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(54) BARRIERS

(57) Disclosed is a barrier apparatus for use as a vehicle barrier comprising: one or more barrier members; a plurality of separate support base parts each adapted for ground engagement by placement upon a ground or floor surface to each of which is fixed a respective housing part, wherein at least one said housing part includes a barrier member; each housing part comprises a duct extending in a direction along the respective support base part from a duct opening at an end of the duct accessible from an edge of the respective support base part; and, a coupling part adapted for concurrent insertion into a respective duct of each said housing part of two said support base parts when aligned thereby to couple together adjacent support base parts of the plurality of separate support base parts.

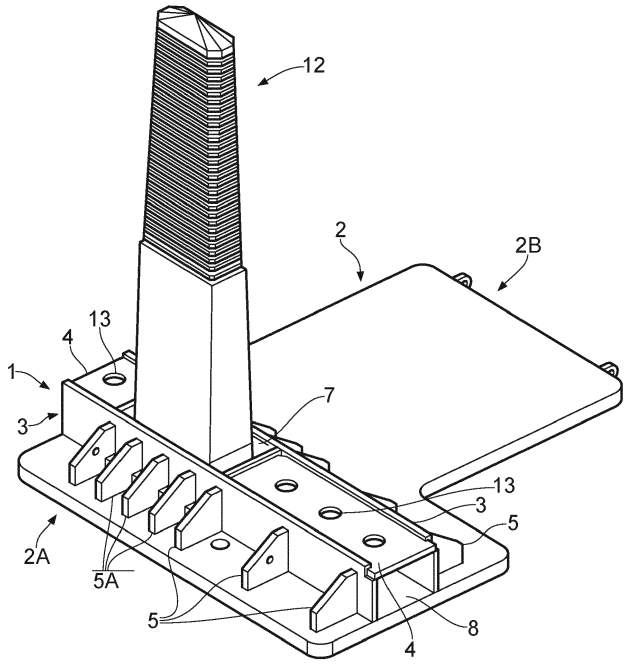

FIG. 1

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Description

FIELD

[0001] The invention relates to vehicle impact barriers.

BACKGROUND

[0002] The provision of vehicle impact barriers for use in vehicle highways and pedestrian highways, or both, is an engineering challenge when there exist severe constraints on the depth of excavation possible within which to embed parts of the barrier. This is most acutely when the highway in question is, for example, located across the span of a bridge. This can be appreciated when one realises that whereas a regular terrestrial highway is formed upon the ground surface of Earth which may permit excavations of sufficient depth to accommodate vehicle impact barrier engineering works, this is not the case when the highway is formed on a bridge span.

[0003] A vehicle impact barrier must be of sufficient strength and engineering integrity to be able to withstand very high impact forces and when there are no constraints upon the depth of excavation for accommodating such an impact barrier, the engineering form and structure of the barrier may be relatively simple. However, when severe constraints are imposed, regarding permissible excavation debts, the engineering form and structure of the vehicle impact barrier must be very carefully considered if it is to meet the stringent requirements imposed by excavation depth limitations while simultaneously meeting the stringent requirements imposed by impact resistance needs. To be truly (e.g. officially) rated as vehicle impact-resistant barrier, a barrier must undergo onerous impact tests before it is permitted to enter public use as a vehicle impact-resistant barrier.

[0004] The present invention aims to address these challenges.

SUMMARY

[0005] The present invention provides a barrier apparatus according to the appended claims.

[0006] In a first aspect, the present disclosure provides a barrier apparatus for use as a vehicle barrier comprising: one or more barrier members; a plurality of separate support base parts each adapted for ground engagement by placement upon a ground or floor surface to each of which is fixed a respective housing part, wherein at least one said housing part includes a barrier member; each housing part comprises a duct extending in a direction along the respective support base part from a duct opening at an end of the duct accessible from an edge of the respective support base part; and, a coupling part adapted for concurrent insertion into a respective duct of each said housing part of two said support base parts when aligned thereby to couple together adjacent support base parts of the plurality of separate support base parts.

[0007] Preferably, the at least one barrier member and the at least one housing part which includes the barrier member, are both upstanding from the support base part. The housing part may be formed upon an upper surface of the support base part, For example, if the support base part comprises a flat sheet (e.g. steel sheet), then the housing part may be fixed to the sheet surface uppermost in use. The means that the surface of the support base part need not have any housing part, or any barrier part, projecting outwardly from the lowermost surface of the support base part. This is a particular advantage for a barrier intended for placement within a very shallow excavation, such as in a highway on a bridge span, the excavation need only accommodate the base support part and little or none of the housing part which supports the barrier member of the vehicle barrier assembly.

[0008] The housing part is preferably dimensioned and arranged for retaining the base end of a barrier member when the barrier member is upstanding from the base support part. The one or more barrier members may be separable (e.g. detachably attachable) from the structure of the housing part. For example, a barrier member may have a base end dimensioned to slot into a socket formation of the housing part to mount the barrier part to the support base part via the socket of the housing part. The barrier part may be an elongated post or bollard. The barrier part may be generally rectangular in transverse cross-section or may be round (e.g. circular) in transverse cross-section, and may be tubular.

[0009] The housing part may define a socket part dimensioned and arranged for receiving the base end of a said barrier member into the housing together with one or more rigid billet parts for constraining the position of the barrier member within the housing part, and/or cementing material for cementing the bollard member to the housing part.

[0010] The barrier member may comprise a laterally projecting portion (e.g. a lug, flange or ridge) defining an anchor part adapted to abut against a component of the housing part to render that component an obstruction to extraction of the barrier from the housing part. The anchor part may project from the barrier part in a direction towards the nearmost edge of the base support part e.g. the side of the barrier apparatus from which vehicular impact is expected, or may be positionable to project in that direction.

[0011] Desirably, the barrier member includes a fixed anchor part adjacent a base end thereof and outwardly projecting therefrom in a direction transverse to the longitudinal axis thereof wherein the housing part is dimensioned to receive the base end with the anchor part in abutment against the housing part such that the base end of the barrier member is thereby prevented from passing through the housing part. The base support part may possess an aperture defining a through-opening into which the foot (e.g. terminal base end) of the barrier part resides or is positionable. The housing part may comprise a wall part defining a wall of the duct, and a lower

edge of the wall part may be exposed to, or span, the aperture and may be located relative thereto to the aperture to extend over the anchor part, when seated therein, thereby to form an obstruction to removal of the foot of the barrier part from the aperture when seated therein. An upper surface of the may abut the lower edge when the foot of the barrier part is seated within the aperture.

[0012] A transverse dimension of the socket part may exceed a corresponding transverse dimension of those parts of the barrier member which the socket part is arranged to admit by an amount sufficient to define a gap therebetween within which the bollard member is moveable to adjust its position and/or inclination relative to the base support part and/or relative to the housing part.

[0013] The base support part may possess an aperture defining a through-opening into which the foot (e.g. terminal base end) of the barrier part resides or is positionable. The foot of the barrier part, when so positioned, may abut or oppose the edges of the aperture, such that vehicle impact forces imparted to the barrier part may be transferred to one or more edges of the aperture via the foot of the barrier part. The support base plate may comprise an aperture cover base plate which extends across the aperture to close it at the underside of the support base part. The aperture cover base plate may thereby define a floor or seat of a recess in the support base part defined collectively with the through-opening.

[0014] Alternatively, a barrier member may be integrally formed with the housing part. For example, the housing part may comprise a wall part defining a wall of the duct, and a barrier part may comprise one or more upstanding limb or tongue sections extending or upstanding from the wall. For example, the duct may comprise two wall parts each of which comprises one or more such upstanding limb or tongue sections. The limb or tongue section of of two opposing duct walls may also oppose each other. Opposing such limb or tongue sections may be rigidly connected by an upstanding intermediate strut or strip fixed to, and extending between, the two opposing limb or tongue sections.

[0015] The barrier apparatus may be made from a metal, such as steel. The support base part and/or the housing may be made from a first metal or alloy (e.g. steel) and the barrier member may be made from another (different) metal or alloy. The housing part may be connected to the support base part by welding (e.g. fillet welds). The support base part may comprise a substantially flat plate, such as a single-piece plate. The housing part may comprise a plurality of metal plate pieces welded together to form the structure of the housing (e.g. the duct).

[0016] Desirably, the duct is dimensioned and arranged for containing an end of the coupling part together with cementing material for cementing the coupling part to the housing part within the duct thereof. The lateral dimensions of the duct, transverse to its length, preferably exceed the corresponding lateral dimensions of the coupling part to such an extent that the cementitious material inserted into the duct may encapsulate (e.g. surround most of, or substantially all of) those portions of the coupling part within the duct. The coupling part may comprise a rigid elongated body. The elongated body of the coupling part may be linear along its long axis. The elongated body of the coupling part may comprise a plurality of parallel, separate and separated, rigid, elongated sub-parts fixed together by rigid transverse part(s) extending between them. This increases the surface area of the coupling part accessible to cementitious material. The transverse parts provide effective means for anchoring the coupling part within the cementitious material.

[0017] A transverse dimension of the socket may exceed a corresponding transverse dimension of those parts of the barrier member which the socket is arranged to admit by an amount sufficient to define a gap therebetween through which one or more rigid billet part(s) are inserted, or cementing material is flowable, to fill regions within housing part which surround the parts of the barrier member therein.

[0018] Desirably, the at least one barrier member comprises at least one bollard. The housing part may be substantially elongated and linear, The duct may be substantially linear. Successive support base parts may be arranged in a linear array, side-by-side, with their respective housing parts (and ducts) collinearly aligned to place adjacent ducts, upon adjacent support base plates, in pairs in communication with each other having a part of a common coupling member within each duct of the pair and extending from one duct to the other. The collinearly aligned housing parts may form a part of a kerb, and may be encapsulated in a concrete kerbstone, for example. The housing part of at least one support base part desirably comprises a plurality of said ducts each extending in a respective direction along the support base part from a respective duct opening accessible from different respective edges of the support base part, thereat to receive a respective said coupling part to couple a plurality of adjacent support base parts at said different respective edges of the support base part concurrently. The plurality of said ducts may each extend in a respective direction mutually in parallel along the support base part.

[0019] The housing part may include a wall part extending along the base support part to define at least a part of a wall of the duct, and extending from the base support part in a direction upstanding therefrom to define at least a part of a said barrier member. The part of the wall of the duct may comprise a tongue portion, limb portion or sheet portion extending upwardly from an upper edge of wall part of the housing part to a height sufficient to define a barrier member (or a part of one). Two opposing such wall parts of the may be arranged with respective tongue, limb or sheet portions in register and opposing each other from opposite sides of the housing part, and may collectively form a barrier member. The opposing respective tongue, limb or sheet portions may be fixed together by a strut or plate passing from one to the other across the space between them.

[0020] The base support part may include a through-

opening arranged in register with the housing part and dimensioned to admit therethrough parts of the barrier member so as to extend from within the housing part in a direction transverse to the base support part, and a transverse dimension of the base end of the barrier member exceeds a corresponding transverse dimension of the housing part such that the base end of the barrier member is thereby prevented from passing through the housing part. For example, the barrier part may be insertable, or inserted, into the housing part from below via the through-opening, by passing the length of the barrier member though the through-opening until the base end of the barrier member is brought into engagement with the parts of the base end having the transverse dimension exceeding that of the housing part. This is as an alternative to inserting the barrier member base-first into the socket part of the housing, from above.

[0021] The support base part may comprise a plate member having said through-opening on register with the socket part at the periphery of the through-opening thereby placing said through-opening in communication with the socket part.

[0022] In a second aspect, the present disclosure provides a vehicle barrier comprising said barrier apparatus described above, in assembled form.

[0023] In a third aspect, the present disclosure provides a kerb assembly comprising the barrier apparatus described above, in which the housing part of at least one of the plurality of separate support base parts is embedded within a cementing material forming a kerb.

[0024] In a fourth aspect, the present disclosure provides a kerb assembly comprising a vehicle barrier including: a concrete kerbstone part presenting a concrete outer kerb surface; one or more barrier members embedded within the kerbstone and upstanding from the outer kerb surface; a plurality of separate support base parts each adapted for ground engagement by placement upon a ground or floor surface wherein at least one said support base part includes a barrier member; and, one or more coupling parts connecting together two adjacent said support base parts of the plurality of separate support base parts, wherein at least one of the one or more coupling parts is embedded within the kerbstone. The barrier apparatus described above provides an example of this. The housing parts may be embedded within the kerbstone (e.g. concrete) with the coupling part fixed within the duct of the housing parts. Alternatively, in a different arrangement, a coupling part may be connected to each of two adjacent support base parts via at least two fixture members (e.g. bolts) spaced apart at the respective support base plate to prevent rotation of the coupling part relative to the coupling part in the plane containing both. Alternatively, in a different arrangement, a coupling part may comprise two or more rigid tubular members, at least one of which is fixed to a respective one of each of two adjacent support base plates, the tubular members being positionable in register such that a coupling shaft passes within the tubular bore of at least one tubular member on each one of two adjacent support base parts, thereby to connect the two support base parts. The coupling shaft extends within the plane of the support base parts to prevent rotation of the coupling part relative to the support base parts in the plane containing them.

[0025] The term "including" herein may refer to being (or being adapted to be) included within a structu re.

BRIEF DESCRIPTION OF DRAWINGS

[0026] There now follows a description of some examples and embodiments of the invention which are useful for understanding but which are not intended to limit the scope invention.

Figure 1 illustrates a vehicle impact barrier;

Figure 2 illustrates a plan view of the vehicle impact barrier of figure 1;

Figure 3 illustrates a cut-away view of the impact barrier of figure 1;

Figure 4 illustrates a side view of the view illustrated by figure 3;

Figure 5 illustrates a side view of the view illustrated by figure 3, with a bollard in a locked position;

Figure 6 illustrates a side view of the view illustrated by figure 5;

Figure 7 illustrates a view of a vehicle barrier apparatus, in which a bollard component part is omitted for clarity;

Figure 8 illustrates a plan view of a vehicle barrier apparatus illustrated in figure 7, in which a bollard component part is omitted for clarity;

Figures 9A, 9B, 9C and 9D illustrates a plan view, and three cross-section views, of a vehicle barrier apparatus illustrated in figure 8, in which a bollard component part is omitted for clarity;

Figure 10A illustrates a plan view of a vehicle barrier apparatus illustrated in figure 7, in which a bollard component part is included, together with two coupling members;

Figure 10B illustrates a coupling member;

Figure 10C illustrates a plan view of a vehicle barrier apparatus comprising two vehicle apparatus assemblies as illustrated in figure 7, in which a bollard component part is included, together with two coupling members;

Figure 11A and 11B show a cross-section of you and a perspective view of a road and pedestrian surface upon a bridge within which an excavation is formed;

Figure 12A and 12B show a cross-section of you and a perspective view of a road and pedestrian surface upon a bridge within which an excavation is formed within which a vehicle barrier assembly is located;

Figure 13A and 13B show a cross-section of you and a perspective view of a road and pedestrian surface upon a bridge within which an excavation is formed within which a vehicle barrier assembly is located, wherein the excavation is re-surfaced and in which a kerb assembly is provided in which the barrier apparatus is integrated into a kerbstone assembly;

Figure 14 illustrates a vehicle impact barrier apparatus;

Figure 15 illustrates a vehicle barrier apparatus;

Figures 16A and 16B illustrate a vehicle impact barrier apparatus in the form of a curb assembly wherein the barrier apparatus is integrated into a kerbstone assembly

DESCRIPTION OF EMBODIMENTS

[0027] there now follows a description of a number of examples of the invention which are not intended to be limiting of the scope of the invention, and serve to aid an understanding of the invention. The examples refer to drawings like items are assigned like reference symbols.

[0028] Referring to figure 1 and figure 2, there is illustrated a vehicle barrier apparatus comprising a housing part (1) which is fixed to the surface of, and is upstanding from, a support base plate (2). The support base plate is a support part comprises a continuous sheet of steel to which other component parts of the barrier apparatus are welded or coupled, and is adapted for ground engagement by placement upon a ground or floor surface. A barrier member, in the form of a bollard (12), is connected to the support base plate at a base end of the bollard which is housed within the housing part. The bollard is upstanding from the support base plate and from the housing part to be upstanding relative to the ground surface upon which the support base plate is disposed in use.

[0029] The housing part (1) comprises a duct linear (8) which extends in a direction along the support base part across the surface of the support base part which is uppermost in use, being generally parallel to that uppermost surface. In particular the duct (8) comprises a planar duct floor surface which is provided by the uppermost surface of the support base part, and two linear duct wall parts (3) which each comprise a generally rectangular elongated, planar steel sheet are each is welded to the uppermost planar surface of the support base part along one elongate edge of the duct wall part in question so as to be generally upstanding (substantially perpendicular) from the planar surface of the support base part. The two duct wall parts are of substantially the same elongate length and possess substantially the same maximal transverse width along the majority of (but not all of) the elongate length of each duct wall part. Consequently, the two duct wall parts are disposed to oppose each other in plain parallel opposition across the border of the duct.

[0030] The uppermost elongate edge of one duct wall part is substantially the same height above the planar surface of the support base part as the uppermost page of the other of the duct two wall parts. As a result, the two uppermost elongate edges of the two duct wall parts extend linearly, in parallel and at the same height above and cross the uppermost surface of the support base part. A duct roof plate (4) extends between opposing inner duct wall surfaces, from one to the other of the two opposing duct wall parts at a height adjacent to the uppermost elongates edge of the two duct wall parts. The duct roof plate covers substantially the entire length of the duct formed in combination with the duct floor, and the two duct wall parts (3), and is spaced from the duct floor by a substantially uniform vertical spacing from, and in plain-parallel opposition to, the duct floor along the length of the duct. In this way, a substantially rectangular duct, of rectangular cross section, or generally "box-section" duct (eight) is formed.

[0031] A terminal edge of the duct roof plate spans between two terminal vertical edges of the two duct wall parts (3), to define an end opening of the duct (8) disposed immediately adjacent a terminal plate edge of the support base part (2). A coupling part (see item 20; Fig. 10A, Fig.10B, Fig.10C) is dimensioned and arranged for concurrent insertion into each one of the two respective ducts formed by the housing parts of two adjacent support base parts via the respective duct openings thereof, when positioned/align mutually in register. For example, one half (or thereabouts) of the coupling part may be inserted into the duct of one of the two aligned support base parts, with the other half (or thereabouts) of the coupling part inserted into the duct of the other two of the aligned support base parts. Cementitious material, such as grout or concrete, may then be poured into each of the two ducts to surround and encapsulate the inserted coupling part and to fill those parts of the respective duct which are not occupied by the coupling part the duct becomes completely full of cementitious material within which part of the coupling part is embedded. In this way, the two adjacent support base parts may be coupled together.

[0032] A linear array of three evenly spaced fluid-flow through-openings (13) formed within the duct roof plate (4) so as to permit a fluid communication into the bore of the duct from outside of the duct, independently of the duct opening. These fluid-flow through-openings are dimensioned and adapted to permit a steady flow of liquid

cementing substance (e.g. grout or concrete) into the bore of the duct, to permit any free space within the bore of the duct to fill with cementing material.

[0033] The duct roof plate may be welded to the duct wall parts, or me be provided with lugs or notches dimensioned and arranged to cooperate with slots or ledges formed within wall parts of the duct to permit the weight of the duct roof plate to be supported at the slots or ledges of the walls of the duct, via the lugs or notches of the duct roof plate. The slots or ledges, and the lugs or notches maybe positioned, dimensioned and arranged such that the former cooperate in register with the latter when the duct roof plate is positioned to complete the formation of the duct.

[0034] The housing part (1) of the barrier apparatus extends linearly across the uppermost surface of the support base part (2) from one terminal edge of the surface to an opposite terminal edge, and comprises two ducts, as described above, each one of which presents the respective duct opening which is accessible from a respective one of the two opposite terminal edges of the support base part. Included within the structure of the housing part, and separating the two ducts of the housing part, is a socket part (7) formed between two opposing portions of the duct wall parts (3) where no duct roof plate (4) is present and to terminal duct end plates (3B) disposed within the housing part to define terminal perspective ends of the two ducts. A segregated portion of the cavity of the housing part is thereby made accessible, independently of the two duct parts of the housing, and this defines the socket part.

[0035] A base end of the barrier bollard (12) is inserted into the socket part such that the remaining, upper parts of the bollard are outstanding from the base support plate (2) in a direction generally perpendicular to the plane of the base support plate. It is noted that the transverse width of the base of the bollard in the dimension transverse to the longitudinal length of the housing part, is smaller than the corresponding transverse width of the socket part along that damage (i.e. the spacing between opposing duct walls (3). Similarly, the transverse width of the base of the bollard in the dimension along the longitudinal length of the housing part, is also smaller than the corresponding longitudinal width of the socket part along the dimension (i.e. the spacing between two opposing terminal duct end plates (3B). A gap formed between the walls of the socket part and the opposing vertical surfaces of the base end of the bollard is, in use, filled by billet members (14) as is shown in the plan review of the barrier apparatus illustrated in figure 2. Each billet member may be formed from solid steel, or other rigid and sufficiently in that-resistant material. Each billet member may be solid. The billet members may collectively fully fill the socket part, collectively with the base end section of the bollard, or may simply extend transversely from an inner vertical wall surface (3) to an opposing vertical surface of the end part bollard within the socket part, without fully filling all remaining parts of the socket not occupied by the bollard. The billet members (14) also serve to transfer impact forces from an impacted bollard (12) into a duct wall (3, 3B) of the housing, and therefrom into a buttress member (5) and ultimately into the base support plate (2).

[0036] A multitude of space-apart, separate buttress members (5, 5A) are each vertically upstanding from the uppermost surface of the support base plate (2) and are simultaneously transversely extending from the outermost vertical surface of a respective one of the two vertical duct wall parts (3). Each individual buttress member presents two support edges, one horizontal and one vertical, which meet at a right-angled convex corner shaped to fit into the concave corner formed by the meeting of duct wall part with the uppermost surface of the support base plate. The vertical support edge of the two support edges, is welded along its entire length to a vertical outer surface of the a respective one of the two vertical duct wall parts. The horizontal support edge of the two support edges, is also welded along its entire length to a horizontal outer surface of the support base plate. Seven such buttress members are welded to each one of the two duct sidewall parts (3), and to the upper surface of the base support plate, thereby providing fourteen buttress members for supporting the housing (1) imposition upon the uppermost surface of the base of support plate (2).

[0037] It is noted that a greater proportion of the total number of buttress members are welded to the housing immediately adjacent those parts of the housing where the socket part is formed, and in which the base end of the bollard (12) is inserted. In particular, ten buttress members are welded adjacent to the socket part, with five buttress members welded on one side of the housing and five welded on the other side of the housing at either side of the socket part. The buttress members adjacent the socket part are evenly spaced in a direction along the longitudinal axis of the housing part so as to provide an even load-bearing capacity against impact forces imparted to the housing via the bollard when a vehicle impacts the bollard.

[0038] The housing is a generally linear structure which extends linearly in a direction generally parallel to a front edge (2A) of the support base plate such that the housing is closer to the front edge of the support base plate and is relatively further away from a rear edge (2B) of the support base plate. The front edge of the support base plate is, in use, positioned to face the expected direction of oncoming vehicle impact upon the bollard (12), whereas the rear edge of the support base plate would be positioned away from the expected direction of vehicle impact upon the bollard. Consequently, a greater proportion of the body of the support base plate extends away from the housing (1) to one side of the housing to provide the function of an "anti-tipple" foot which helps disperse, into the underlying ground surface, the substantial torque or turning forces imparted to the barrier apparatus when a vehicle impacts the side of the bollard (12) adjacent to the new edge (2A).

[0039] Referring to figure 2 and figure 3, the support base plate (2) possesses a rectangular aperture (2C) defining a through-opening passing through the support base plate, which is covered at the underside surface of the support base plate by a cover plate (6) which is bolted to the support base plate at its underside surface to close the through-opening there. The effect is to provide a recess within the upwardly-facing surface of the support base plate into which the almost base end surface of the bollard (12) is inserted. This recess is arranged in register with the walls of the socket part and, as a result, defines the lowermost terminal and of the socket part (7).

[0040] Three of the four edges of the rectangular aperture (2C) in the support base plate coincided with (i.e. in register) three of the four vertically upstanding walls (3,3B) of the socket part defined by the two terminal duct end walls (3B) and the duct sidewall (3) furthest from the front edge (2A) of the support base plate. However, the width of the through-opening in the dimension transverse to the longitudinal axis of the housing, and of the socket part, is greater than the width of the socket part in that dimension. This means that a portion of the lowermost edge (15B) of the fourth vertically upstanding wall (3) nearest to the front edge (2A) of the support base plate, passes over the rectangular aperture of the through-opening (2C) so as to over-hang the full longitudinal width of the through-opening. This over-hanging edge portion of the upstanding wall (3) provides a detent or catch (15B) under which may be positioned a lateral protrusion (15, e.g. a lug, plunge or lip) of the bollard (12) defining an anchor part extending laterally outwardly from the terminal base end of the bollard in a direction generally parallel with the plane of the support base plate, such that extraction of the bollard from the socket part is prevented by action of the detent or catch. Once in this position, the lowermost vertical edges of the bollard reside within the through-opening of the rectangular aperture (2C) in opposition to the vertical internal walls of the rectangular aperture of the support base plate. Consequently, when vehicle impact forces are imparted to the bollard (12), some of the impact load may be transferred from the bollard to the support base plate (2) via the internal walls of the rectangular aperture. This is an efficient means of load transfer.

[0041] In the example shown in present drawings, the over-hanging edge defining the detent or catch (15B) resides at a vertical position slightly above the plane of the uppermost surface of the support base plate so as to provide ample room for positioning the lateral protrusion (15) of the anchor part underneath the detent (15B) when positioning the foot of the bollard within the socket part (7) in use. A cover portion (16) extends from the portion of the duct wall (7) defining the detent, to the upper surface of the support base plate at the edge of the through-opening immediately adjacent to the detent, so as to cover those portions of the through-opening (2C) between them which would otherwise be exposed and into which the lateral protrusion is intended to reside when the bollard is finally positioned. This cover portion (16) prevent ingress of detritus, debris and other unwanted materials that might otherwise block the sliding insertion of the lateral protrusion (15) of the anchor part of the bollard foot into a position under the detent, when within the through-opening.

[0042] This positioning of the pollard (12) within the socket part (7) of the housing is shown in more detail in the cross-sectional views of the barrier apparatus illustrated in figure 4, figure 5 and figure 6. In particular, the foot of the bollard (12), which includes its lateral protrusion (15; anchor part), is inserted into the socket part such that the lowermost base surface of the bollard rests upon the basic cover plate (6) of the through-opening (2C) formed within the support base plate (2). In this position, the bollard is pushed, in a lateral direction corresponding to the direction in which the lateral protrusion of the anchor part protrudes, so as to position the uppermost surface of the lateral protrusion defining the anchor part, directly underneath the detent (15B) provided by the housing. Figure 4 shows the bollard in this intermediate position. Figure 5 shows the position of the bollard (12) after it has been further laterally pushed to fully insert the lateral protrusion of the anchor part of the bollard foot under the detent and also such that the upstanding sides of the bollard immediately above the detent are abutted against the opposing surface of the sidewall portion (3A) of the socket part. the detent. Simultaneously, the extreme lateral edge of the lateral protrusion (15) of the anchor part abuts the opposing internal edge of the aperture (2C) within the support base plate. Finally, figure 6 illustrates the barrier apparatus in a subsequent condition in which the bollard is positioned as described with reference to figure 5, and in which a solid steel billet (14) is inserted into the remaining space formed between upstanding side of the bollard and an opposing internal sidewall of the socket (7). The billet is dimensioned to abut the bollard side and the opposing internal sidewall of the socket simultaneously, including the contiguous internal edge (2E) of the aperture (2C) so as to enable transfer of impact loads from the bollard to the housing and the support base plate simultaneously, via the billet. In alternative arrangements, the bollard may be circular in the cross-section across its long axis, and the lateral protrusion of the anchor part may extend from only one diametric side of the bollard at/adjacent its foot. The width of the projection may be no greater than the diameter of the bollard at its foot. The bollard may be connected to the housing part in an 'insert-and-twist' action in the matter of a bayonet fitting whereby the anchor foot of the bollard is initially inserted into the socket part with the anchor part extending in a direction along the longitudinal axis of the housing part (and of the elongated socket part) to position the anchor part adjacent to the detent. By twisting the bollard by 90 degrees about its long (vertical) axis, the anchor part is swung into register underneath the detent to lock the bollard to the housing part.

[0043] Figure 7 shows an alternative arrangement of

the barrier apparatus, with the bollard excluded for clarity, in which the housing comprises two ducts (8) of equal length and dimensions, which are separated by a socket part (7).

[0044] Figure 8 shows a plan view and a side view of the barrier apparatus, with the bollard excluded for clarity, illustrated in figure 7.

[0045] Figure 9A shows, once more, the plan view of the barrier apparatus, with the bollard excluded for clarity, together with cross-sectional views shown in figures 9B, 9C and 9D, to illustrate the variation vertical/height dimensions of the duct walls (3) of the housing both within the duct (8), as shown in cross-sectional views of figures 9C and 9D, and within the socket part of the housing as shown in figure 9B, which also shows the through-opening formed in the support base plate and the detent formed by the housing at the socket part.

[0046] Figure 10 a illustrates a plan view of the barrier apparatus illustrated in figure 8 and figure 9A, with the bollard (12) and billets (40) in place within the socket part. Two coupling members (20) are each partially inserted into a respective one of the two ducts (8) of the barrier apparatus such that approximately one half of each coupling member resides within a respective duct, and the other half projects outwardly from the duct at the duct opening so as to extend transversely from the side edge of the support base plate (2) in a direction generally collinear with the longitudinal axis of the housing. As illustrated in figure 10B, each coupling member comprises a pair of spaced, plane-parallel, elongated rectangular steel beams (21) joined together by two separate relatively short steel bars (22) which extend between opposite opposing plane surfaces of the two parallel rectangular steel beams of the coupling member to which opposite ends of the steel bars are welded. This arrangement provides an elongated coupling member with substantial open space between the two plane-parallel rectangular steel beams arranged for admitting cementitious material (e.g. grout or concrete) between them, and around them, when the cementitious material is poured into the duct of the apparatus, via the fluid-flow-through-openings (13) to fix the coupling member within the duct of the housing within which it resides. Figure 10C illustrates how this arrangement permits to adjacent barrier apparatuses to be coupled together by a shared coupling member. The shared coupling member extends from one duct of a first of the two adjacent barrier apparatuses, and into the duct of the other of the two adjacent barrier apparatuses so as to couple the two apparatuses together.

[0047] Figures 11A to 13B collectively show a use of the barrier apparatus in a preferred embodiment of the invention for the purposes of providing a vehicle impact barrier between a road surface intended for motor vehicles and a road surface intended for bicycles, wherein the road surfaces are located on a bridge or other carriageway in which there exists a very limited depth below the road surface available for excavation within which to accommodate the vehicle impact barrier.

[0048] Referring to figure 11A and figure 11B, there is illustrated a section of a road surface on a bridge (not shown) comprising a road surface intended for motor vehicles (31) and a pavement (30) intended for pedestrians. Excavation (32) of the vehicle road surface is shown. Referring to figure 12A and figure 12B, there is illustrated the excavated road of figures 11A and 11B into which a multitude of barrier apparatuses of the type illustrated in figure 10C are positioned such that the support base plate parts (2) of each of the individual barrier apparatuses are disposed within the excavation (32) within the road surface. The multitude of coupled barrier apparatuses are coupled so as to extend collinear in parallel with the excavation within which they are inserted. Referring to figure 13A and figure 13B, there is illustrated the barrier apparatus and road portion described above with reference to figures 12A and 12B, in which the excavation (32), and the support base plate parts (2) disposed within the excavation, are buried beneath an overlaid road surface (31), such that the housing parts upstanding from each one of the base plate parts upwardly projects from the overlaid road surface and is not buried by that road surface. Instead, the upwardly projecting housing parts are encased, encapsulated and covered by a continuous concrete curb structure (34) from the uppermost surface of which project each one of the plurality of bollards (12) of the barrier apparatuses.

[0049] Figure 14 illustrates an alternative embodiment of the barrier apparatus according to the present invention in which each of the two opposing duct walls (3) includes an upwardly extending tongue portion (120A, 120B) integrally formed with the respective duct wall, which collectively define a vehicle impact bollard. This replaces, or serves the function of, the insertable bollard (12) described above, and obviates the need for a socket part (7) within housing or a through-opening (2C) within the support base plate. The two tongue portions are of equal dimensions and oppose each other and are aligned and disposed in register with one another. A flat, elongated and rectangular, transverse support plate (121) extends from one tongue portion (120A) to the other tongue portion (120B) between the opposing vertical faces thereof, being joined to each of the opposing faces by welding along the edges of the transverse support plate. The elongate/longitudinal length of the transverse support plate matches the height of each of the two tongue portions and terminates at an upper support plate edge which is coincident with the upper terminal edges of the two tongue portions.

[0050] Figure 15 illustrates a variant of the barrier apparatus illustrated in figure 14 in which each of the two tongue portions have a width substantially equal (or more) to half of the longitudinal length of the housing and, as a result, define barrier plate portions (122A, 122B) joined by two separate transverse support plates (123), which, between them, define a cavity (124) within which cementitious material may be deposited. The duct (8)

extends along the entire length of the housing from one edge of the support base plate (2) to the other edge, whereby the barrier plate portions (122A, 122B) provide duct walls for the duct which is in fluid communication with the cavity (124) for allowing cementitious material to fill the duct when the support member (20) is inserted therein.

[0051] Figure 16A shows a cover assembly comprising a vehicle barrier including a kerbstone part (34) presenting an outer kerbstone surface from which project bollard barrier parts (125) which are embedded within the kerbstone and are upstanding from the outer kerbstone surface. A plurality of separate support base plates (130) are each adapted for ground engagement and are placed upon a ground surface across which the kerbstone extends. Each support base plate includes a barrier bollard connected to, (e.g. welded) a respective base plate so as to be upstanding from the uppermost surface of the respective support base plate. Successive support base plates (130) are coupled together by a coupling part (131) located at adjacent, opposing terminal ends of successive support base plates. The coupling part comprises a rectangular steel coupling plate possessing for coupling through-openings arranged adjacent one rectangular end of the rectangular coupling plate, and for coupling through-openings arranged adjacent the other rectangular end of the rectangular coupling plate. One rectangular end of the coupling plate overlays and end of one of the two support base plates of the kerb assembly, and the other rectangular end of the coupling plate overlays and adjacent end of the other one of the two support base plates of the assembly.

[0052] A coupling connection of the two adjacent support base plates is formed by eight bolts (132), four of which pass through the coupling part and an end surface of the first of the two adjacent support base plates (130), and four of which pass through the coupling part and the adjacent end surface of the second of the two adjacent support base plates. Each bolt is secured in place by a respective nut (133). By having at least two bolts (132) forming a coupling connection with each one of the two adjacent support base plates, rotation of the coupling plate relative to the support base plates is prevented, thereby significantly adding to rigidity of the structure. The support base plates (130) and coupling plate (131) are embedded (wholly covered) within the concrete of the kerbstone (34).

[0053] Figure 16 B illustrates an alternative means for coupling adjacent terminal ends of successive support base plates (130) of the kerb assembly of figure 16A. In this arrangement, the terminal edge at the end of one support base plate has fixed (e.g. welded) to it a first and second separate and separated steel tube sections (135A,135B) possessing respective tube bores which have substantially the same diameter and are mutually aligned, in register, so as to concurrently house opposite ends of a common single, cylindrical coupling rod (140). The spacing, along the length of the terminal edge separating the first and second separate steel tube sections, is dimensioned to admit a third steel tube section (136) which is fixed to (e.g. welded) the terminal edge at the end of the other of the two support base plates (130). The third steel tube section has the same diameter as the diameter of the first and second separated steel tube sections, and has a tube bore positionable to align it in register with the tube bores of each of the first and second steel tube sections such that the first, second and third tube sections may concurrently admit the same single cylindrical coupling rod (140) within their bores. In this way, two adjacent support base plates of the kerb assembly may be coupled together in a way which does not permit relative rotation of the support base plates across the surface upon which the support base plates sit.

Claims

1. A barrier apparatus for use as a vehicle barrier comprising:

   one or more barrier members (12);
   a plurality of separate support base parts (2) each adapted for ground engagement by placement upon a ground or floor surface to each of which is fixed a respective housing part, wherein at least one said housing part includes a barrier member;
   each housing part (1) comprises a duct (8) extending in a direction along the respective support base part from a duct opening at an end of the duct accessible from an edge of the respective support base part; and,
   a coupling part (131) adapted for concurrent insertion into a respective duct opening of each said housing part of two said support base parts when aligned thereby to couple together adjacent support base parts of the plurality of separate support base parts.

2. A barrier apparatus according to any preceding claim wherein said duct is dimensioned and arranged for containing an end of the coupling part together with cementing material for cementing the coupling part to the housing part within the duct thereof.

3. A barrier apparatus according to any preceding claim in which the at least one barrier member and the at least one housing part which includes the barrier member, are both upstanding from the support base part.

4. A barrier apparatus according to any preceding claim in which the housing part is dimensioned and arranged for retaining the base end of a barrier member when the barrier member is upstanding from the

base support part.

5. A barrier apparatus according to claim 4 in which the housing part defines a socket part (7) dimensioned and arranged for receiving the base end of a said barrier member into the housing together with one or more rigid billet parts (14) for constraining the position of the barrier member within the housing part, and/or cementing material for cementing the bollard member to the housing part.

6. A barrier apparatus according to claim 5 in which a transverse dimension of the socket part exceeds a corresponding transverse dimension of those parts of the barrier member which the socket part is arranged to admit by an amount sufficient to define a gap therebetween within which the bollard member is moveable to adjust its position and/or inclination relative to the base support part and/or relative to the housing part.

7. A barrier apparatus according to claim 5 or claim 6 in which a transverse dimension of the socket exceeds a corresponding transverse dimension of those parts of the barrier member which the socket is arranged to admit by an amount sufficient to define a gap therebetween through which the one or more rigid billet part(s) are inserted, or the cementing material is flowable, to fill regions within housing part which surround the parts of the barrier member therein.

8. A barrier apparatus according to any preceding claim in which the at least one barrier member comprises at least one bollard.

9. A barrier apparatus according to any preceding claim in which the housing part includes a wall part (3) extending along the base support part to define at least a part of a wall of the duct, and extending from the base support part in a direction upstanding therefrom, and optionally, to define at least a part of a said barrier member or, when dependent on claim 5, the socket part.

10. A barrier apparatus according to any preceding claim in which the housing part of at least one support base part comprises a plurality of said ducts each extending in a respective direction along the support base part from a respective duct opening accessible from different respective edges of the support base part, thereat to receive a respective said coupling part to couple a plurality of adjacent support base parts at said different respective edges of the support base part concurrently and, optionally, the plurality of said ducts each extend in a respective direction mutually in parallel along the support base part.

11. A barrier apparatus according to any preceding claim in which the base support part includes a through-opening (2C) arranged in register with the housing part and dimensioned to admit therethrough parts of the barrier member so as to extend from within the housing part in a direction transverse to the base support part, and a transverse dimension of the base end of the barrier member exceeds a corresponding transverse dimension of the housing part such that the base end of the barrier member is thereby prevented from passing through the housing part.

12. A barrier apparatus according to claim 11 when dependent upon claim 5, wherein the support base part comprises a plate member (6) having said through-opening on register with the socket part at the periphery of the through-opening thereby placing said through-opening in communication with the socket part.

13. A barrier apparatus according to any preceding claim wherein the barrier member includes a fixed anchor part adjacent a base end thereof and outwardly projecting therefrom in a direction transverse to the longitudinal axis thereof wherein the housing part is dimensioned to receive the base end with the anchor part (15) in abutment against the housing part such that the base end of the barrier member is thereby prevented from passing through the housing part.

14. A barrier apparatus according to any preceding claim in assembled form to provide a vehicular barrier.

15. A barrier apparatus according to any preceding claim in which the housing part of at least one of the plurality of separate support base parts is embedded within a cementing material forming a kerb.

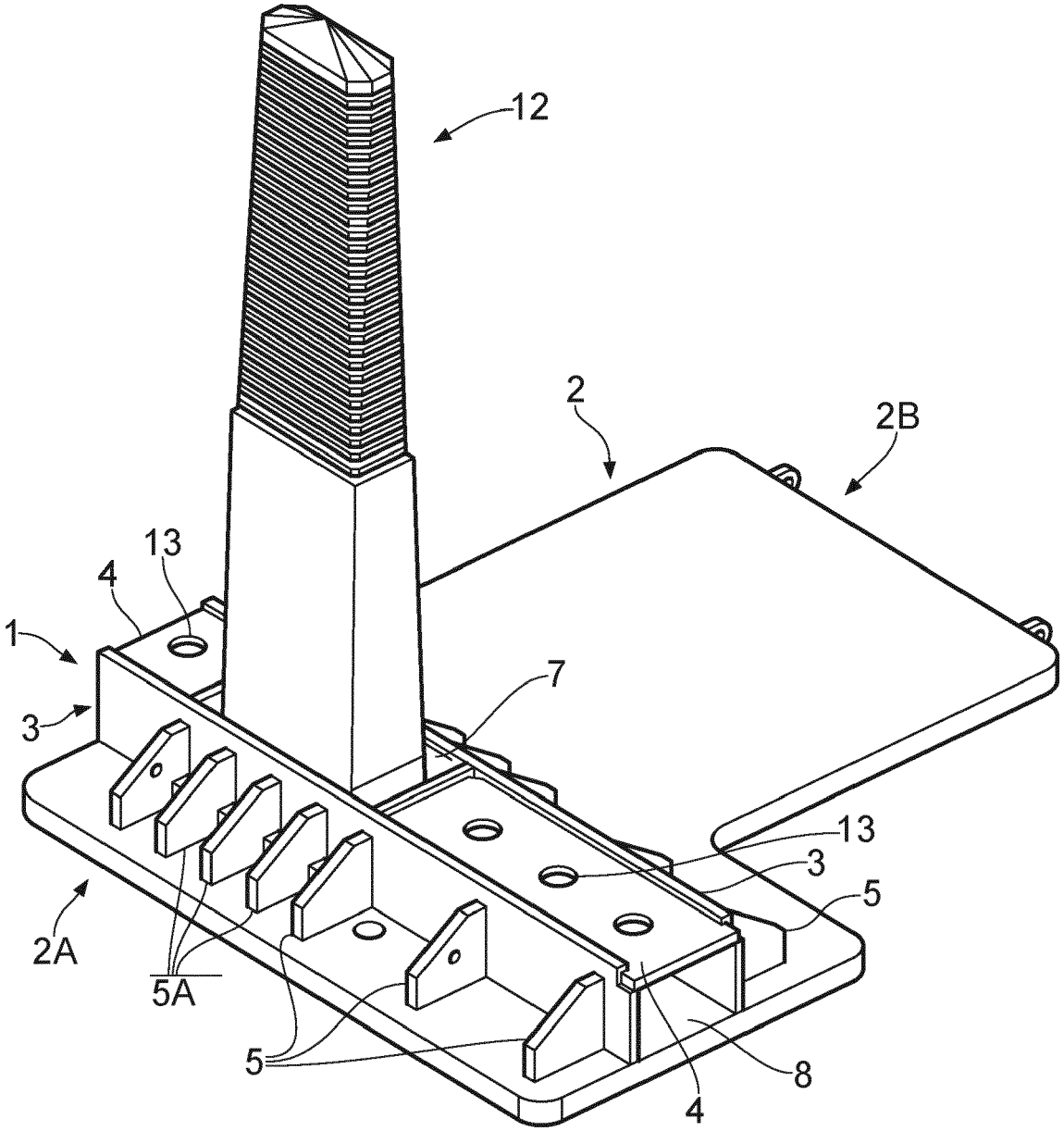


FIG. 1

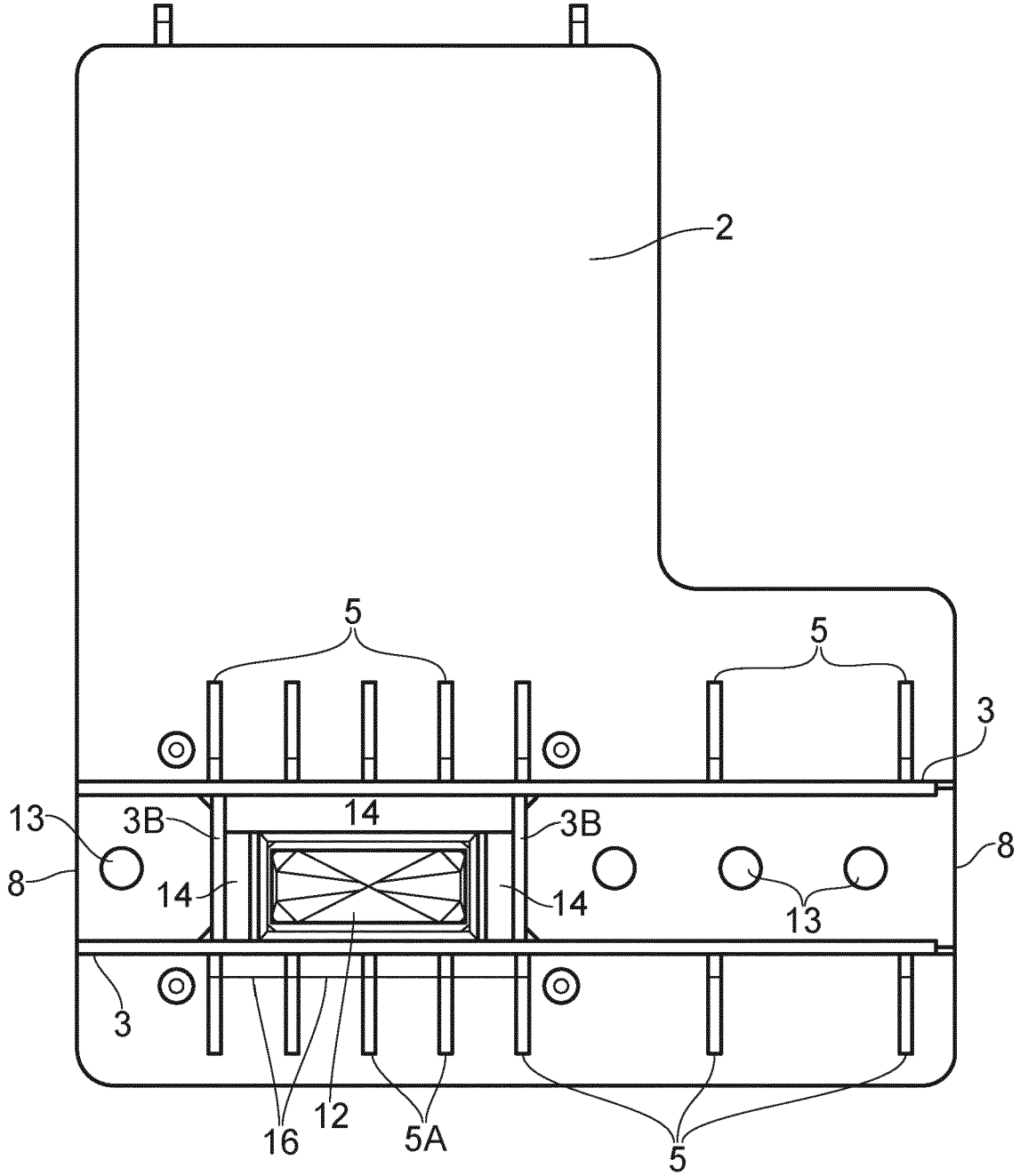


FIG. 2

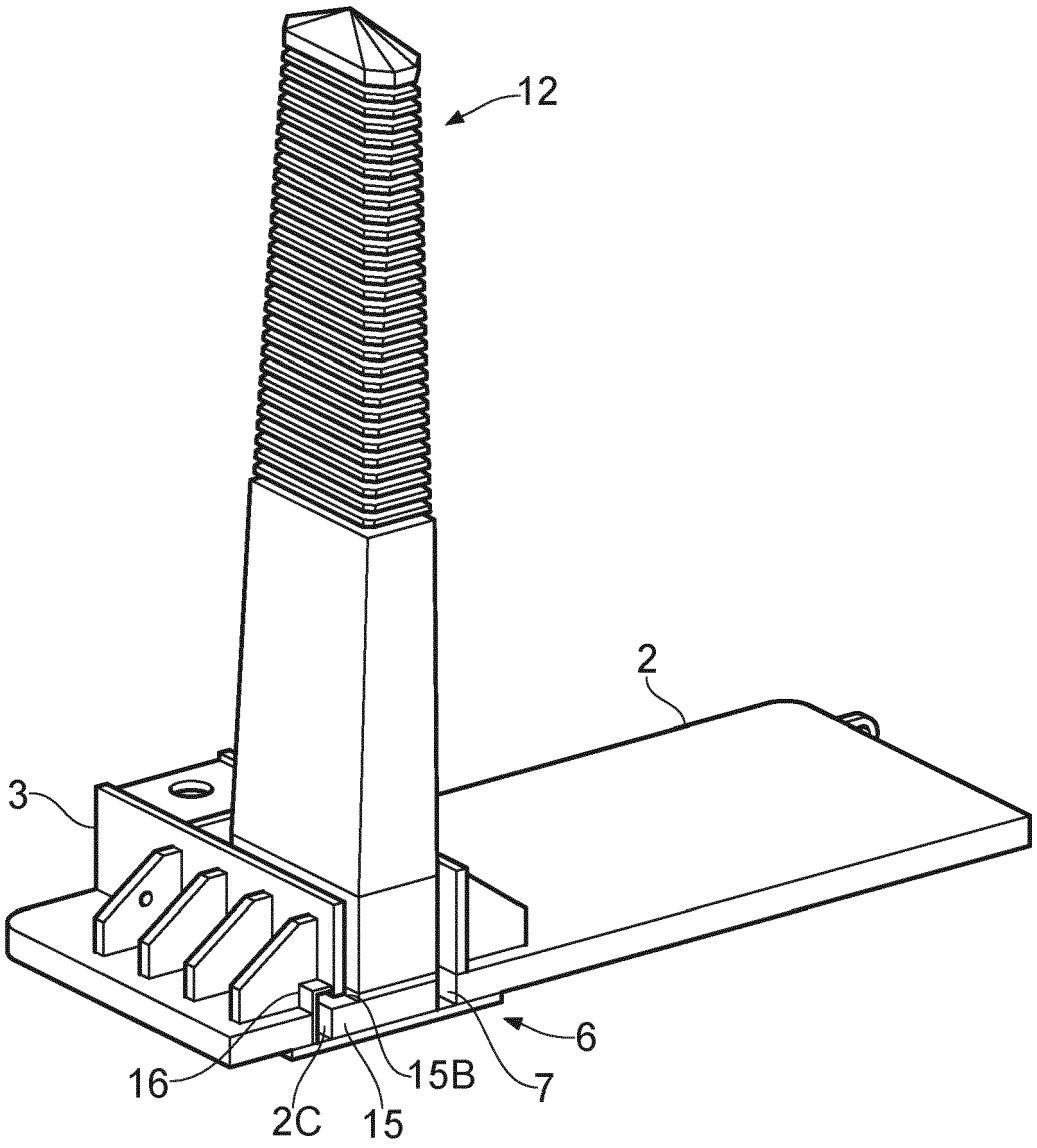


FIG. 3

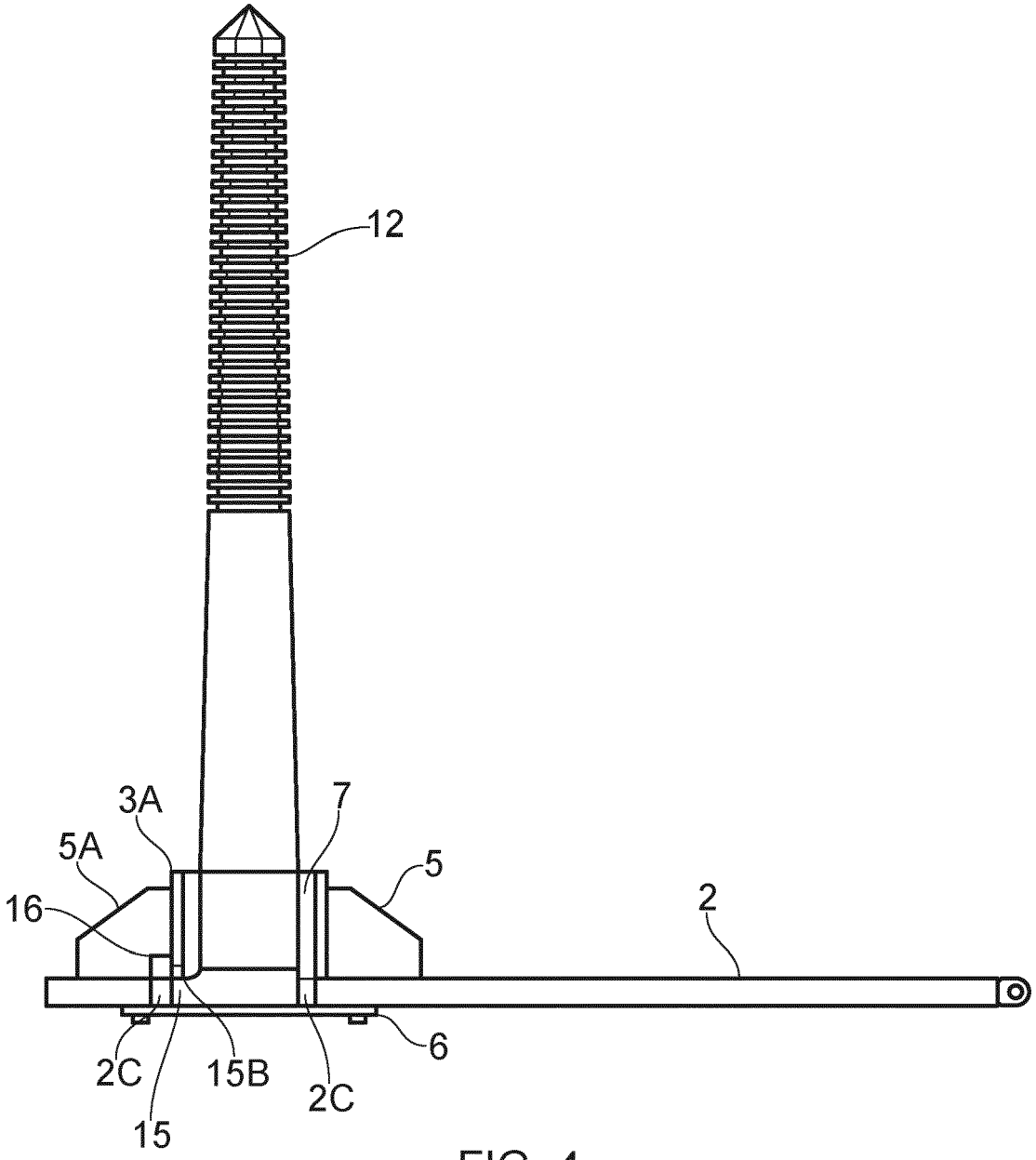


FIG. 4

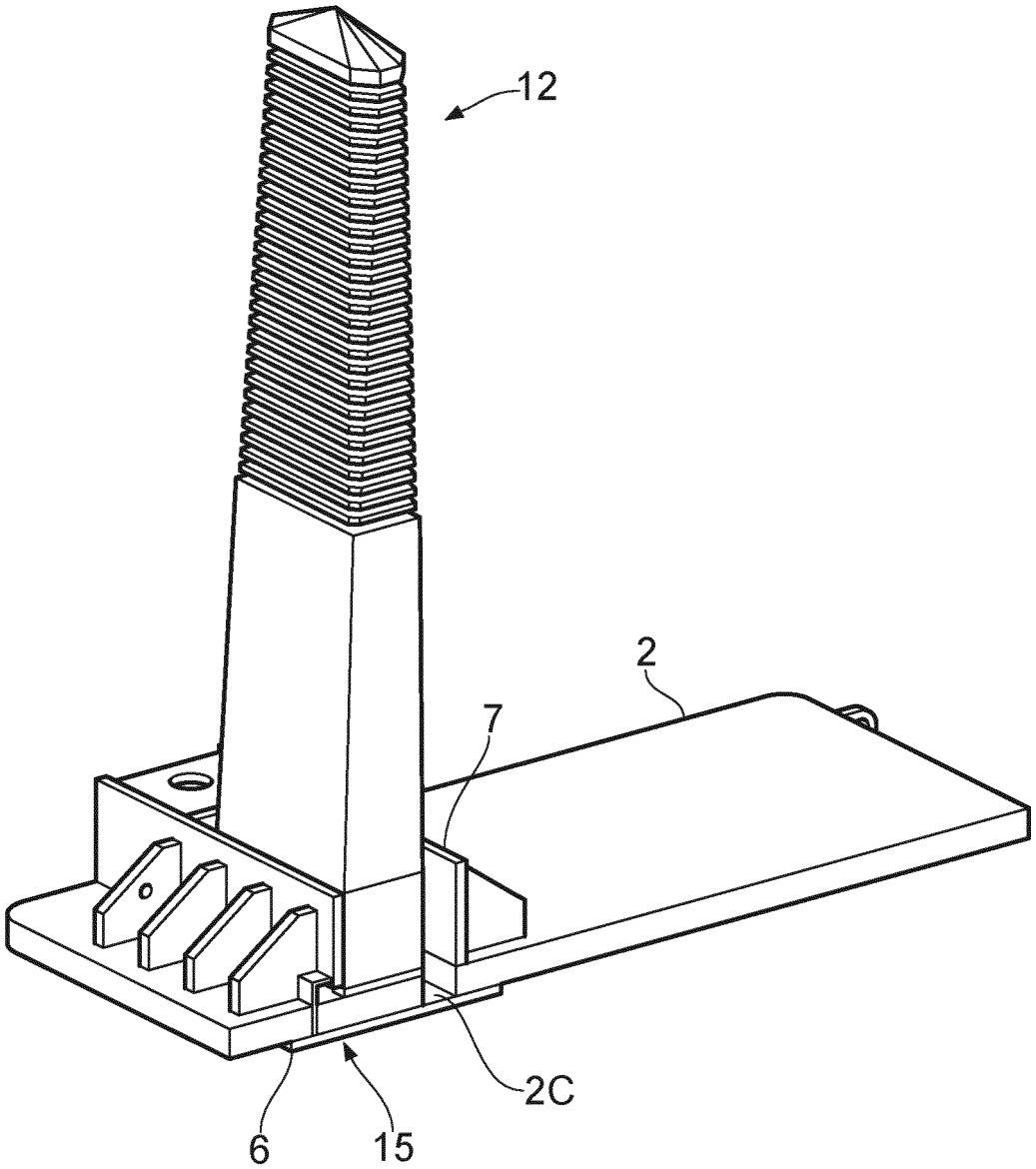


FIG. 5

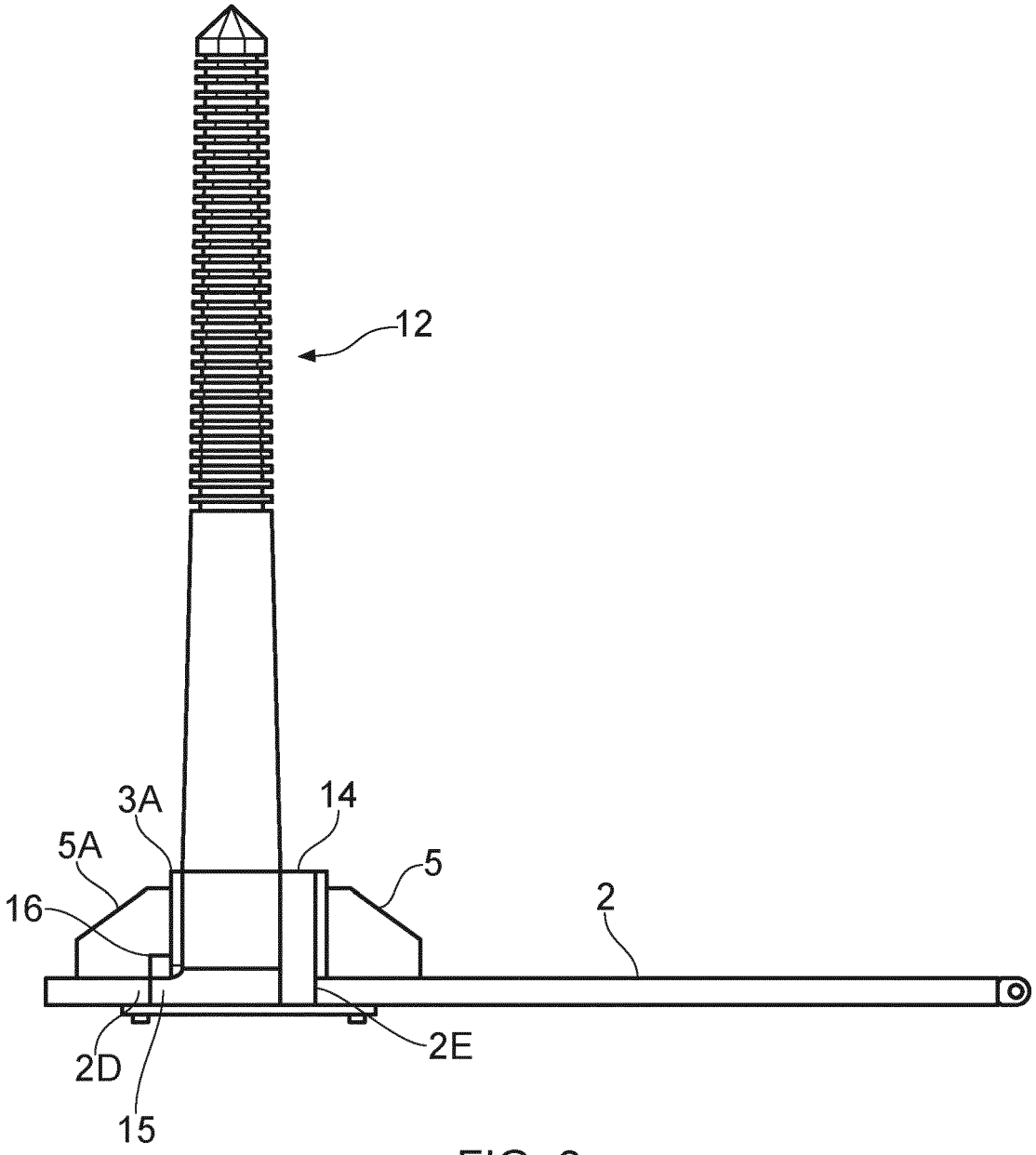


FIG. 6

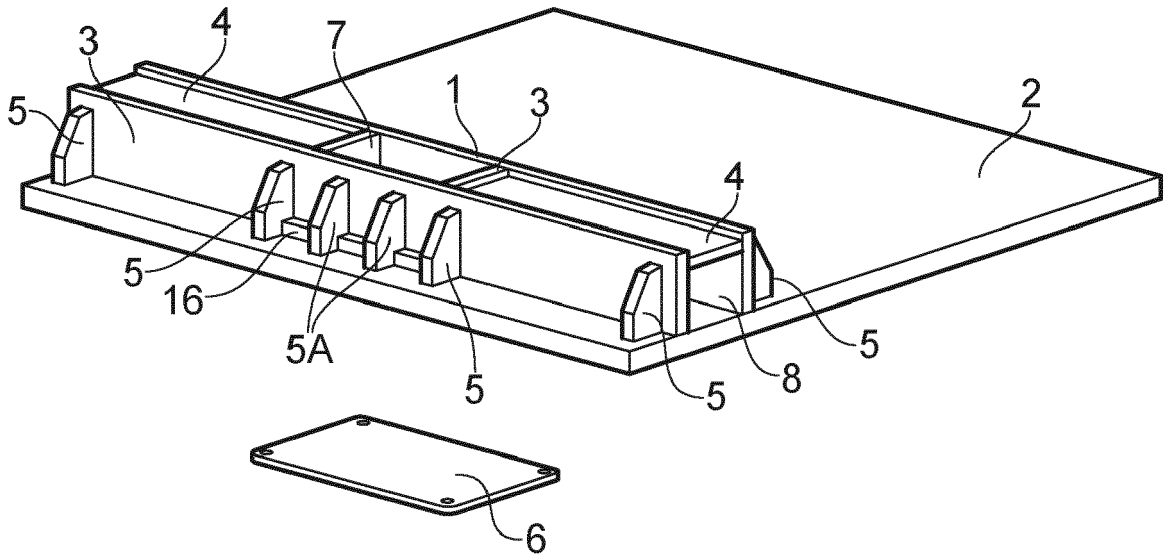


FIG. 7

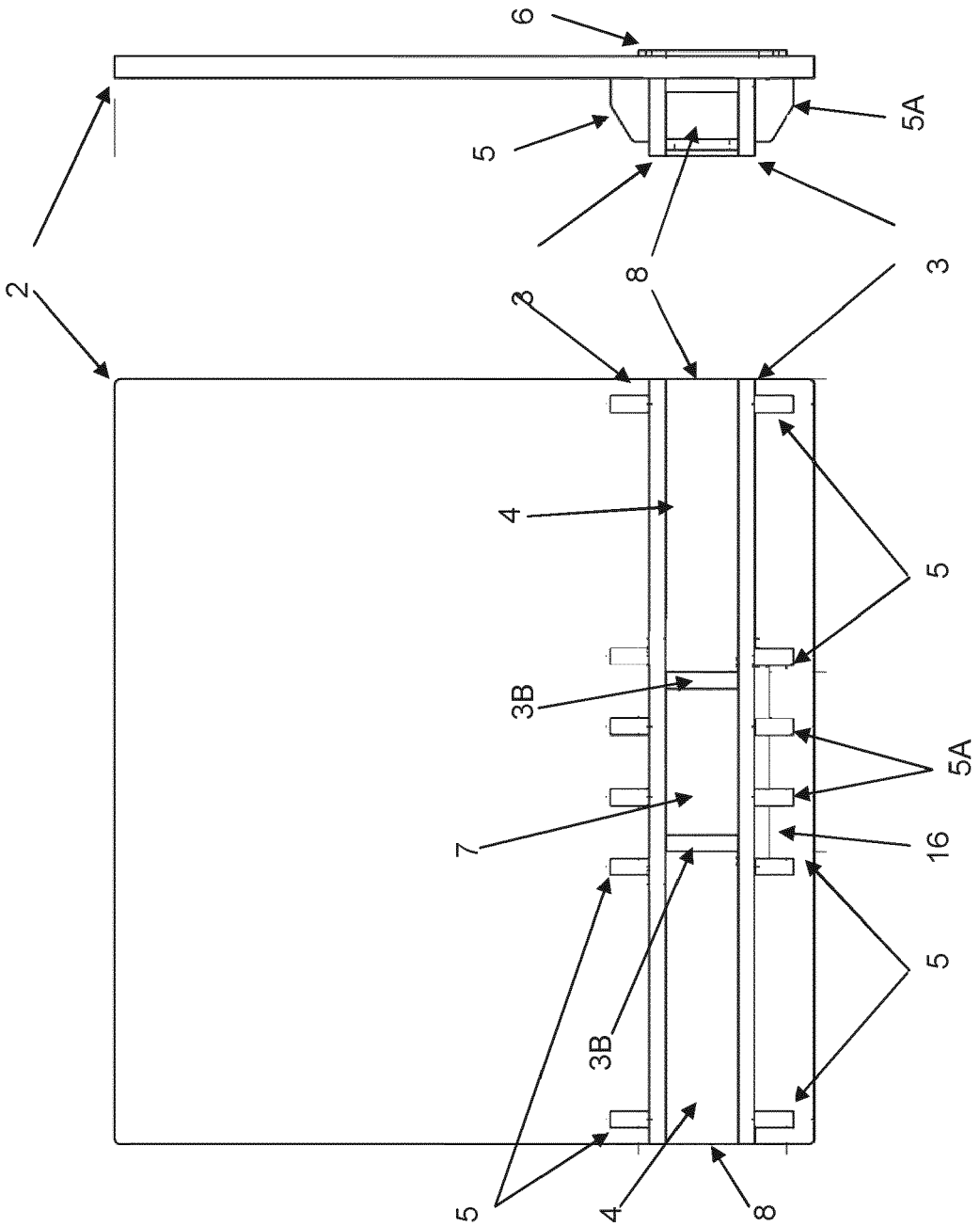


FIG. 8

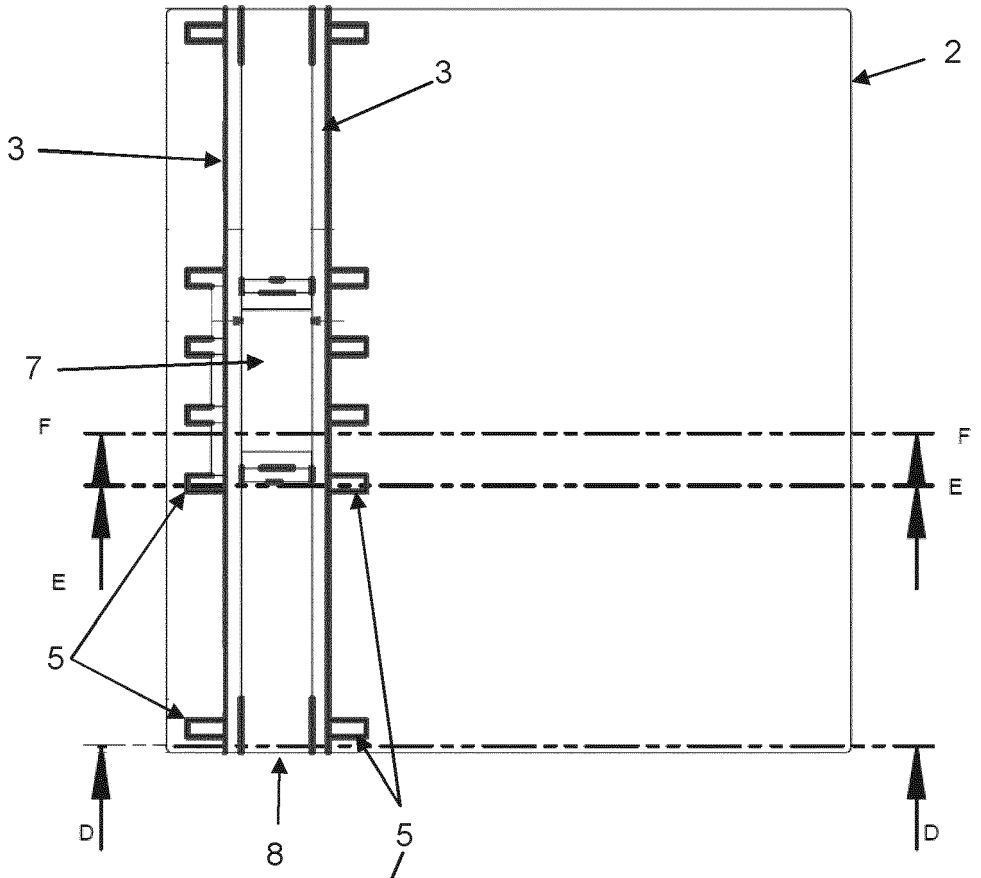


FIG. 9A

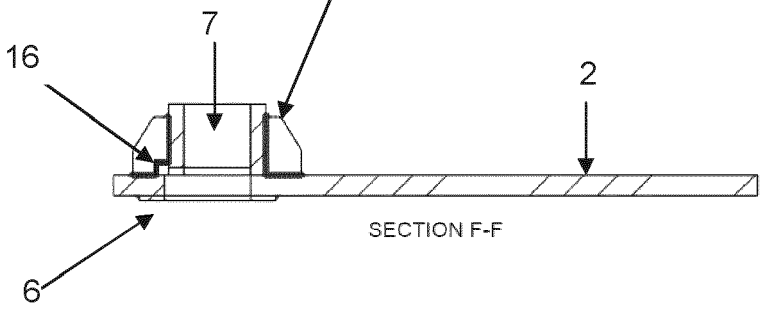


FIG. 9B

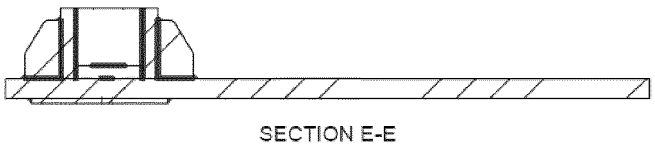


FIG. 9C

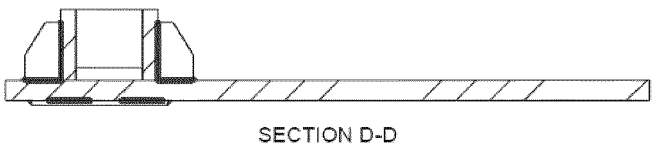


FIG. 9D

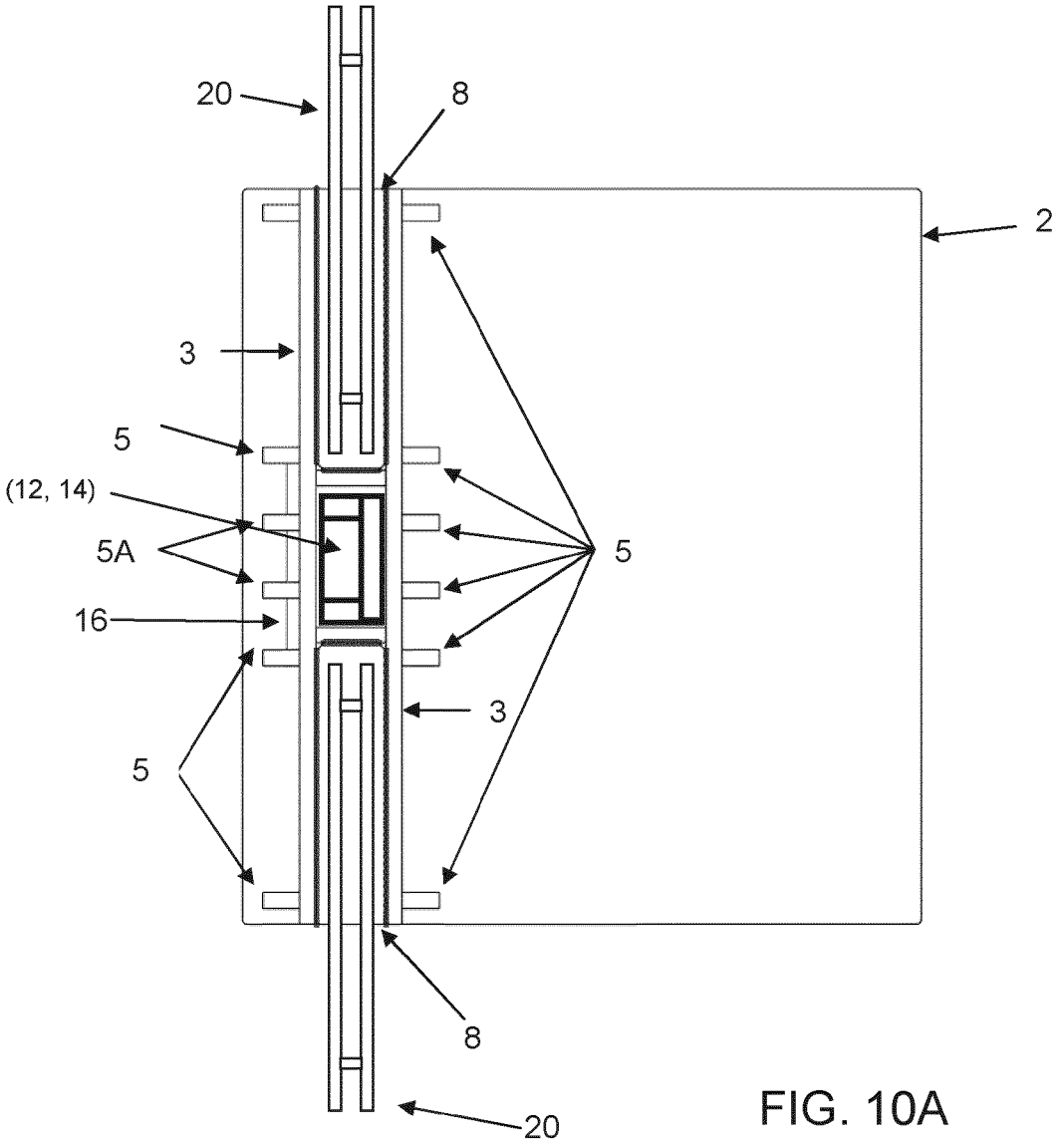


FIG. 10A

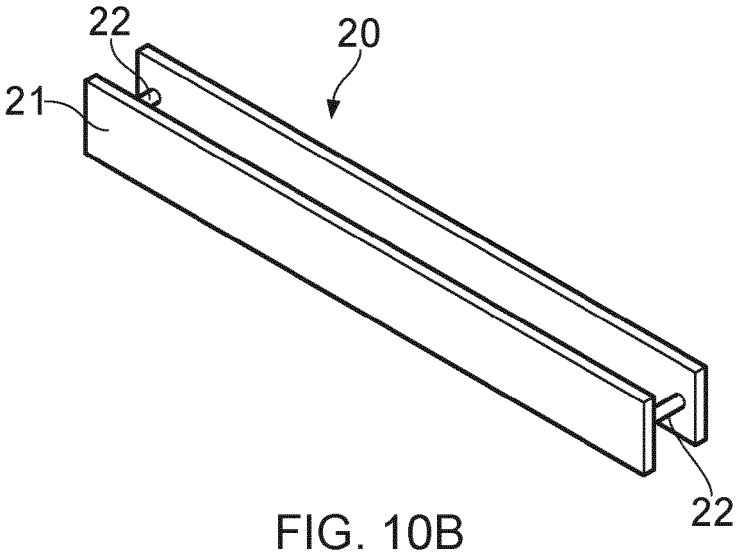


FIG. 10B

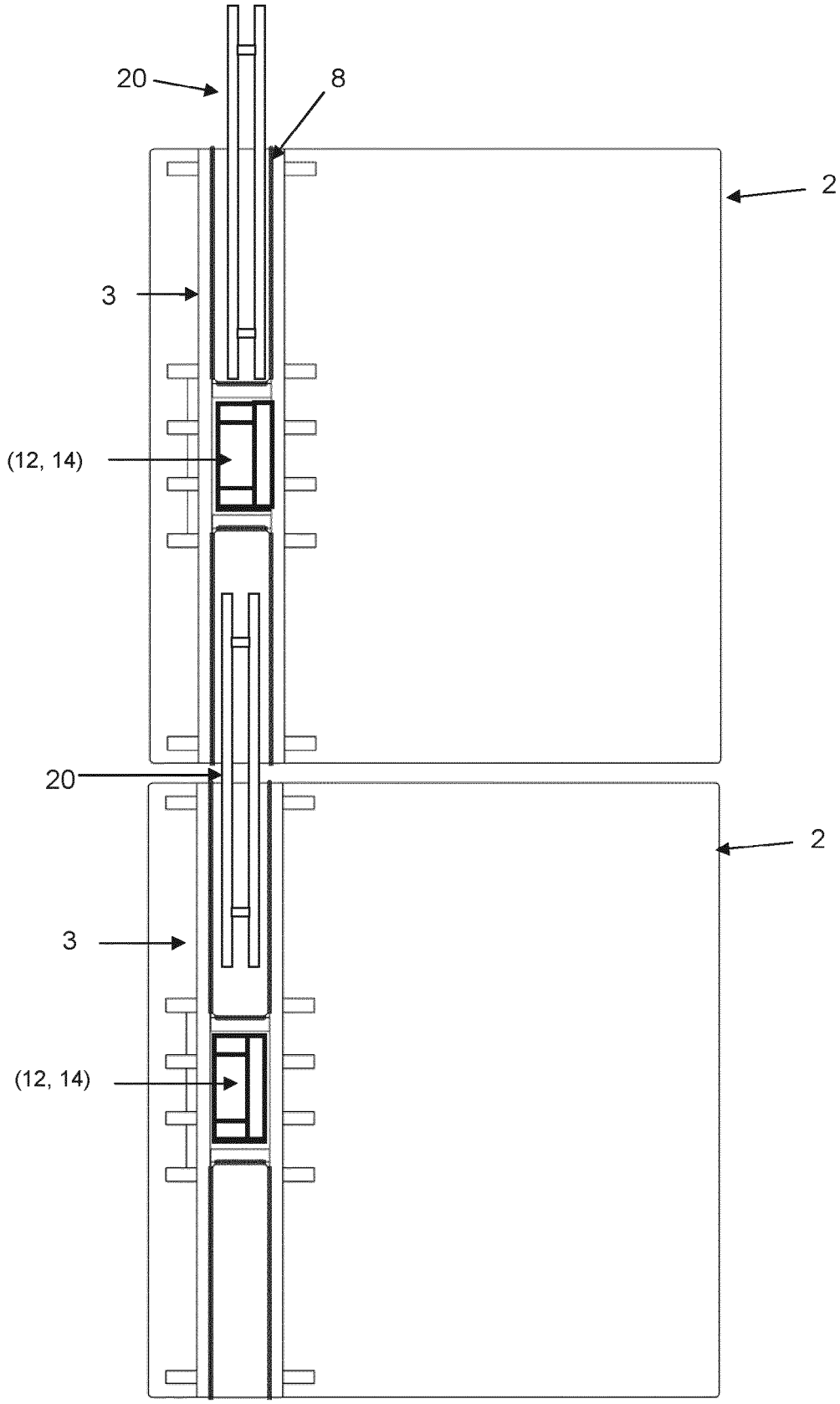


FIG. 10C

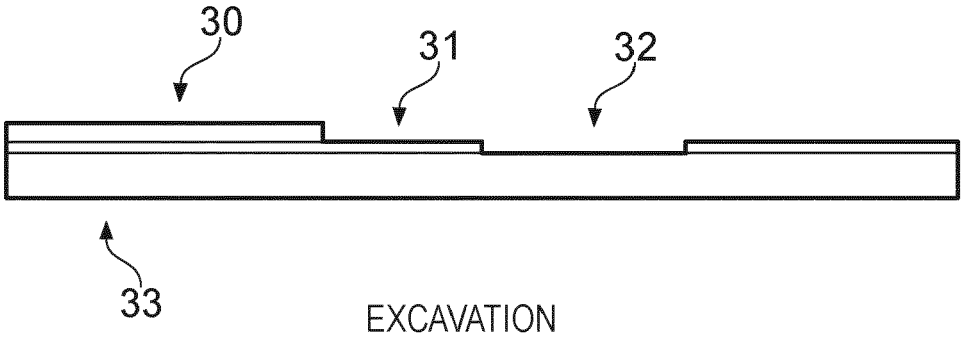


FIG. 11A

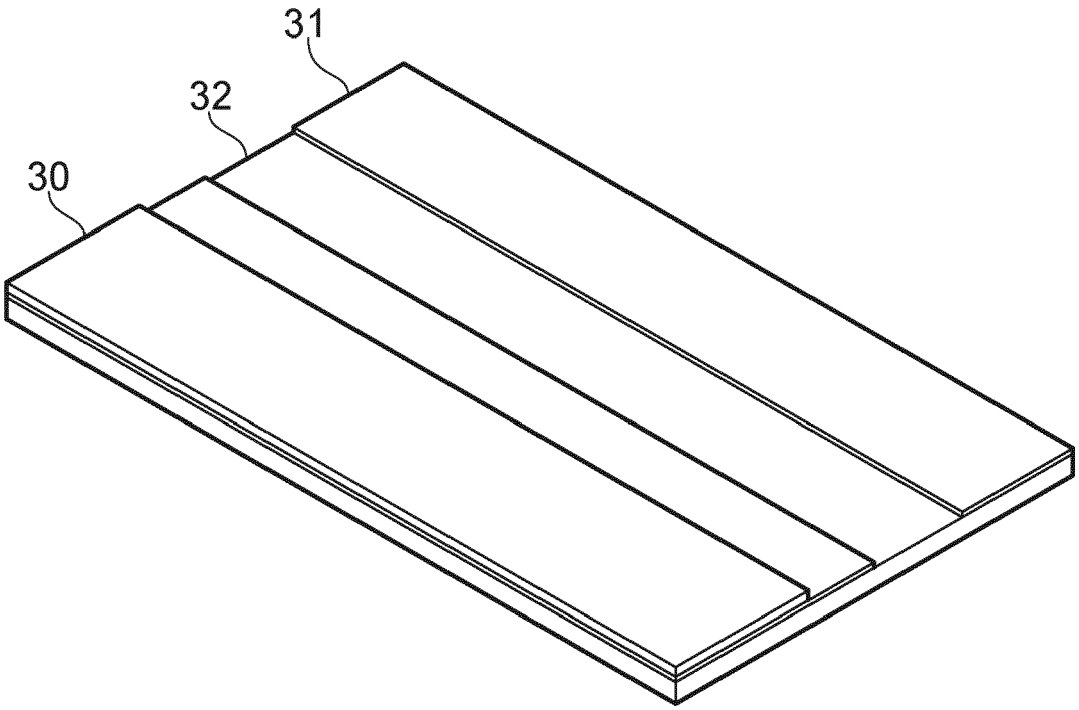
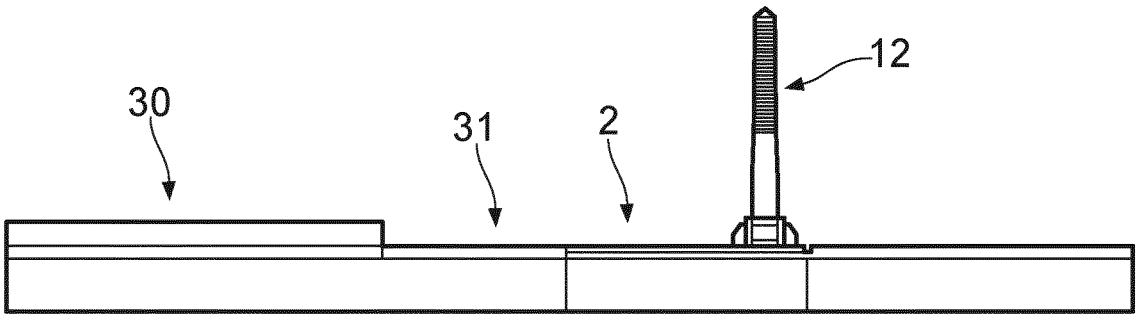


FIG. 11B



BOLLARD PLACEMENT

FIG. 12A

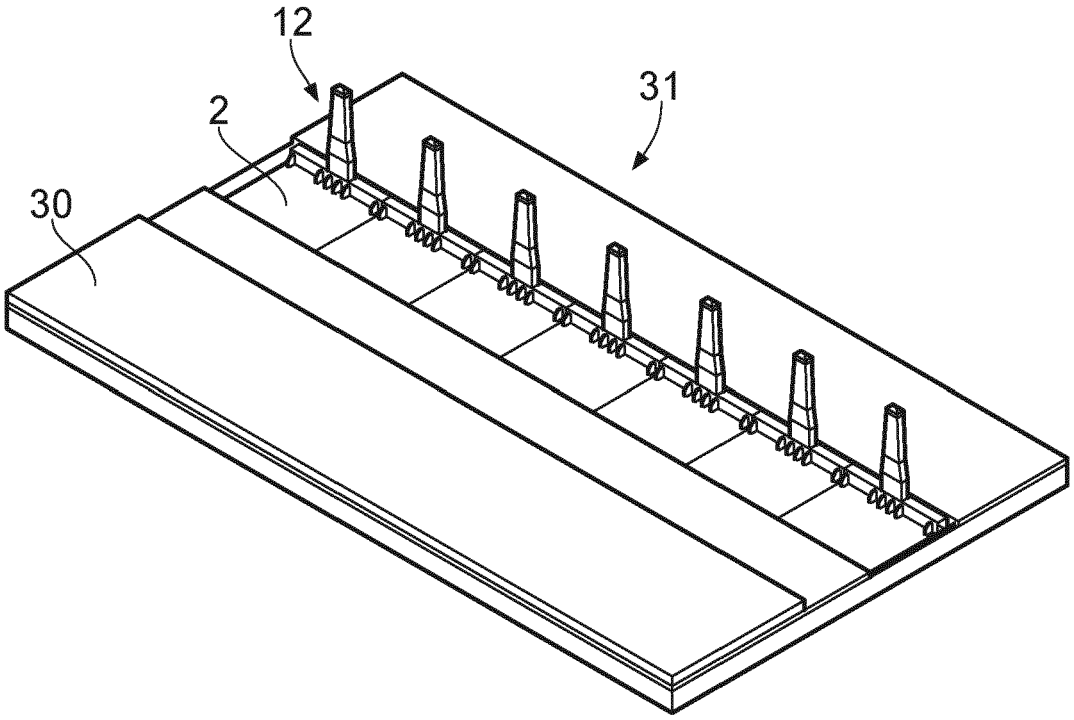


FIG. 12B

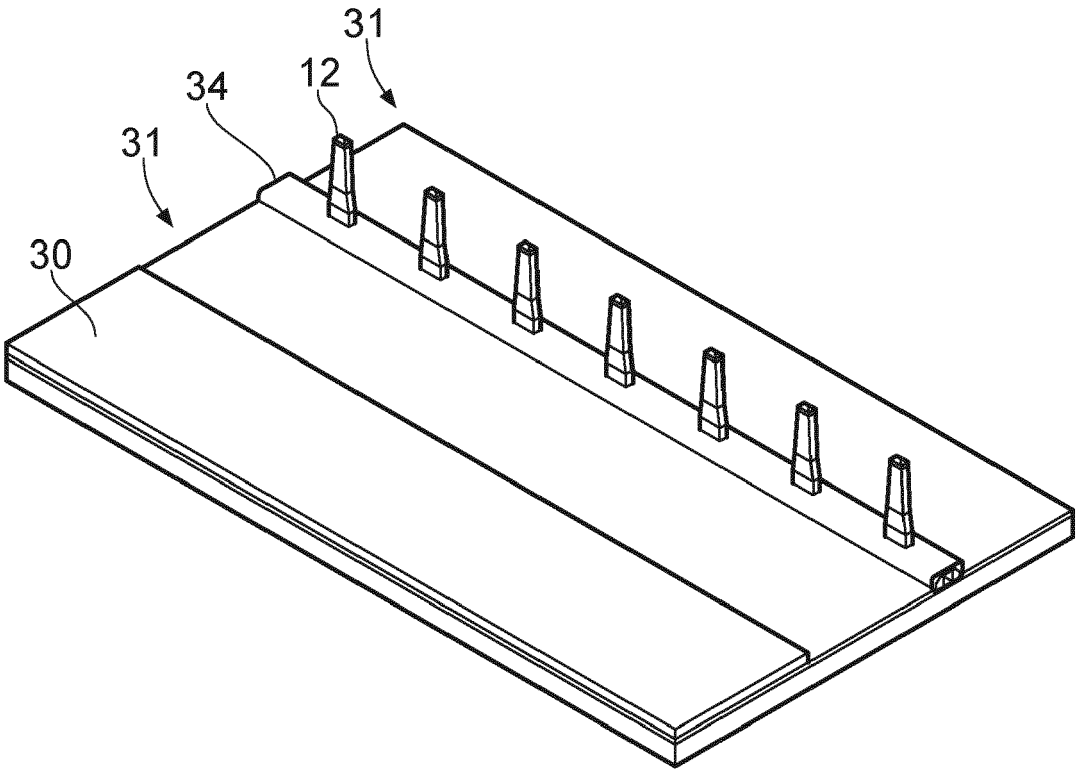


FIG. 13A

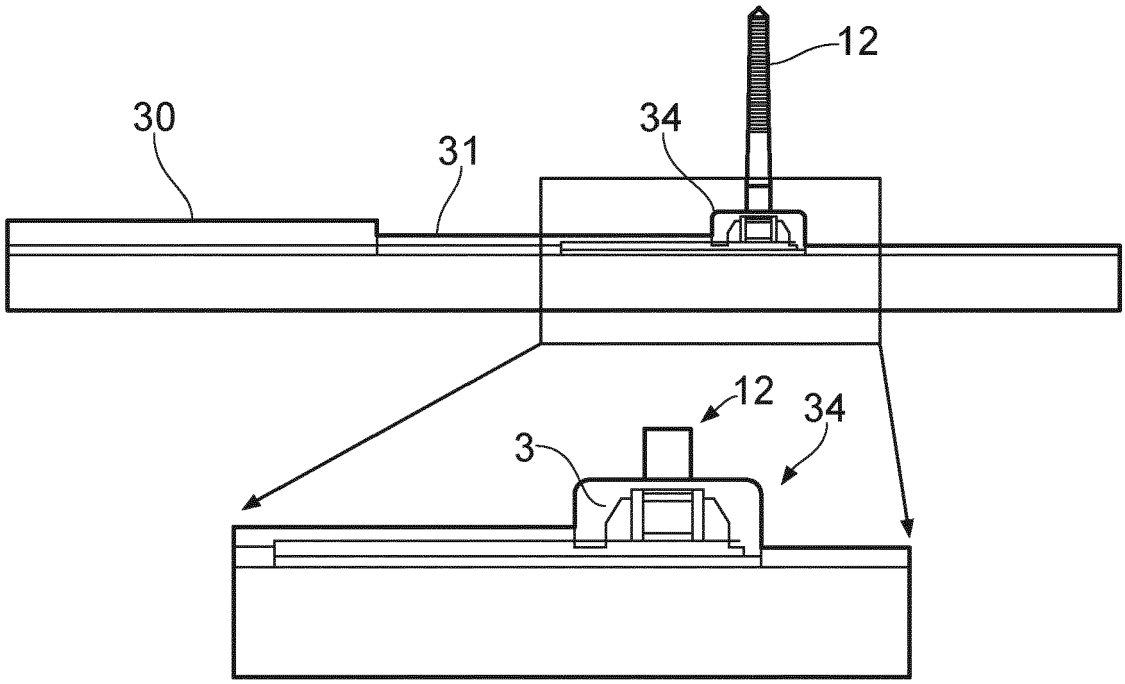


FIG. 13B

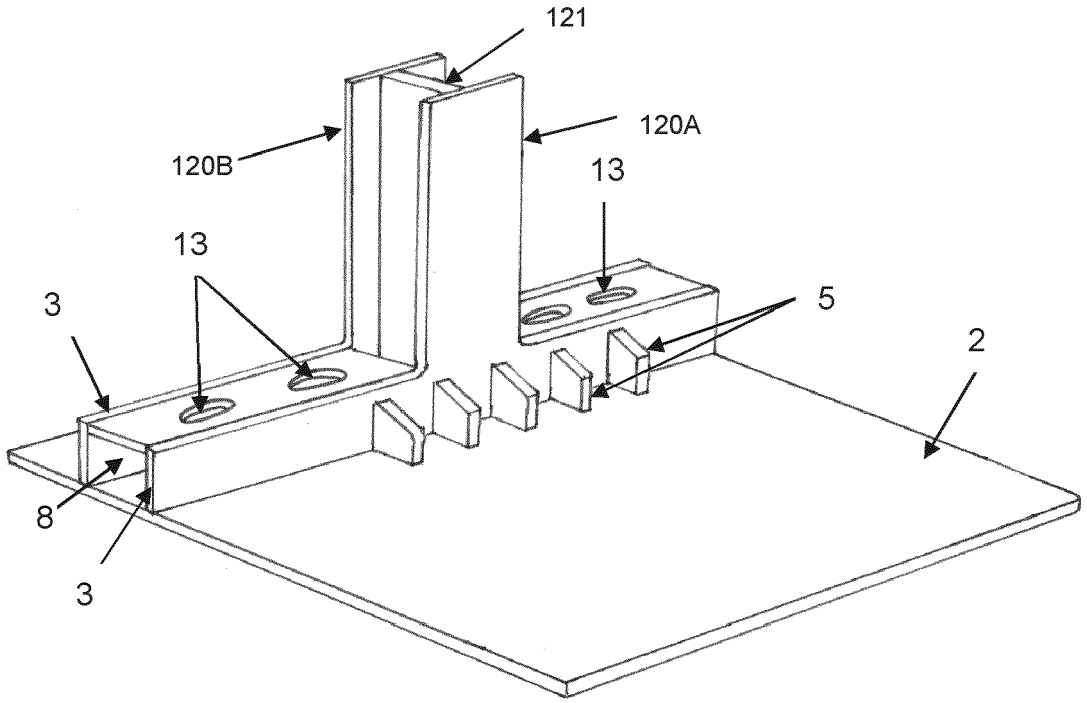


FIG. 14

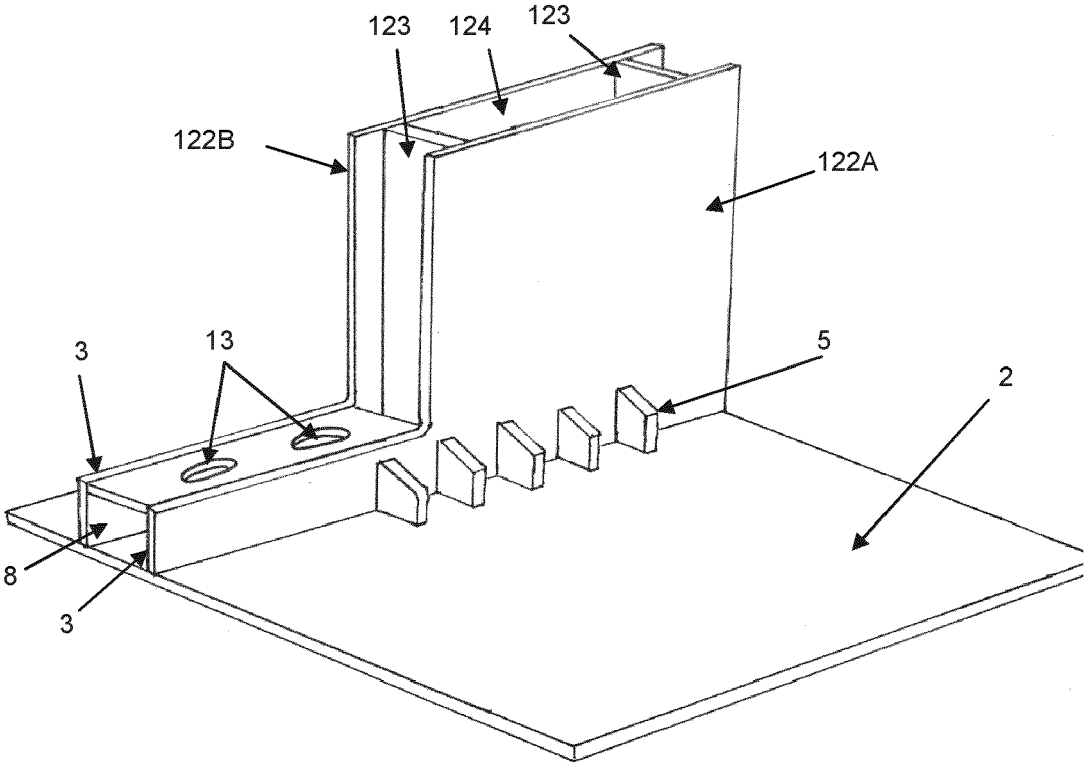


FIG. 15

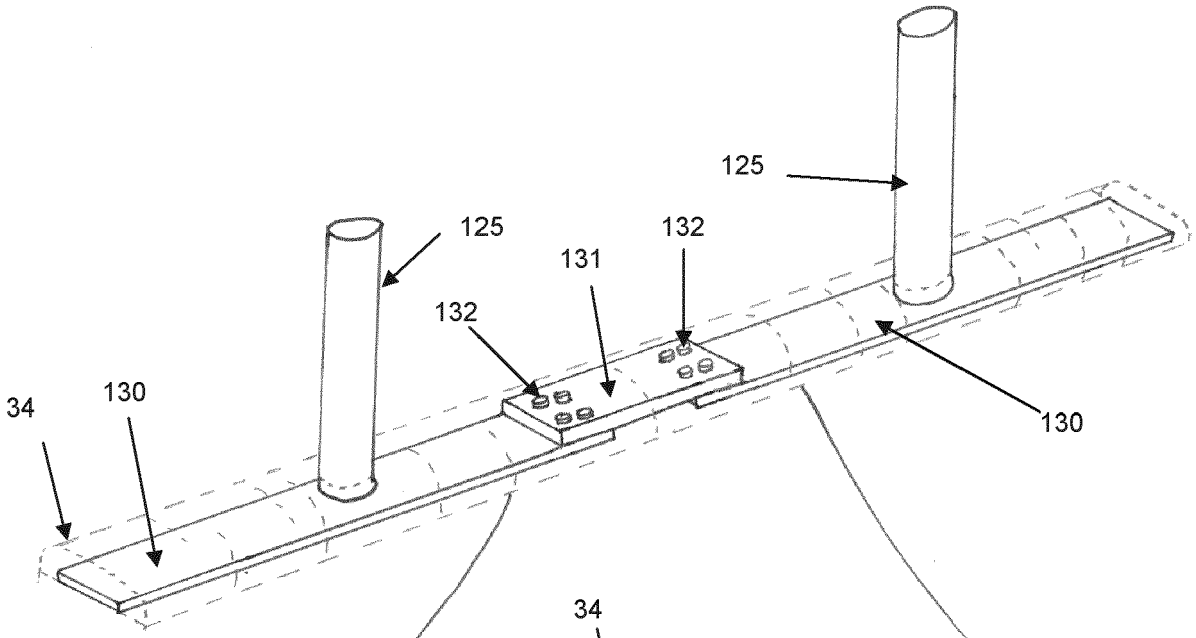


FIG. 16A

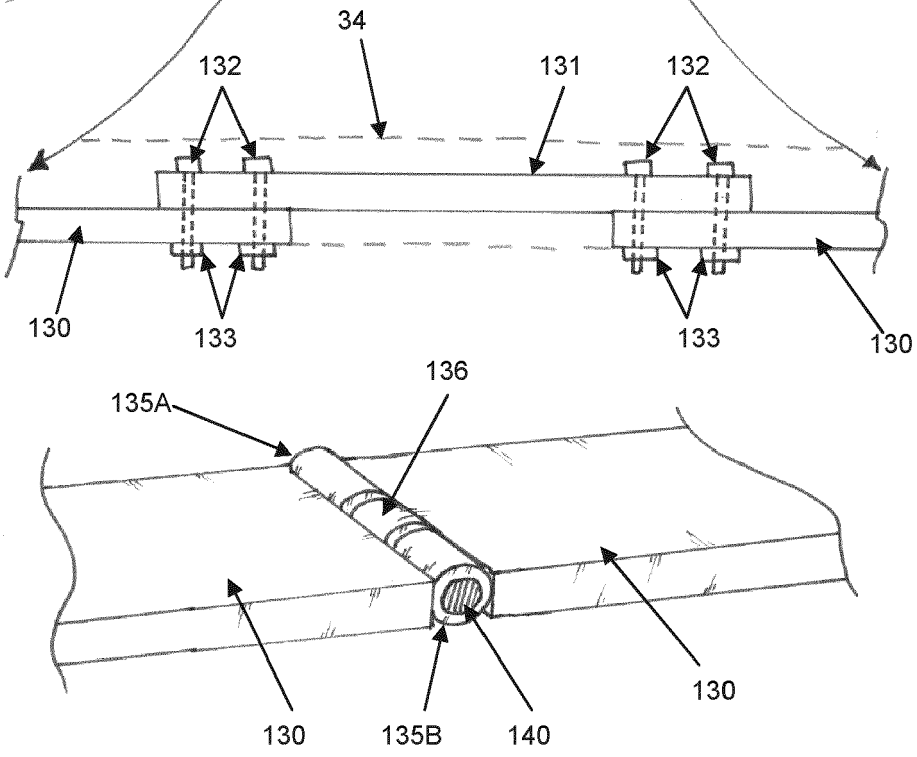


FIG. 16B

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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 3310

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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	8 December 2020	Flores Hokkanen, P

CATEGORY OF CITED DOCUMENTS

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