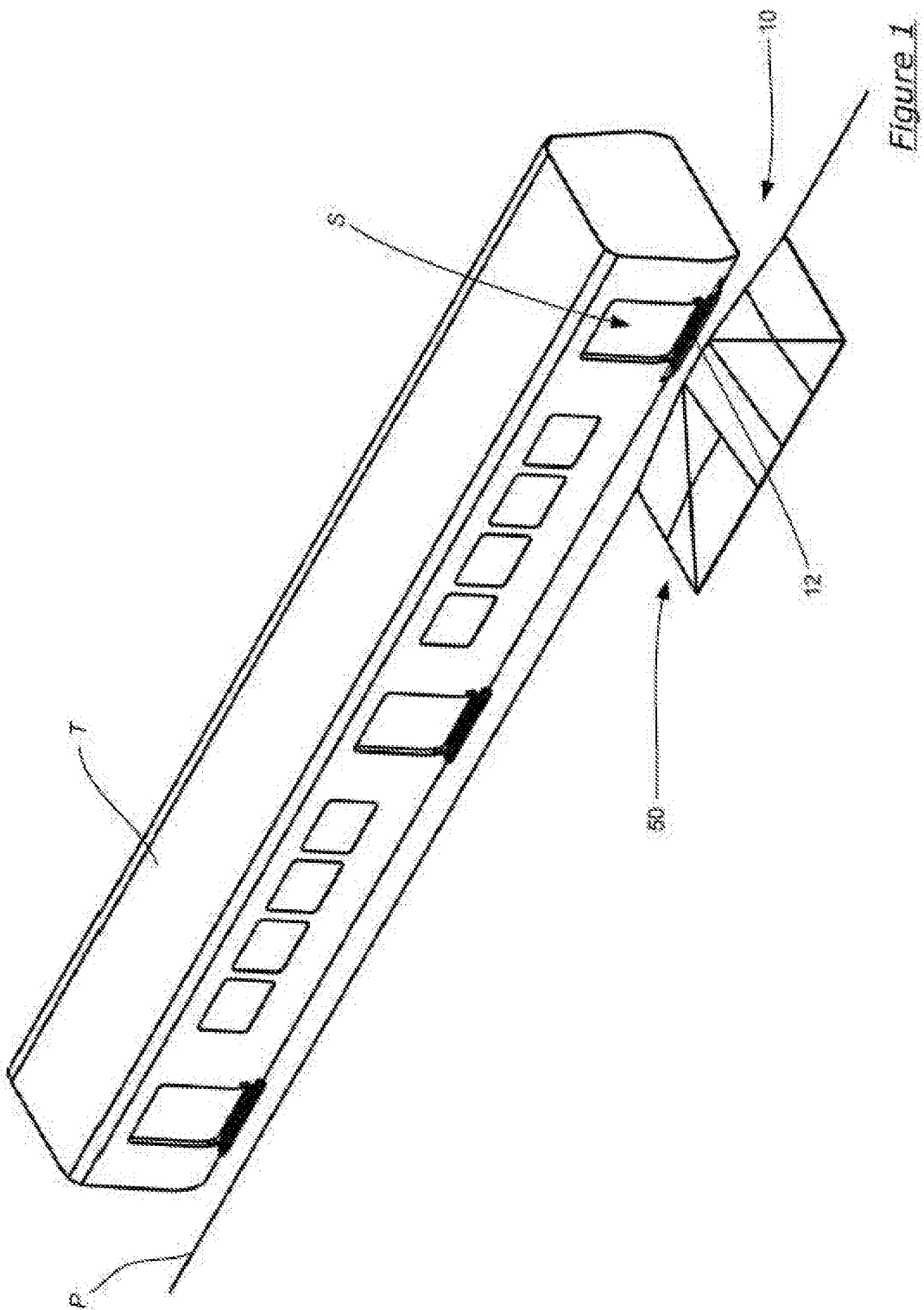
21. A system according to claim 20, wherein the nosing has a profiled surface to deflect the second elongate side in the second direction.

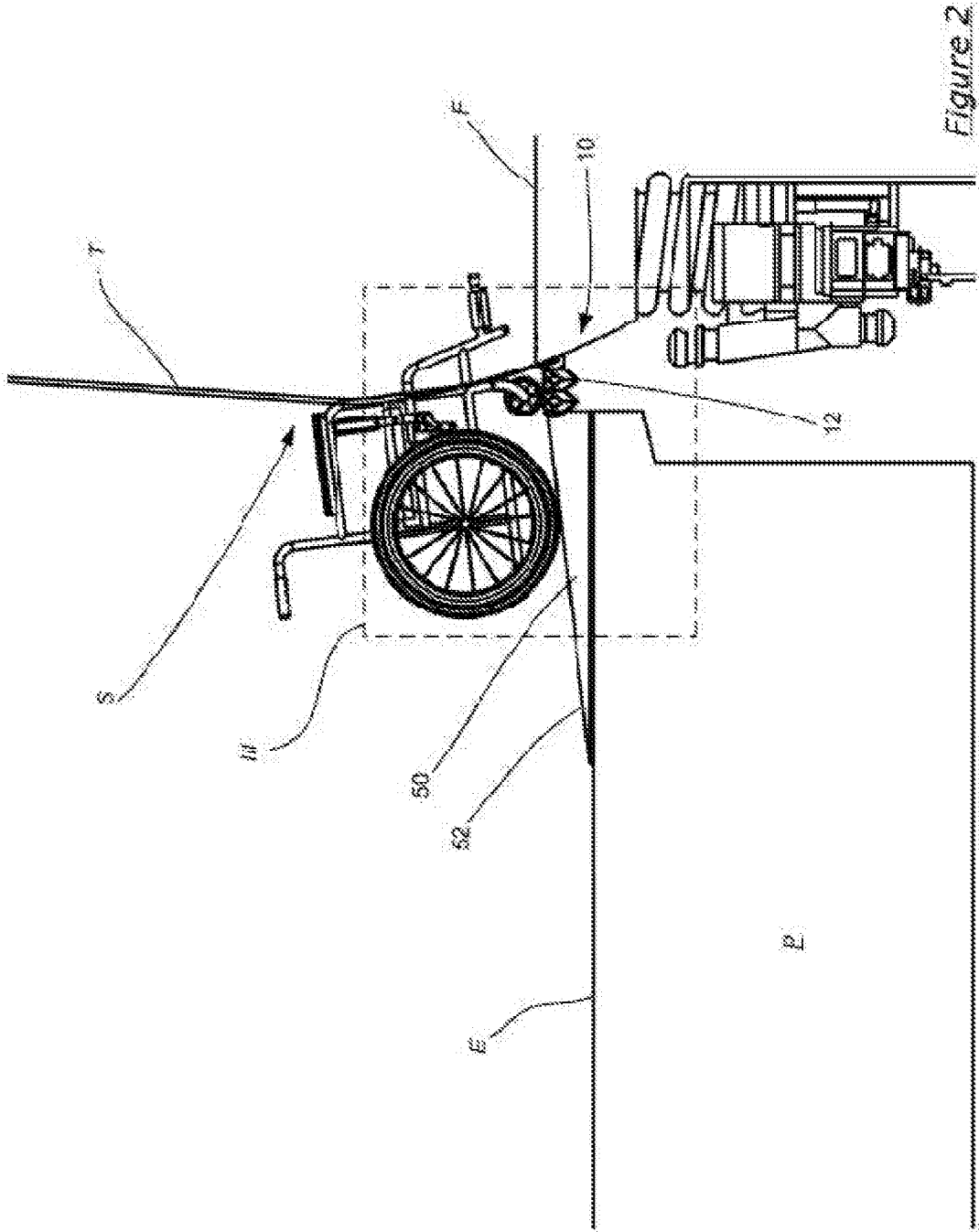
22. A system according to claim 19, further comprising a second device according to any one of claims 1 to 18, mounted to an upright surface of the platform and projecting toward the side of the vehicle.

23. A method for bridging a gap between a platform having an elevated surface, and a transport vehicle that has an internal floor and a side door, the method comprising:

mounting a device according to any one of claims 1 to 18 beneath the doorway of the side door such that an upper edge of the device that is adjacent the first elongate side is approximately level with the internal floor and, when the support body is in its uncompressed state, the device projects outwardly from the side of the vehicle,

whereby, when the transport vehicle is suitably positioned beside the platform with the device engaging the platform such that the support body is compressed, the overlapping leaf members provide a bridging surface between the elevated surface and the internal floor.





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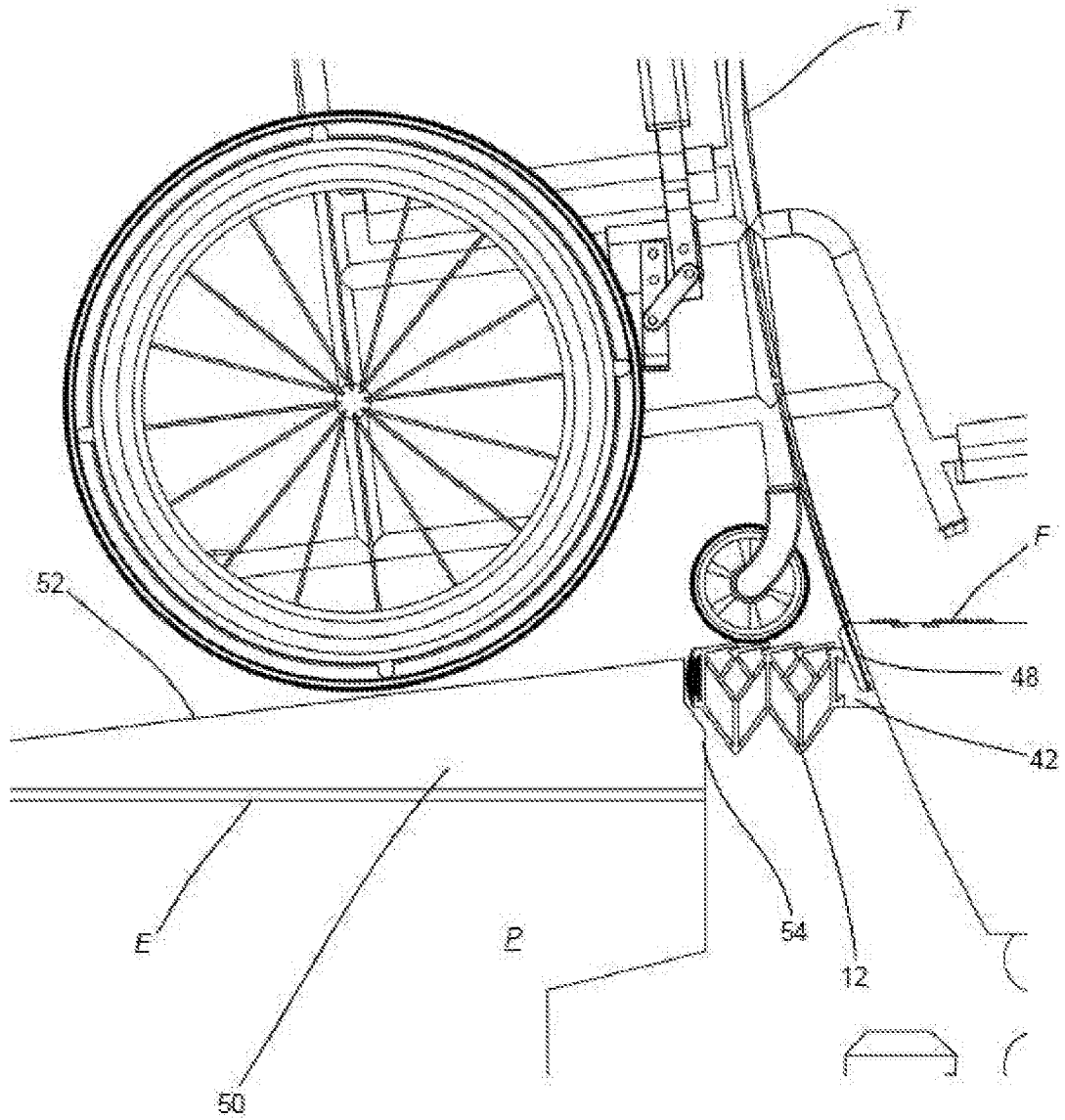


Figure 3

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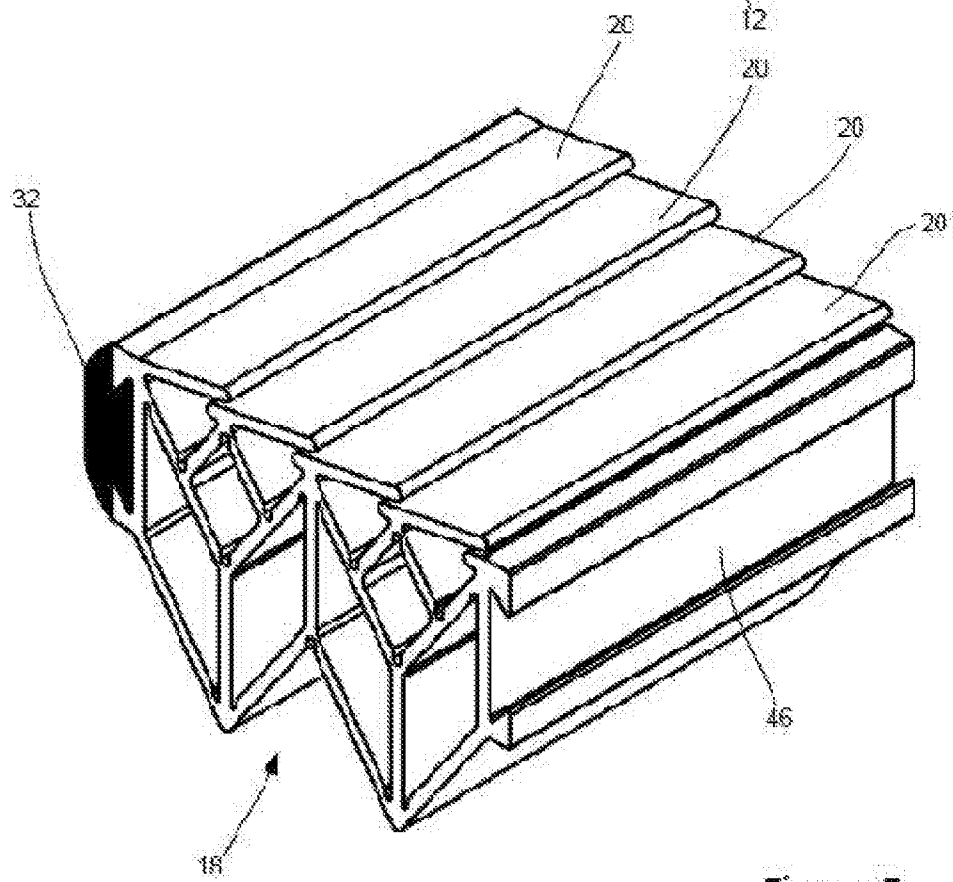
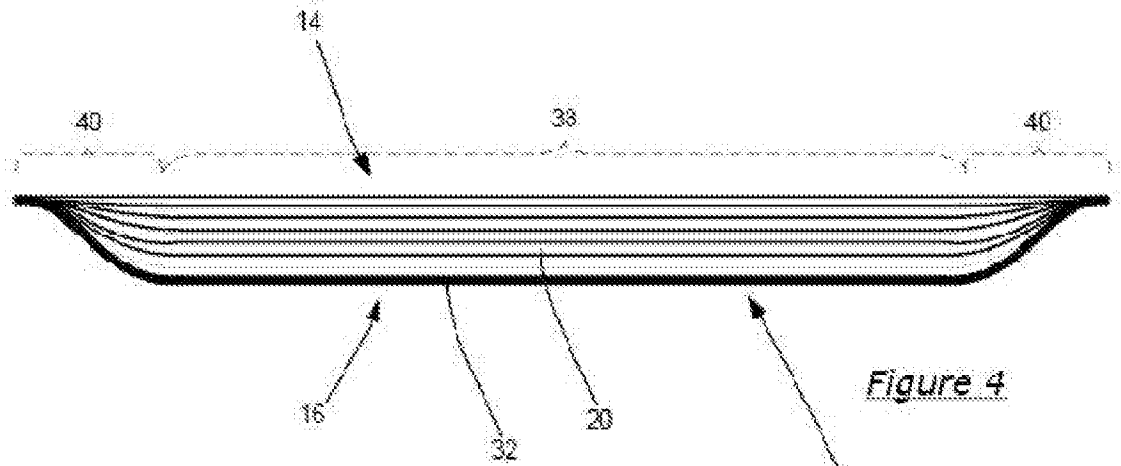
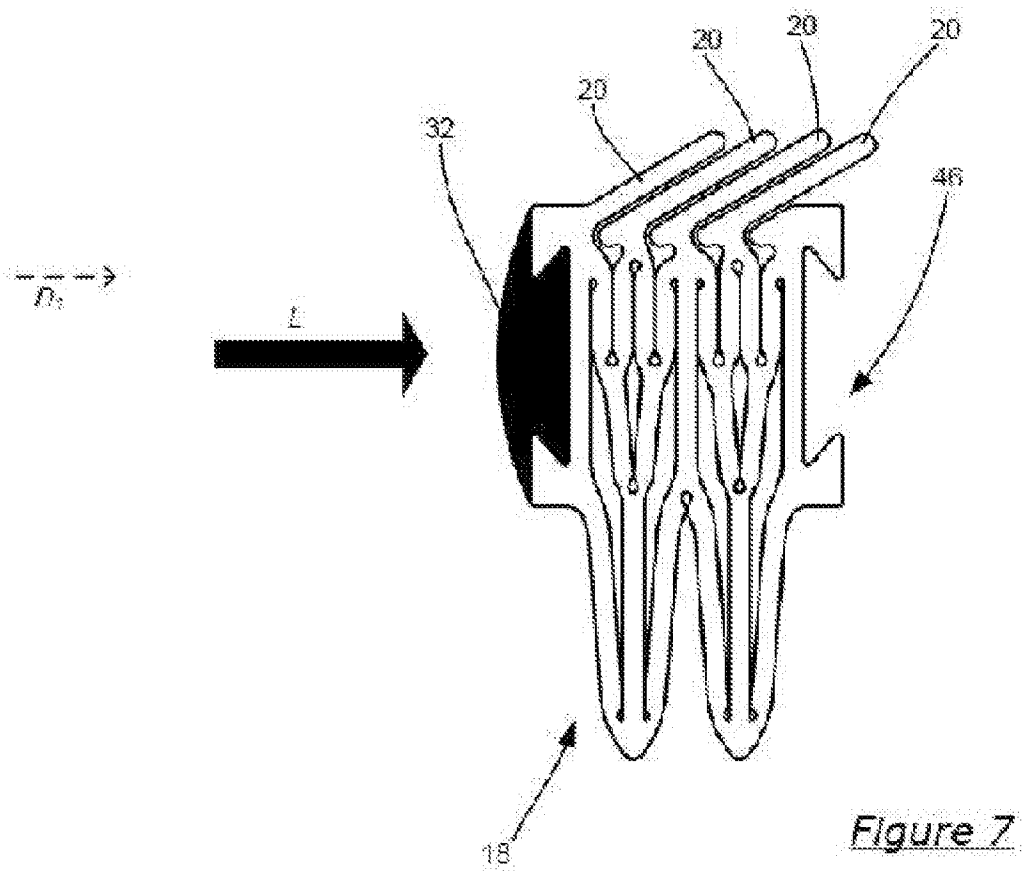
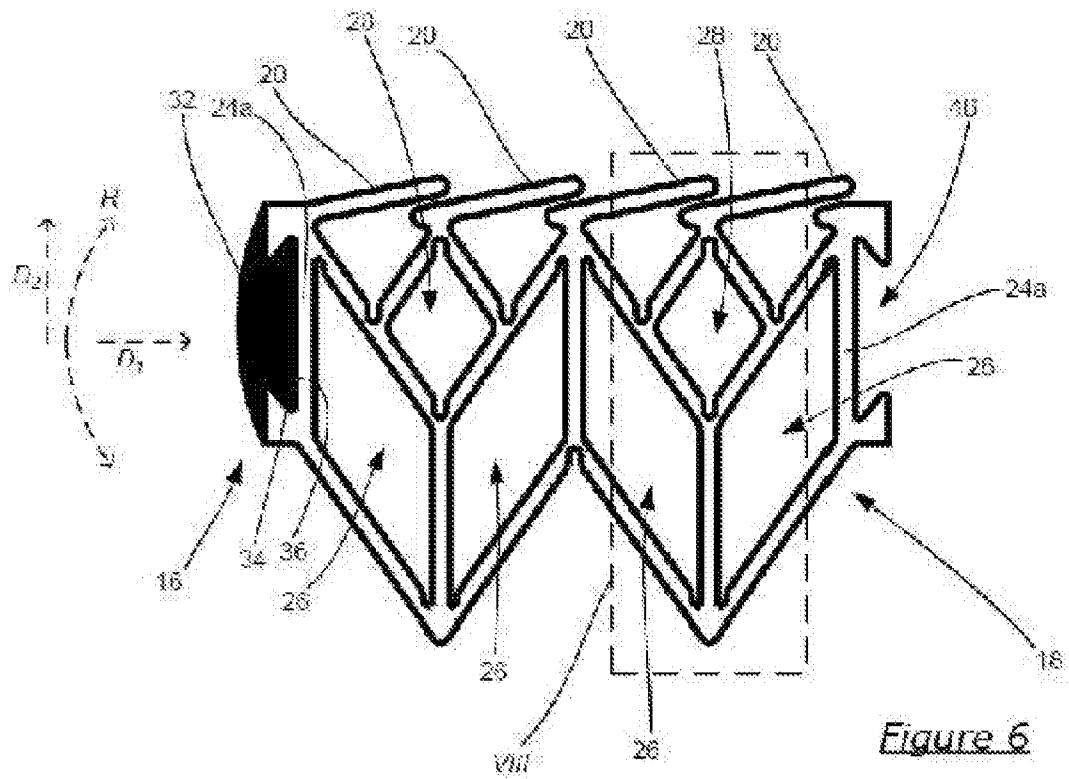


Figure 5

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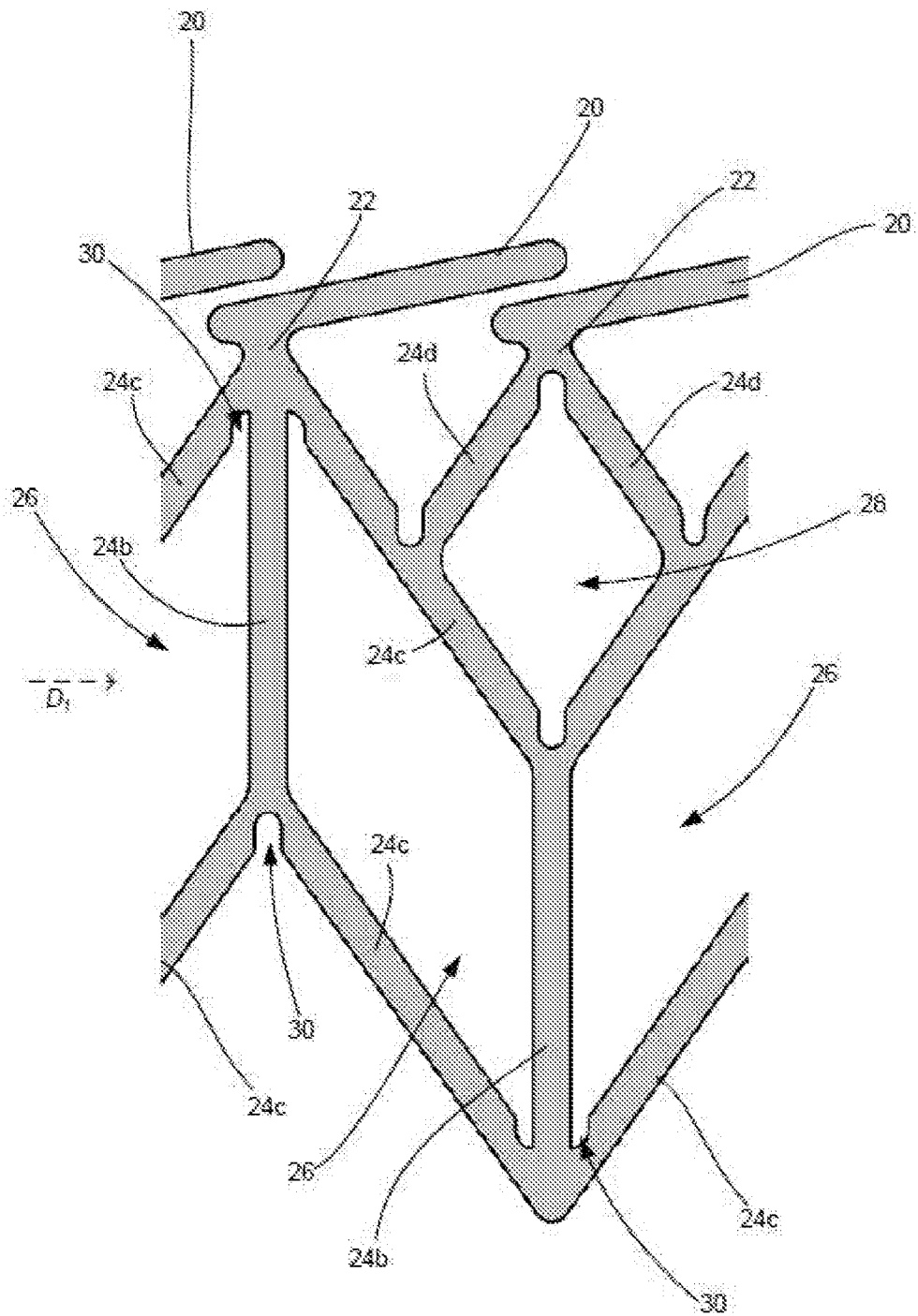


Figure 8

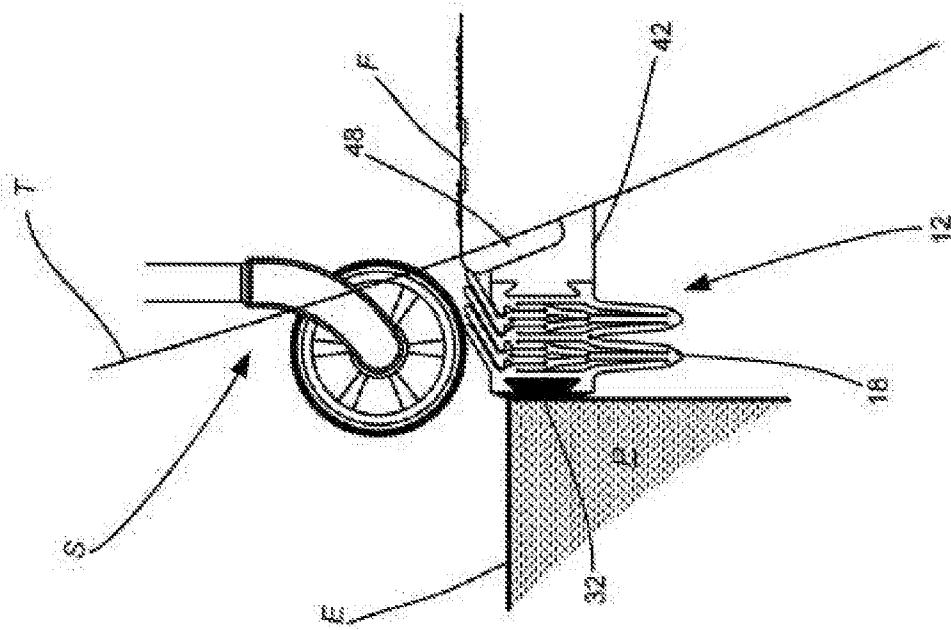


Figure 10

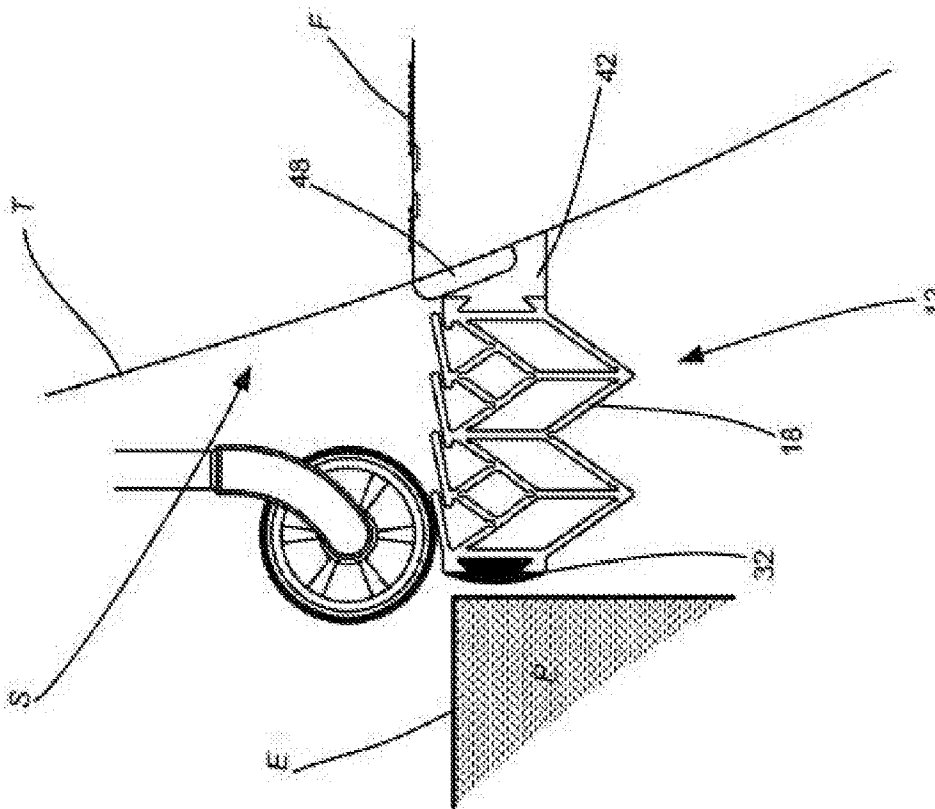


Figure 9

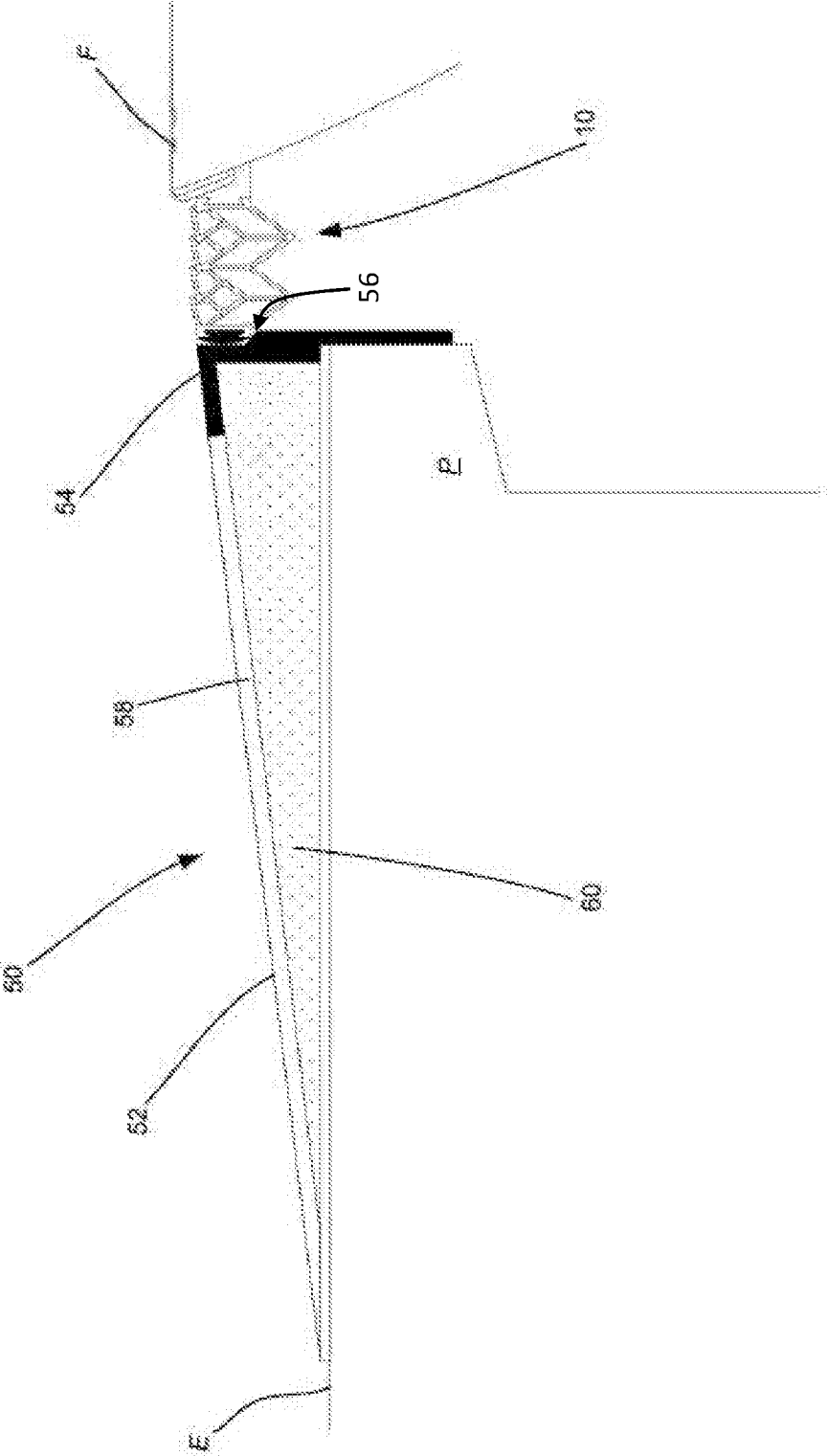
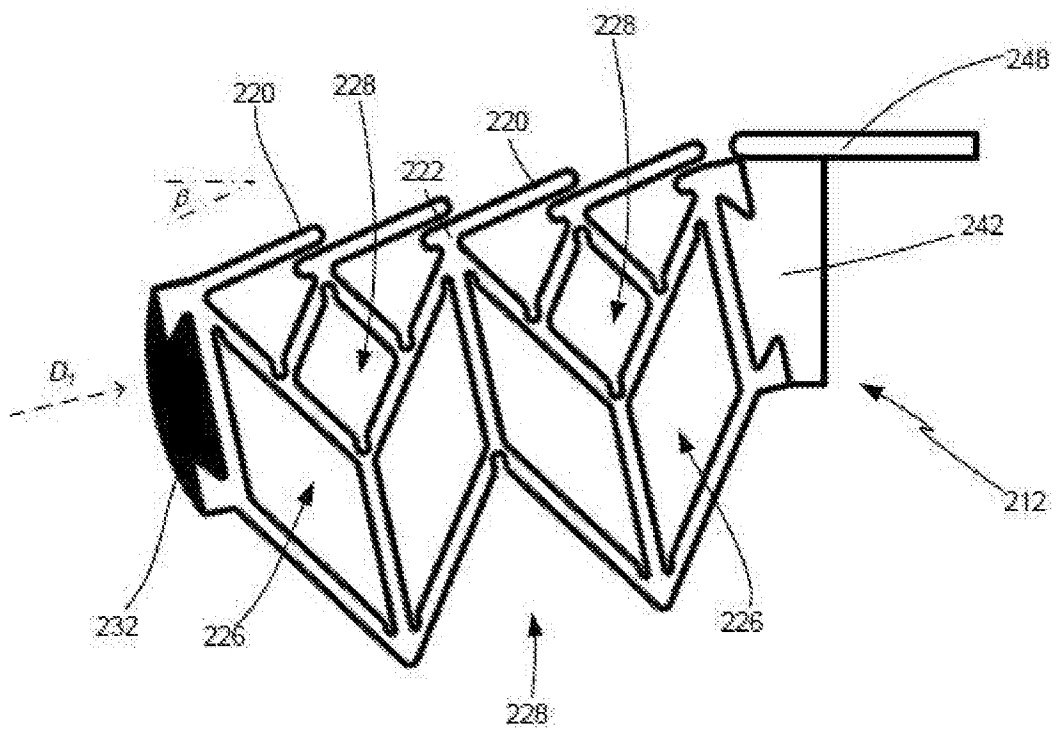
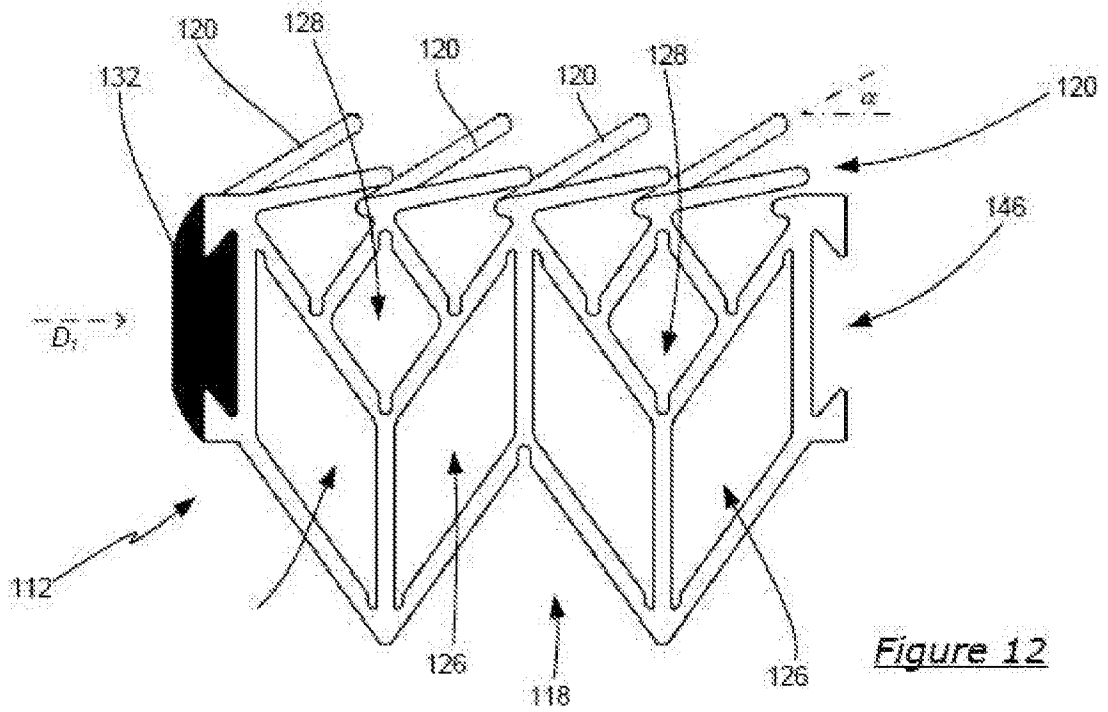


Figure 11

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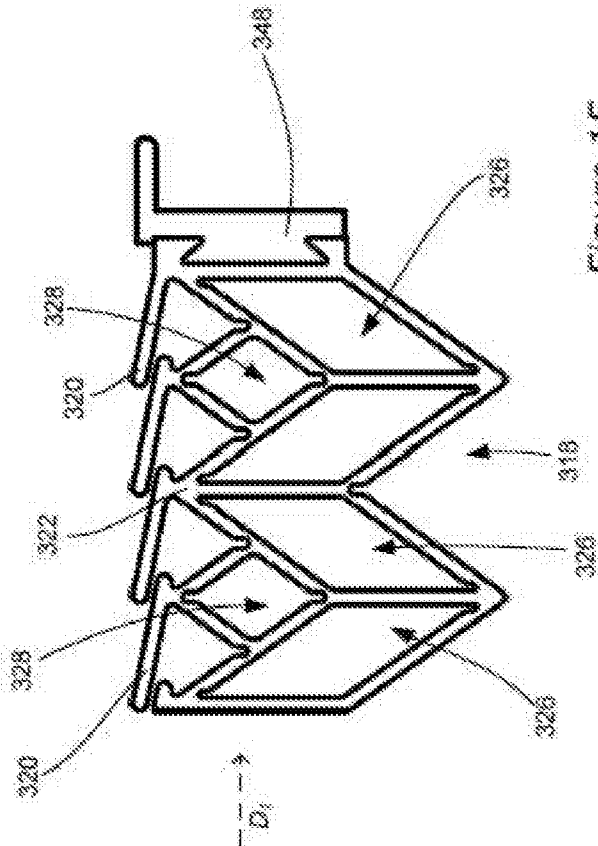


Figure 15

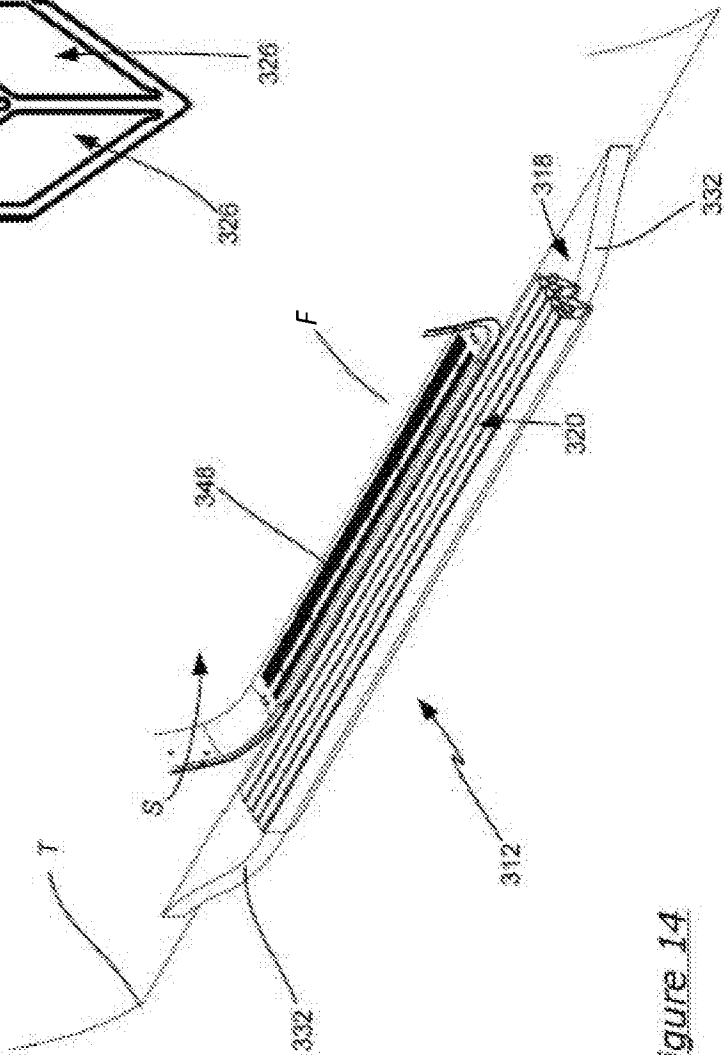


Figure 14

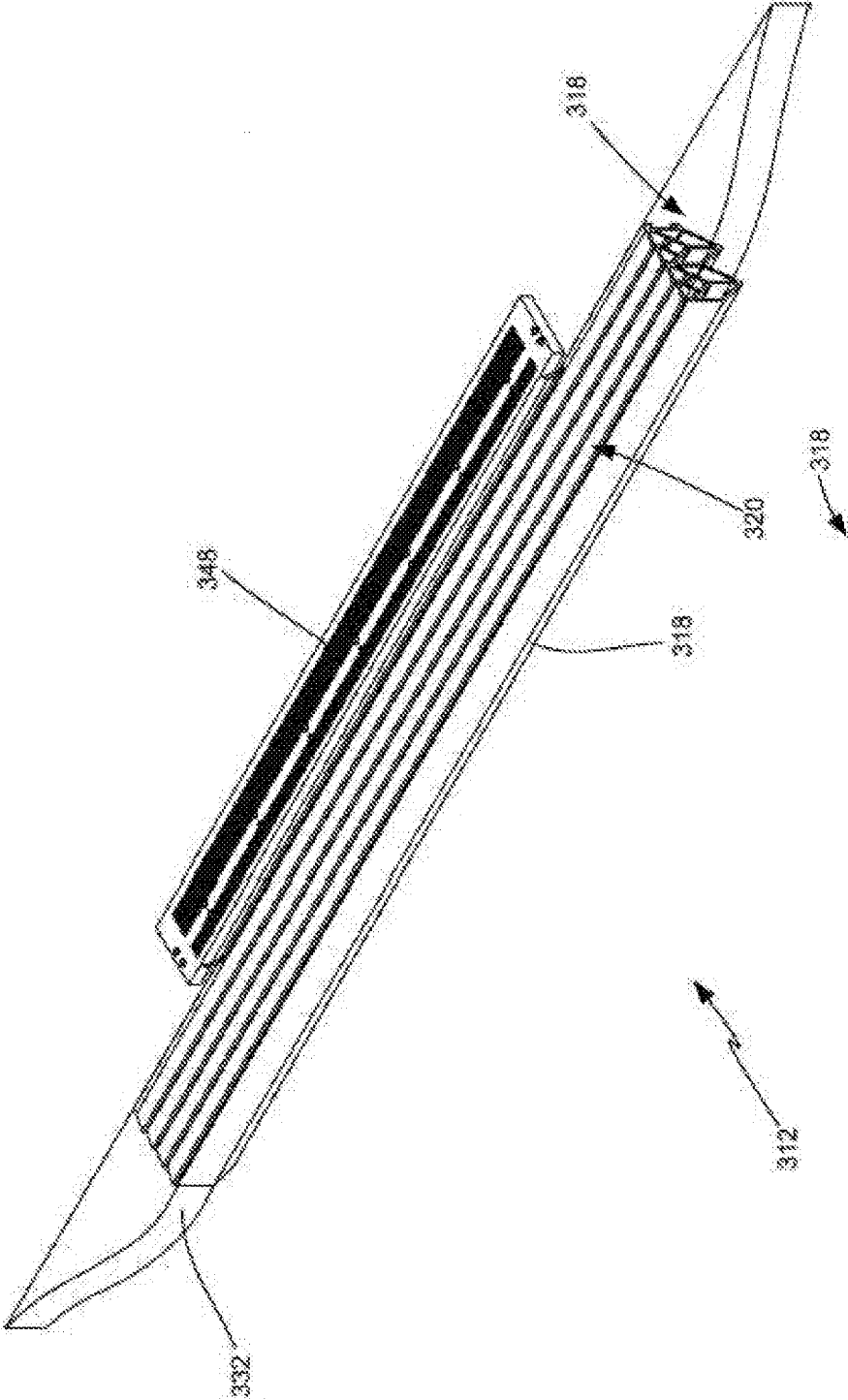


Figure 16

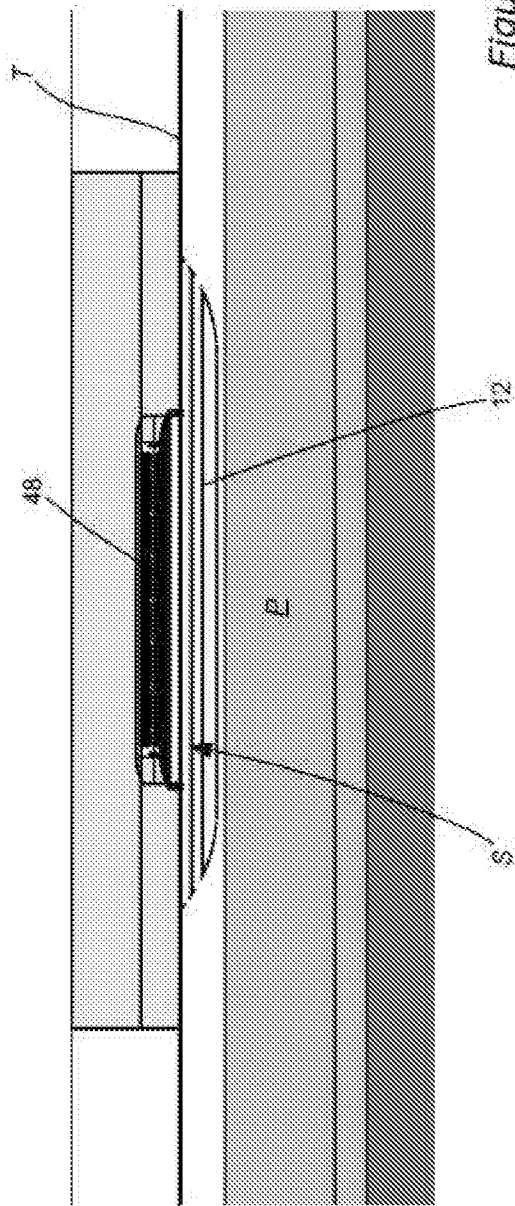


Figure 17

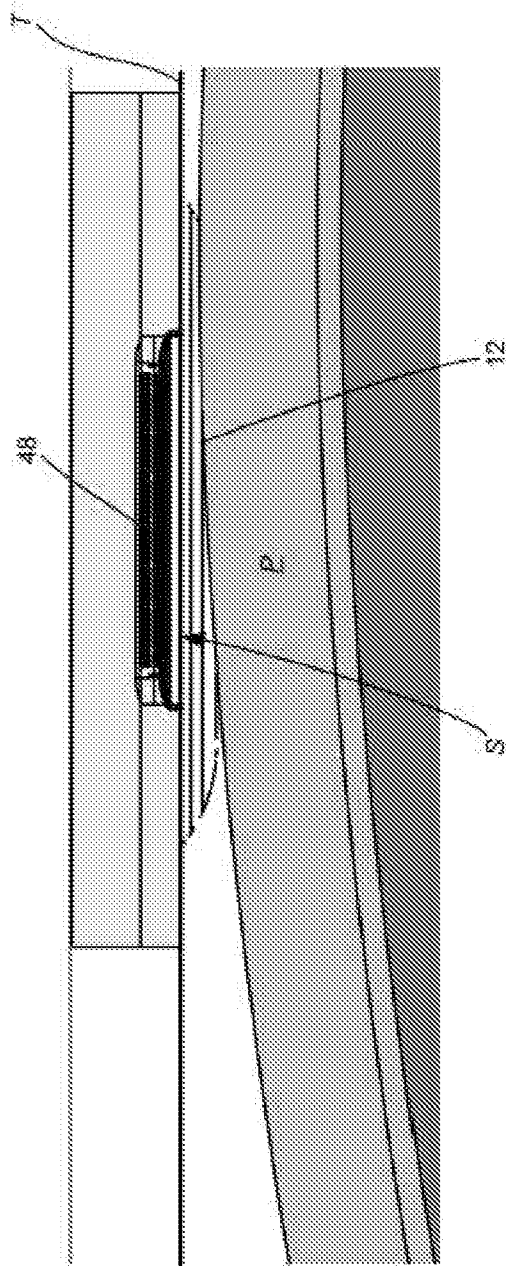


Figure 18

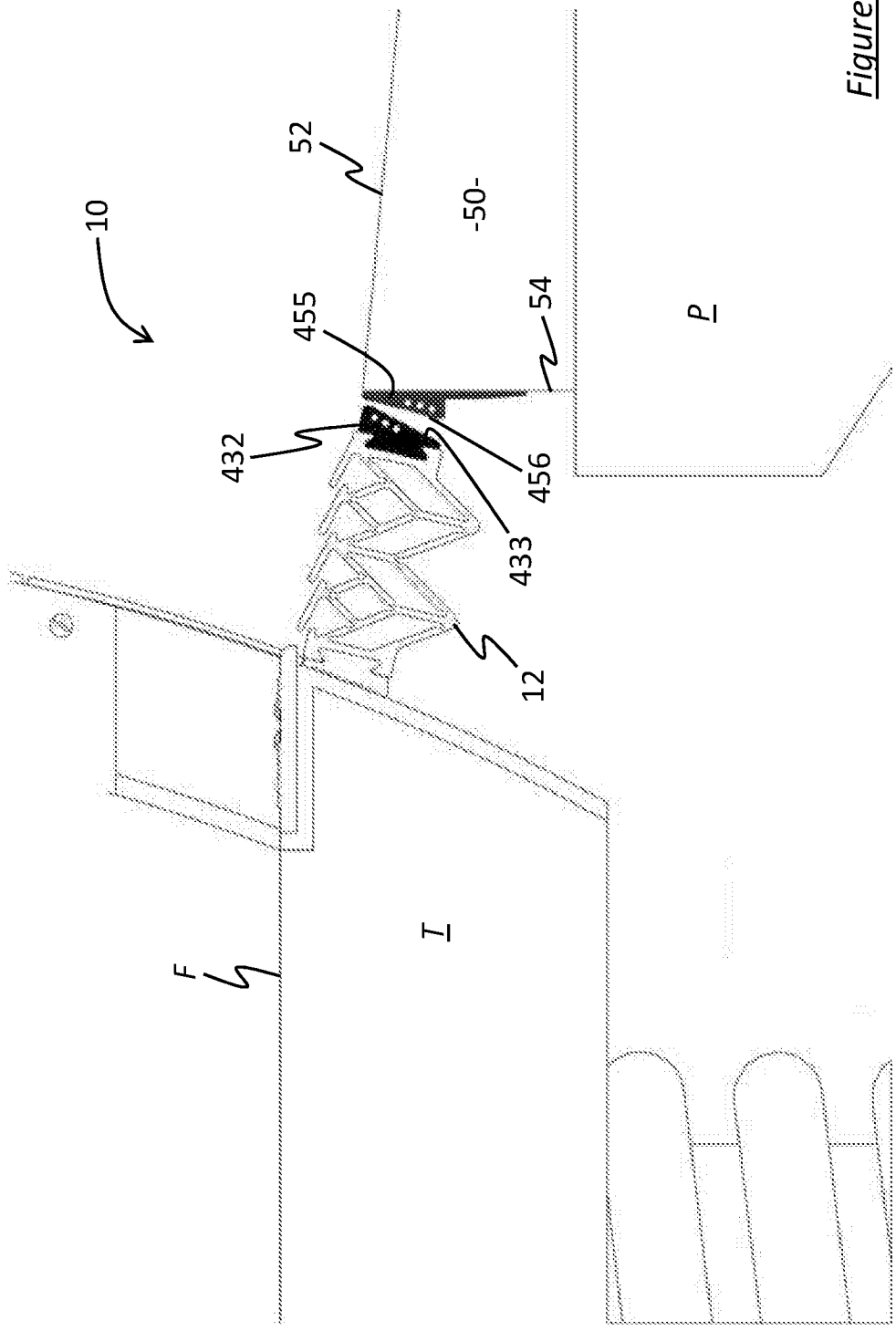


Figure 19

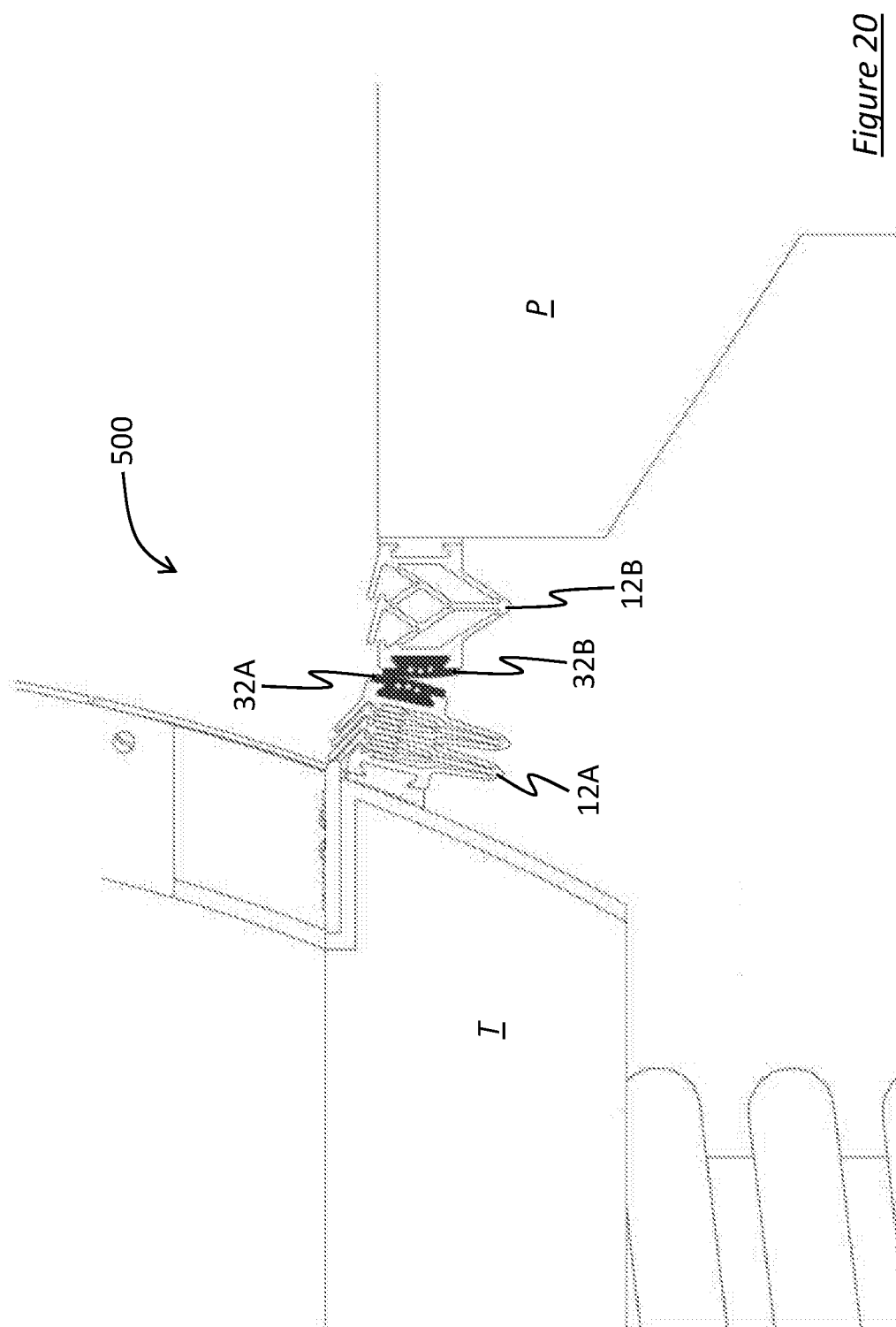


Figure 20

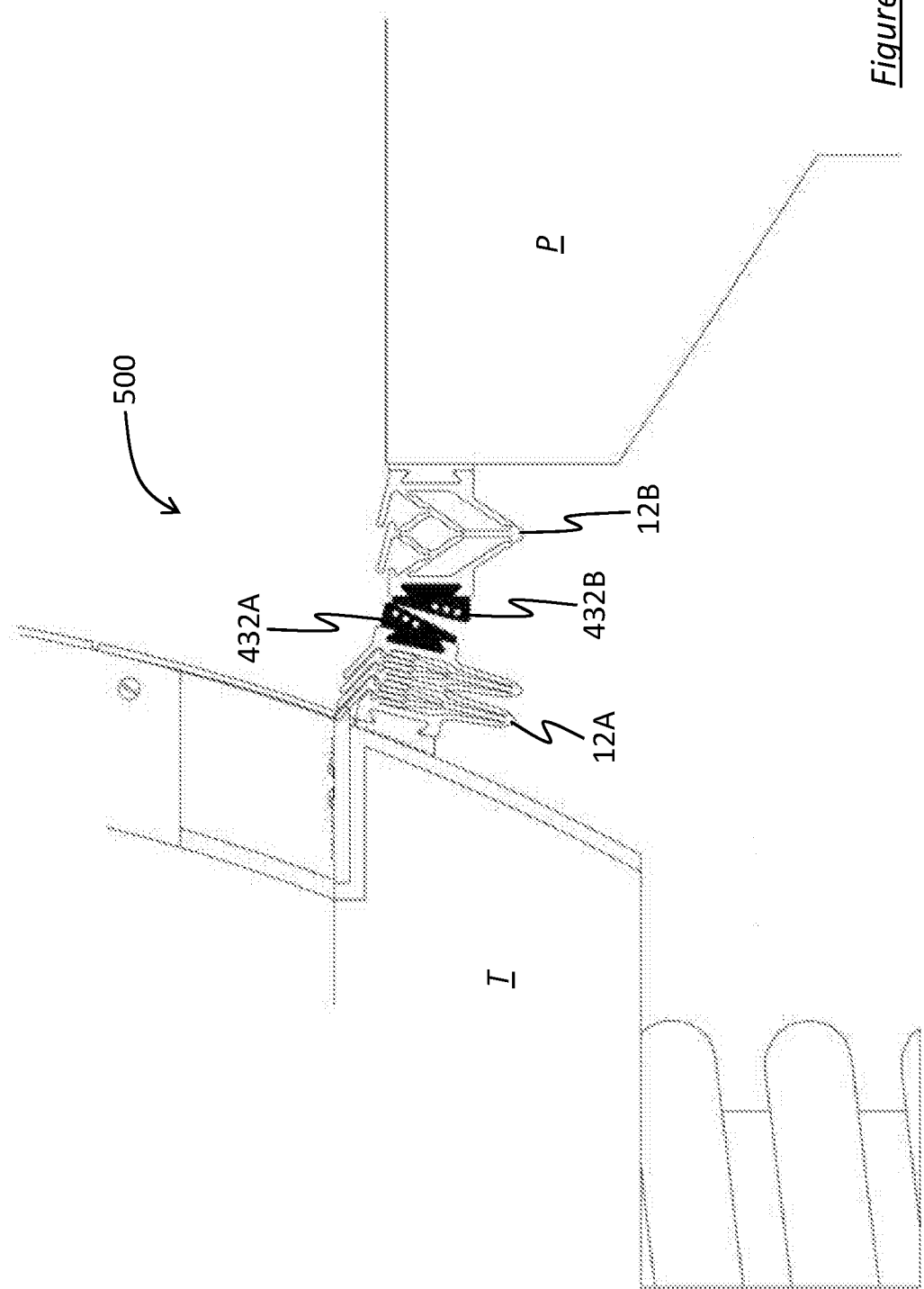


Figure 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2017/050171

A. CLASSIFICATION OF SUBJECT MATTER

B61D 23/02 (2006.01) B61B 1/02 (2006.01) A61G 3/06 (2006.01) B65G 69/28 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIAP, EPODOC: IPC, CPC: A61G3/061, A61G3/067, A61G2220/12, B60P1/43, B61D23/02, B60R3/02, E04G2001/157, E04F2011/005, B63B27/143, B60P1/4492, B65G69/28, E04G27/00, E04G1/15, E04F11/002, B61B1/02, B61D23/00, A61G3/06, B60P1/44, B60R3/00, E01F1/00; Keywords: bridging, safety, platform, gap, ramp, device, telescopic, elastic, resilient, railways, subways, buses, vehicles and similar terms.

Applicant and Inventor name searched in Espacenet, AusPat and Google. Google and Google Patents (Keywords): bridging, safety, platform, gap, ramp, device, telescopic, elastic, resilient, railways, subways, buses, vehicles and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 21 March 2017		Date of mailing of the international search report 21 March 2017	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au		Authorised officer Rohan Amburle AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262256109	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2017/050171
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1826063 A1 (IVECO FRANCE S.A.) 29 August 2007 Abstract, Figs 1-4, items 2, 12, 141, 142, 10 and 32, Description Columns 3-5	1-23
X	KR 20130128223 A (RAINBOW SCAPE CO LTD) 26 November 2013, Machine Translation of the Abstract and Description obtained from EPODOC database. Abstract, Figs 1-9, items 100, 10, 20, 160, 130, 120, 150, 140; Description Paragraphs 18-35	1-23
A	US 2008/0028546 A1 (FULLERTON et al.) 07 February 2008 Figs 1-5	1-23
A	DE 202011001919 U1 (JERTZ) 16 June 2011 Figs 1-4	1-23
A	US 5803523 A (CLARK et al.) 08 September 1998 Figs 1-4	1-23

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/AU2017/050171	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
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		AU 3896697 A	06 Mar 1998
		WO 9806536 A2	19 Feb 1998
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			