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(54) **CLIP-ON CONNECTOR TO GEOGRID FOR SEGMENTAL BLOCK REINFORCED SOIL RETAINING WALL MECHANICAL CONNECTION SYSTEM**

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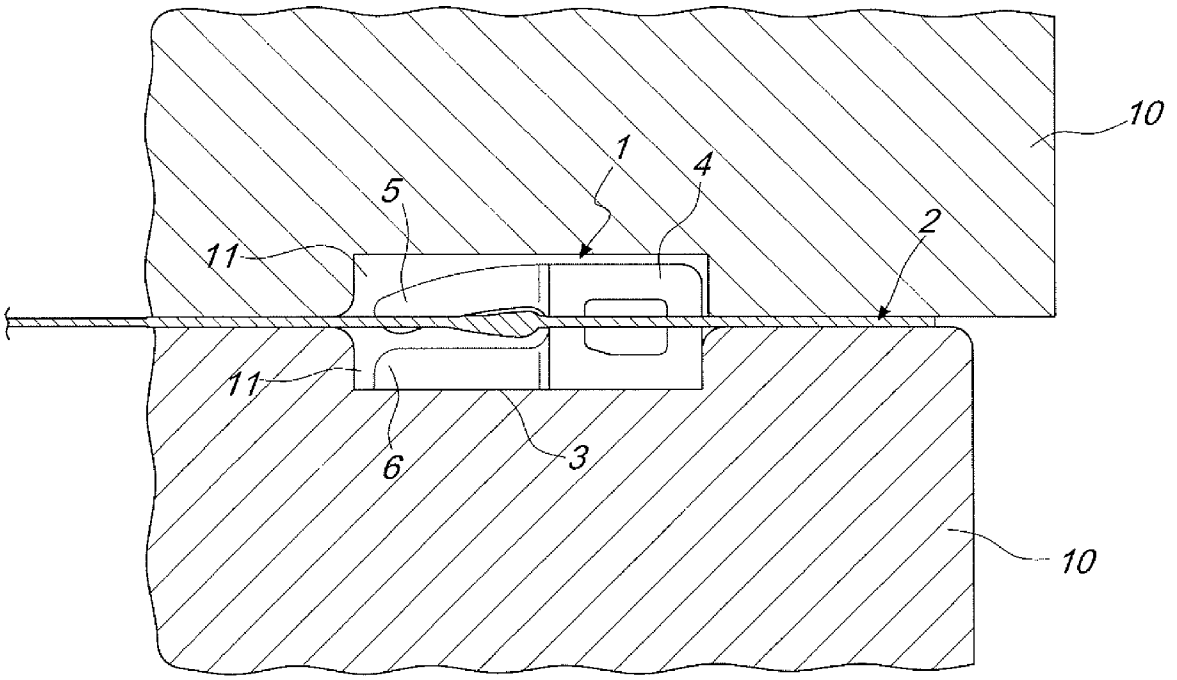
(57) **ABSTRACT**

A clip-on connector adapted to be connected to a geogrid, comprising a base portion wherefrom at least one finger portion extends toward an opposite edge of the base portion, such finger portion defining, with the edge of the base portion, a clip, said clip having two arms respectively defined by said finger portion and by said base portion, the spacing between said two arms being smaller than the thickness of a portion of a geogrid whereon the connector has to be coupled, but such that said geogrid portion can be inserted between said two arms.



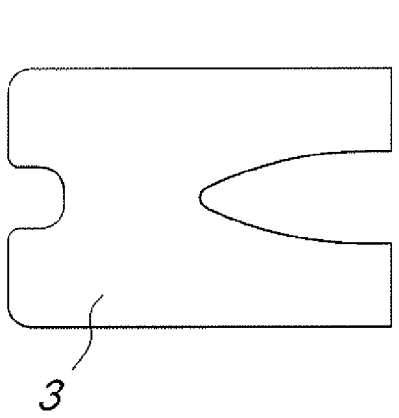


Fig. 1

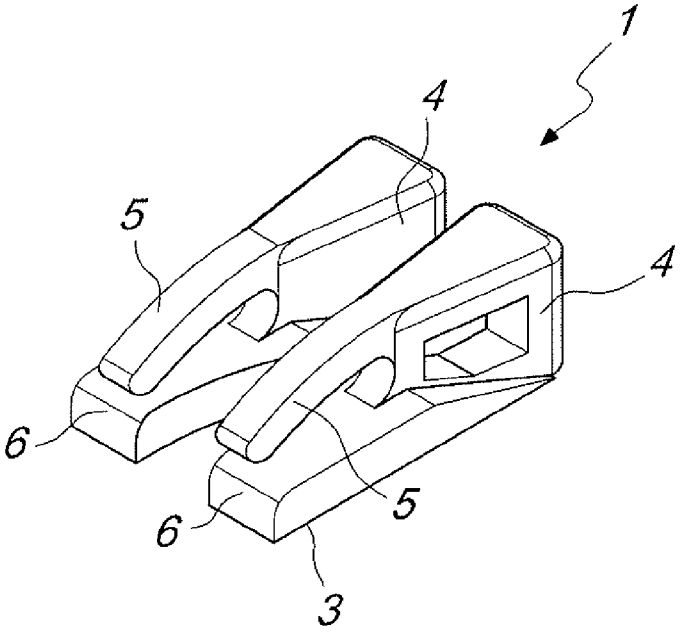


Fig. 1a

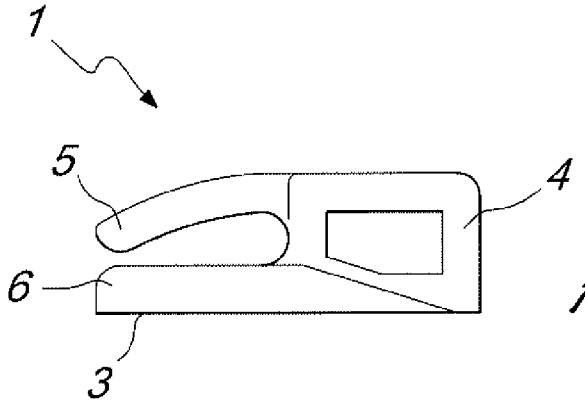


Fig. 2

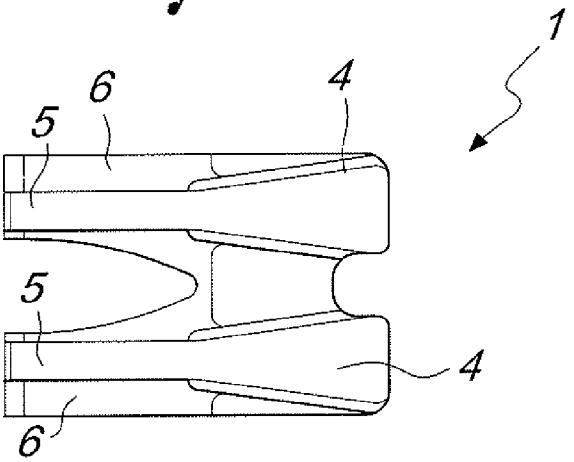


Fig. 3

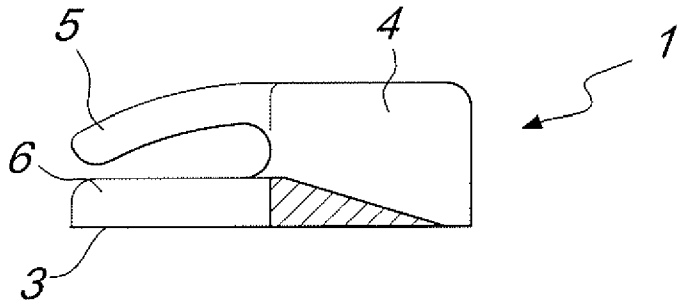


Fig. 4

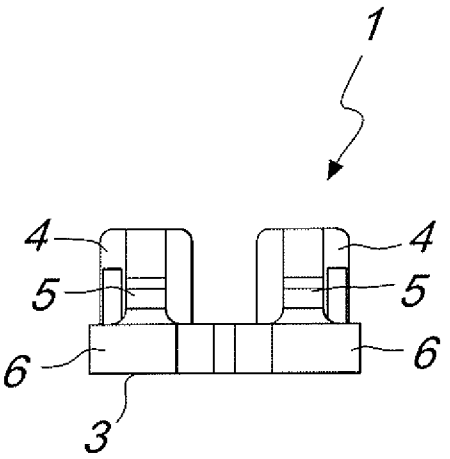


Fig. 5

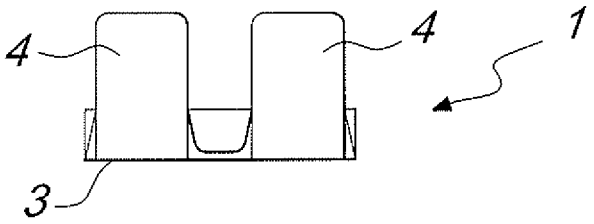


Fig. 6

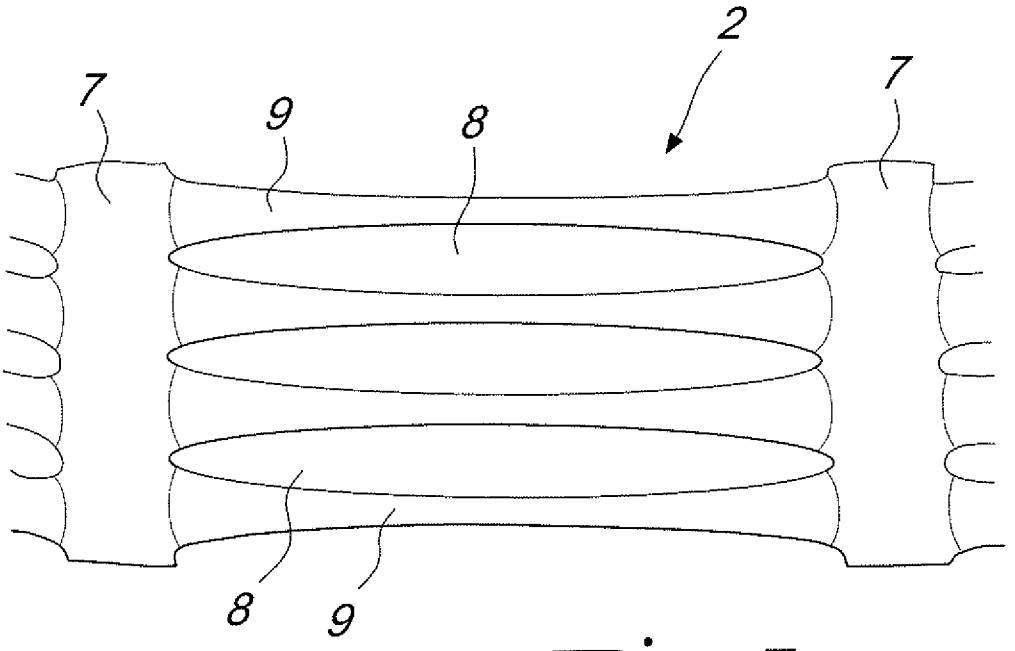


Fig. 7

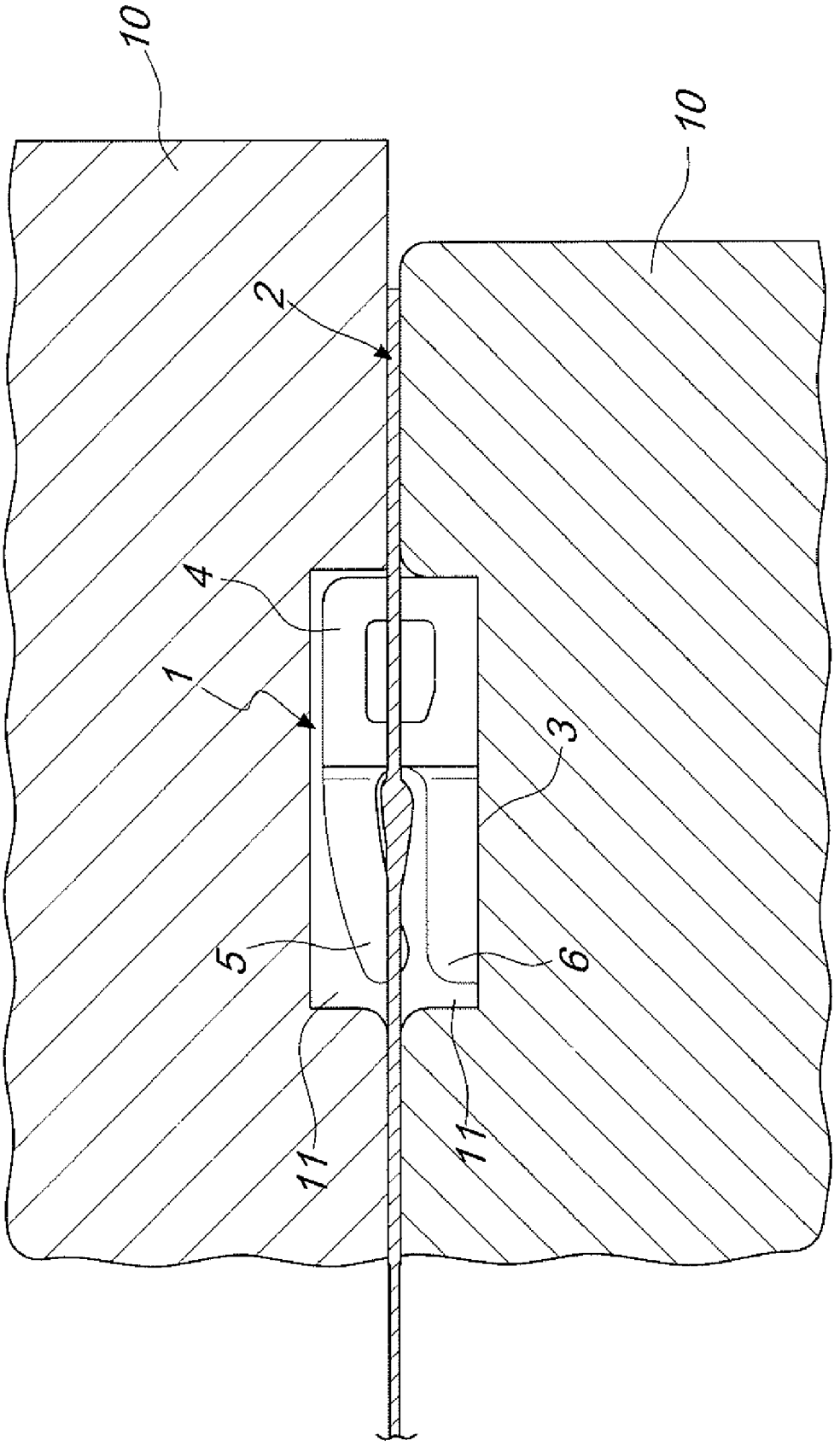


Fig. 8

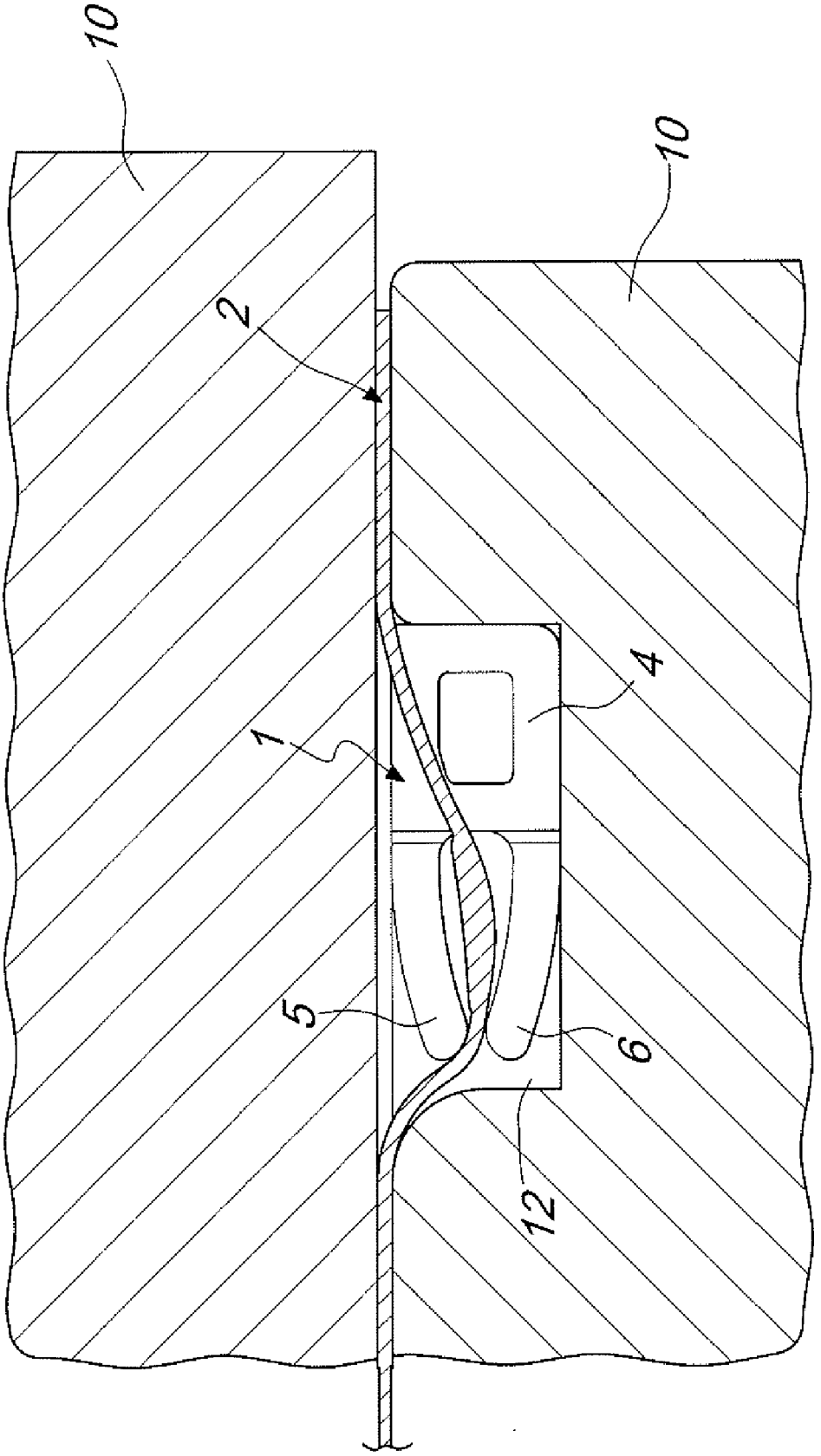


Fig. 9

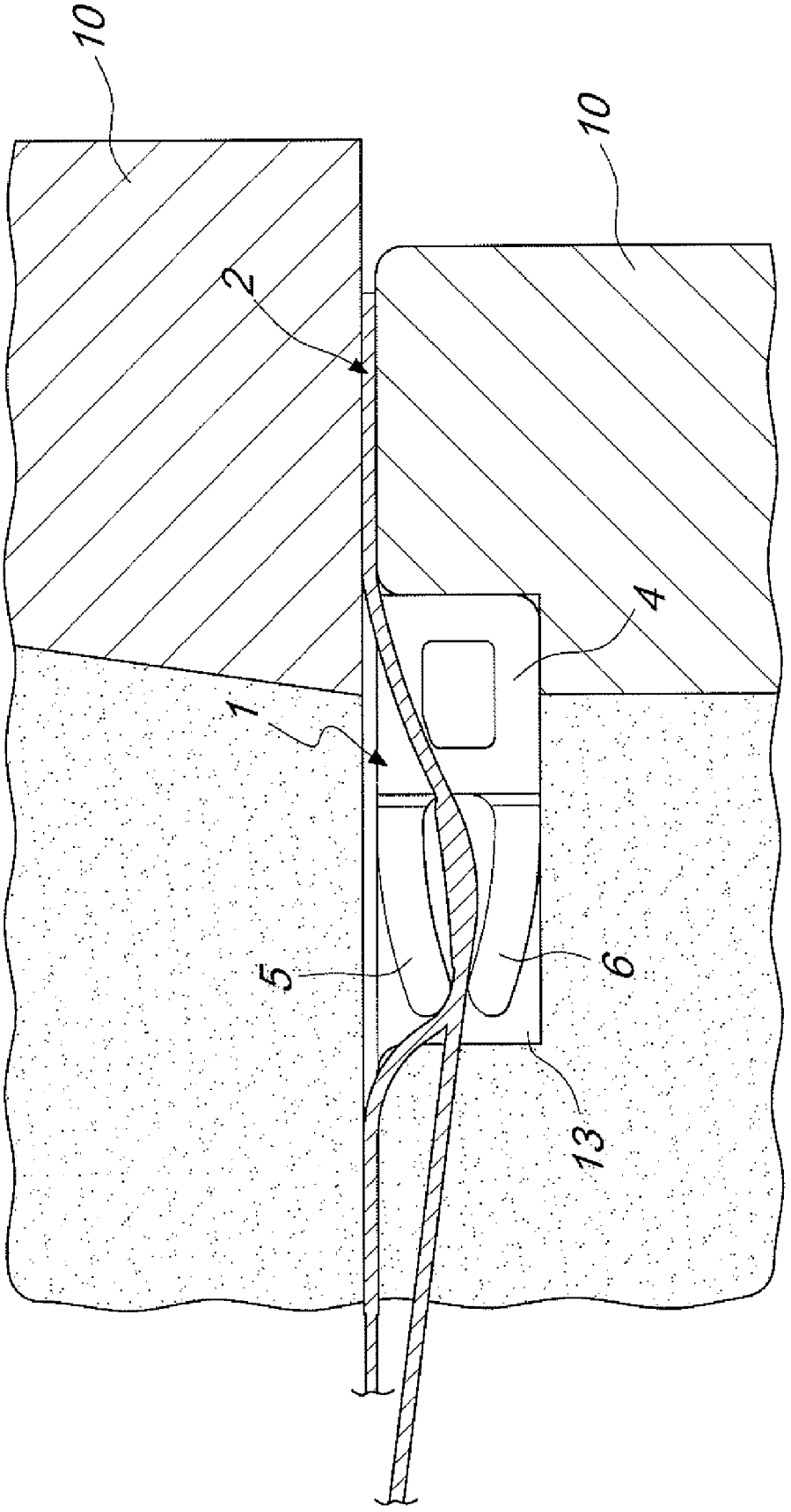


Fig. 10

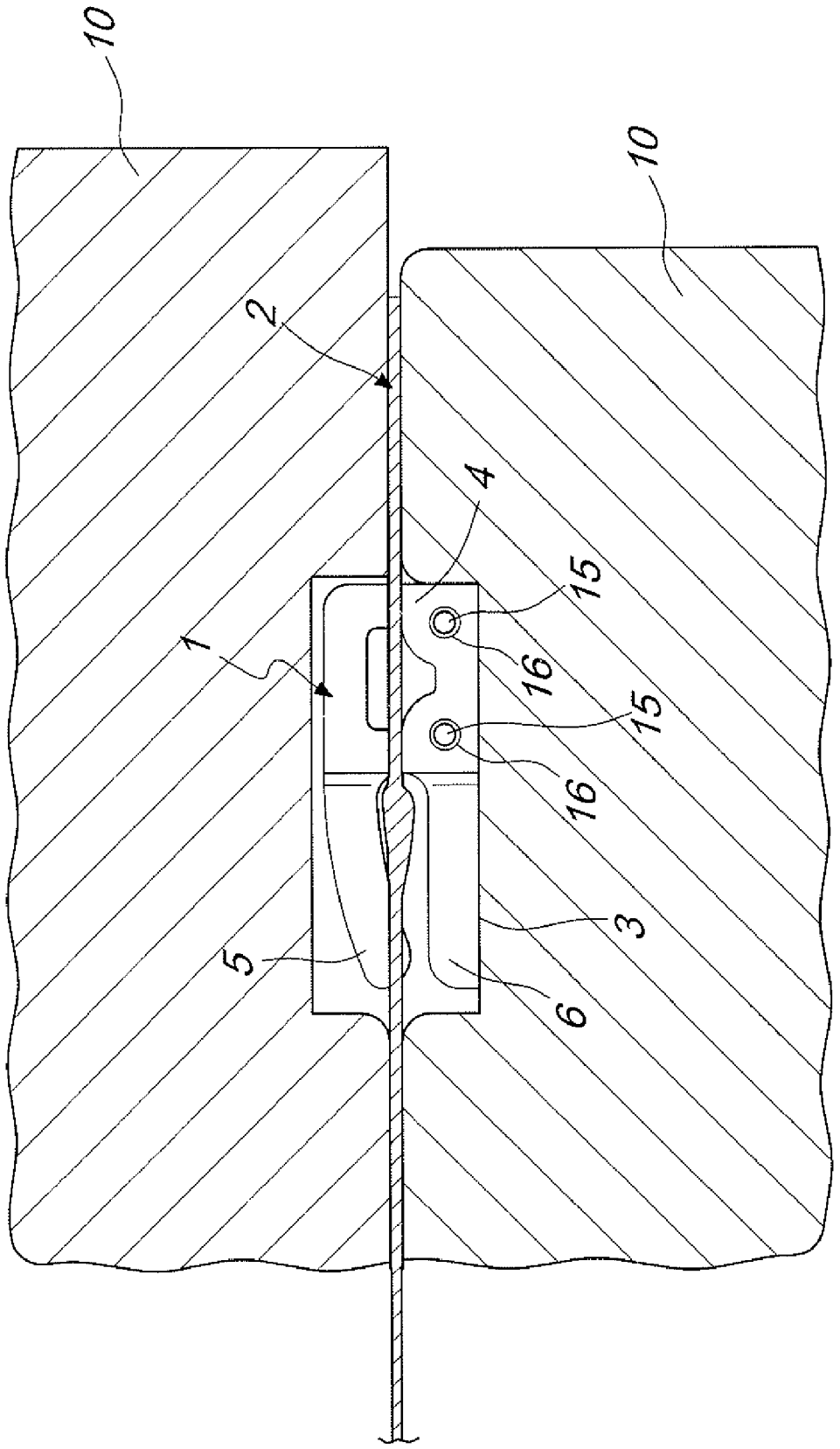


Fig. 11

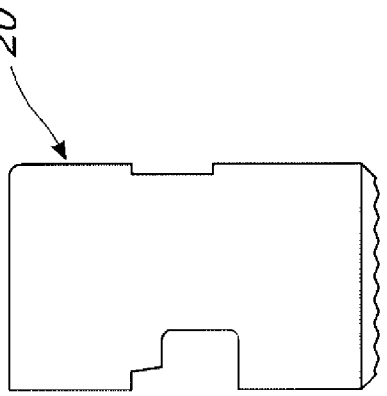


Fig. 12c

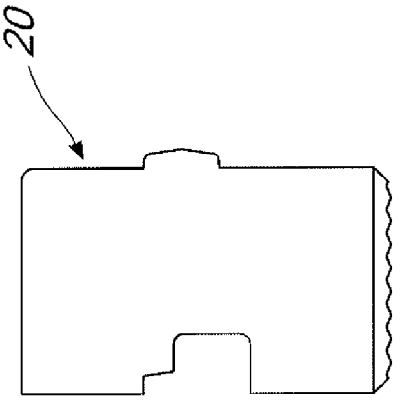


Fig. 12d

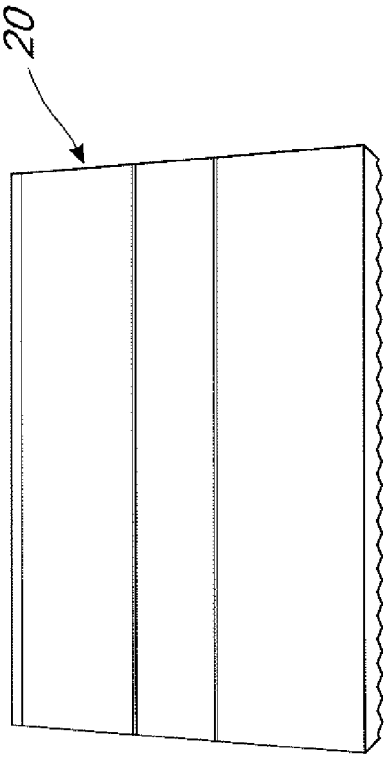


Fig. 12a

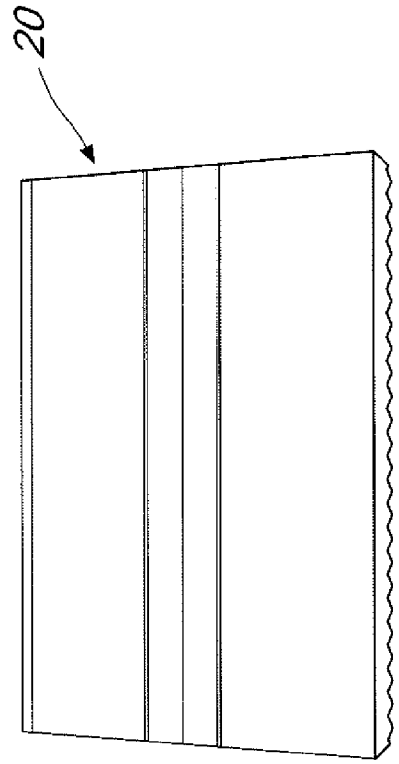


Fig. 12b

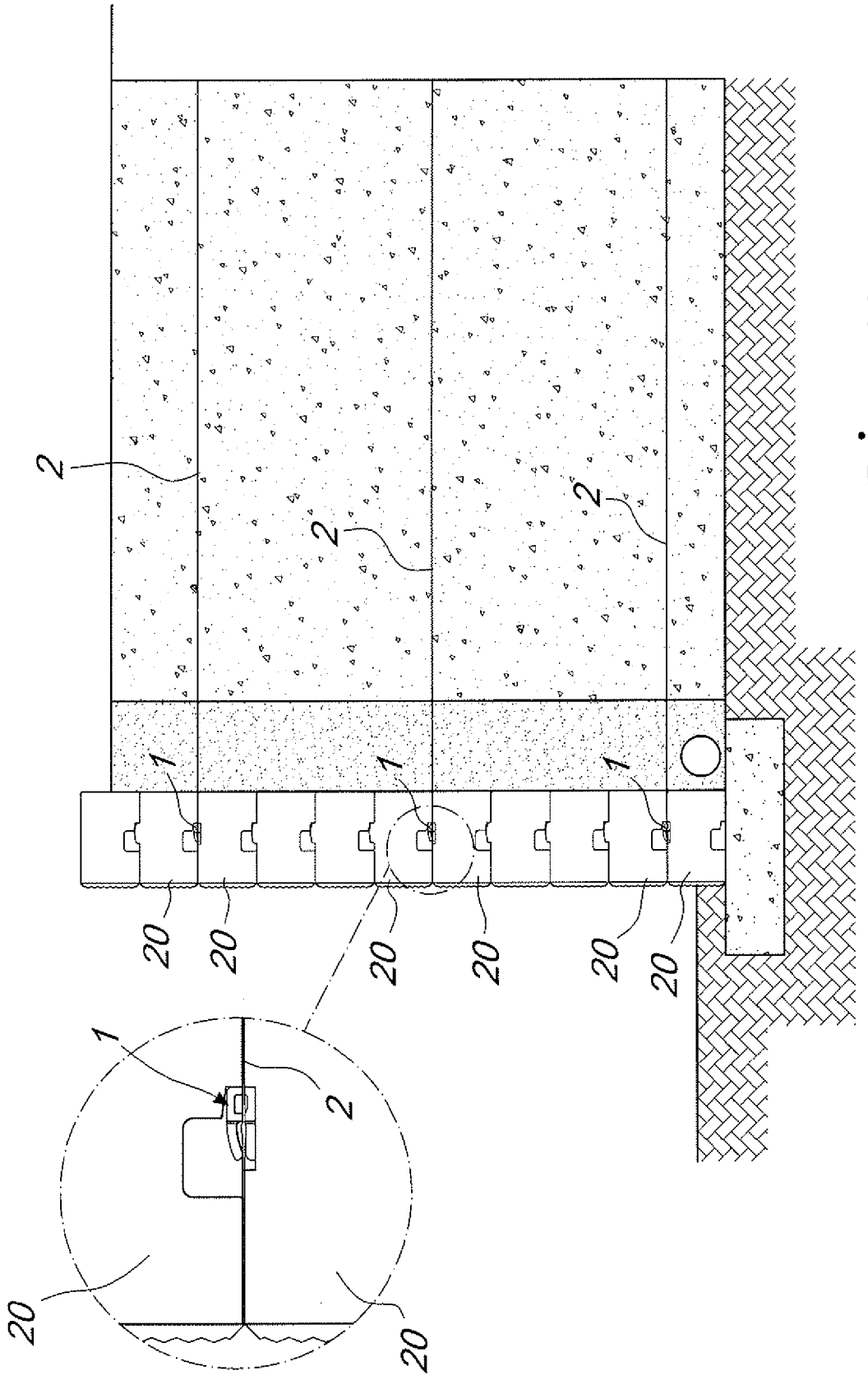


Fig. 13

CLIP-ON CONNECTOR TO GEOGRID FOR SEGMENTAL BLOCK REINFORCED SOIL RETAINING WALL MECHANICAL CONNECTION SYSTEM

TECHNICAL FIELD

[0001] The present invention relates to a clip-on connector to geogrid for segmental block reinforced soil retaining wall mechanical connection system.

[0002] More particularly, the invention relates to a clip-on connector that overcomes some of the outstanding problems in connecting dry laid segmental blocks to geogrids used for reinforced soil retaining structures, in particular achieving full pull out strength connection with the geogrids having high conjunction strength. The connector also provides for the ability to be used with blocks having a connection profile in one bed face only or shared between both top and bottom bed faces or with hollow blocks.

BACKGROUND ART

[0003] As it is known, many solutions exist for concrete panels and blocks with various connection methods between the panels and blocks for retaining walls. Some of these also include methods of connecting various forms of soil reinforcing materials for the construction of reinforced soil structures. These can be metal or polymeric strips, metal ladders or grids, and various forms of polymeric geogrids typically HDPE or Polypropylene extruded grids, or woven or knitted polyester fibre geogrids.

[0004] Geogrids which have a high junction strength between the warp and weft elements of the grid are typically extruded HDPE or modified sheet HDPE materials. These are characterised by the large cross sectional differences between the thin strong tensile elements of the grid and the thicker junction areas of the grid. This type of grid needs careful attention to the connection with segmental blocks. The aim is to obtain a full strength connection between the two. That is to say the connection strength should be equal to the manufactured tensile strength of the geogrid usually taken over one metre width.

[0005] Typically there may be 30 to 50 separate tensile elements per metre of geogrid which must be connected to the segmental blocks. Therefore to obtain a full strength connection between the two, each tensile element of the grid must be supported by or connected to the blocks. This assumes any frictional connection between the grid and blocks is ignored since this is unreliable and dependant on the pressure between the blocks.

[0006] This has been successfully achieved in a previous patent by this inventor in which a concrete comb was used to locate fingers in the apertures of the grid and the comb was supported by the lower and upper blocks in grooves provided for the comb. A separate shallow groove was provided to accommodate the thick transverse junction bar of the grid.

[0007] In other systems the grid has to be manually held in place on top of the blocks whilst further blocks are placed on top of the grid and means of connection.

[0008] In some systems two pins per block are used to connect the upper and lower blocks and theses pins are the sole method of mechanical connection between the grid and blocks and hence can not provide a full strength connection, any other connection being frictional. These pins are sometimes either a very good fit in the holes in the blocks or a very loose fit. In both cases they are disadvantageous because if they are a good fit, they restrict the freedom of the wall to take up uneven settlement and, when a bad fit, they do not provide a good location for the blocks or positive connection with the grid.

[0009] Some other blocks have moulded features on top and so holes must be cut in the grid so it can be then trapped between the blocks and these are worse than the pin connections since the holes cut in the grid seriously weaken it.

[0010] In another commercially available plastic connection system the path of the grid is so disturbed that the grid has to be cut along the thick transverse rib and so the top block sits on the tensile ribs of the grid only along the back edge of the blocks thus causing the wall to rotate forwards which is seriously disadvantageous in itself and just as bad since it allows only a line contact at the front and back of the block.

[0011] This is particularly bad at the back of the block since the pressure between the block and the grid is amplified and could lead to premature grid failure. A bending moment is also placed on the concrete block which is bad and could lead to failure.

DISCLOSURE OF THE INVENTION

[0012] The aim of the invention is to provide a connector that overcomes the drawbacks of the prior art, being able to be connected to a geogrid without the risk that the handling of the geogrid causes the connector to fall off the geogrid.

[0013] Within the above aim, an object of the present invention is to provide a connector that can be used with different blocks.

[0014] Another object of the present invention is to provide a connector that is of easy manufacturing, highly reliable and at low cost.

[0015] The above aim and objects and others that will become more apparent hereinafter, are achieved by a clip-on connector adapted to be connected to a geogrid, characterized in that it comprises a base portion wherefrom at least one finger portion extends toward an opposite edge of the base portion, such finger portion defining, with the edge of the base portion, a clip, said clip having two arms respectively defined by said finger portion and by said base portion, the spacing between said two arms being smaller than the thickness of a portion of a geogrid whereon the connector has to be coupled, but such that said geogrid portion can be inserted between said two arms.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1** is a plan bottom view of the clip-on connector according to the present invention;

[0017] F*igure* **1***a* is a perspective view of the connector according to the present invention;

[0018] FIG. **2** is a side view of the clip-on connector;

[0019] FIG. **3** is a plan top view of the clip-on connector;

[0020] FIG. **4** is a cross-sectional view along line IV-IV of FIG. **3**;

[0021] FIG. **5** is a rear view of the clip-on connector;

[0022] FIG. **6** is a front view of the clip-on connector;

[0023] FIG. **7** is a perspective view of a geogrid to be used with the clip-on connector of the present invention;

[0024] FIG. **8** illustrates the use of the clip-on connector of the invention;

[0025] FIG. **9** illustrates a variation of the use of the clip-on connector of the invention;

[0026] FIG. **10** illustrates a further variation of the use of the clip-on connector of the invention;

[0027] FIG. **11** illustrates a still further variation of the use of the clip-on connector of the invention;

[0028] FIGS. **12***a*-**12***d* illustrate a particular type of block wherein the connector of the present invention can be used;

[0029] FIG. **13** illustrates an overview of a wall made of blocks, with the interposition of geogrids and connectors according to the invention.

WAYS OF CARRYING OUT OF THE INVENTION

[0030] The connector according to the present invention, designated by the reference numeral **1**, is a connector in the form of a clip.

[0031] The connector comprises a base **3** from which at least one finger **4** develops towards an edge of the base and defines with such edge a clip with arms **5** and **6**, the arm **6** being part of the base **3** and the arm **5** being part of the finger **4**. The clip is adapted to passes over a thick transverse bar **7** of uni-axial HDPE/Polypropylene extruded or punched sheet geogrid **2** and provides fingers which occupy the ends of elliptical apertures **8** between high tensile ribs **9** which both extend at generally right angles between the transverse bars **7** of the geogrid **2**.

[0032] The radius in the throat of the connector clip centres the thick transverse bar **7** of the geogrid **2** on the finger part **4** of the connector under load. The cross section of the geogrid **2** varies with its tensile strength ans so the clip part of the connector has to accommodate this variation.

[0033] The finger part **4** of the connector **1** is designed to provide a mechanical connection with the geogrid **2** against pullout forces trying to separate the geogrid **2** from blocks **10**.

[0034] Thus, the clip defined by the at least one finger portion and the edge of the base portion presents a spacing between the two arms that is smaller than the thickness of the portion of the geogrid whereon the connector has to be coupled, but such that said geogrid portion can be inserted between said two arms. In practice, the connector has to be coupled to the geogrid so that the geogrid comes to be inserted between the two arms of the connector.

[0035] Removal of the connector is thus not possible if not desired by the operator, since the two arms have a spacing such that the insertion of the connector occurs if the connector is forced on the geogrid, thanks to the elasticity of at least one of the arms. At the same time removal is also prevented.

[0036] In applications where the connector **1** is in a housing **11** shared between top and bottom bed faces of the blocks **10** (FIG. **8**), the connector also provides a shear key connection between these adjacent blocks **10** thus eliminating the need for any secondary block to block connection means.

[0037] Where the connector housing profile **12** is in one bed face only (see FIG. **9**) or hollow block **13** (see FIG. **10**), the connector **1** provides the pull out resistance for the geogrid **2** only and some other means have to be provided for the block to block shear connection.

[0038] Since the pitch of the apertures **8** of the geogrid **2** can vary according to the manufacturer or strength or due to production tolerances, the clip-on connector **1** as a single piece would normally have a maximum of three fingers **4**. However, different number of fingers could be provided.

[0039] Alternatively to make the connector **1** fully universal and to ease its application on site, single fingers connectors strung together in groups of perhaps 10 or 20 can be used.

[0040] To this regard, FIG. **11** shows single finger connectors strung together on two wires **15** that pass through holes **16** provided in the base **3** of the connectors. Such wires **15** can be made of plastic, pultrusions or stainless steel and in this case the fingers **4** are free to float since the individual connector fingers **4** are narrower than the pitch of the apertures **8** of the geogrid. Single finger connectors could also be used individually.

[0041] One leg or arm of the clip part of the connector can be straight, for example the arm **6** that is part of the base **3**.

[0042] This allows the connector **1** to be housed in a matching block profile such that the shear forces applied to the connector **1** by the adjacent block **10** are transferred to that block **10**.

[0043] In this case the resisting pull out forces are shared between the adjacent blocks. A further advantage of the present connector is that the path of the geogrid is undisturbed being in a straight line.

[0044] Where the connector **1** is housed in one block profile only the whole of the pull out force is resisted by that block only and there is a small diversion of the geogrid **2** from the straight line.

[0045] Where the connectors **1** are applied to hollow blocks **10** the applications can be one or both of these or a combination of the two depending on the particular hollow block design.

[0046] The clip-on nature of this connection system is of benefit to the use with hollow blocks since they can be pitched along the geogrid **2**. This clip-on feature of the blocks is of advantage generally on site since the connectors **1** can not be missed or dislodged once placed on the geogrid **2**.

[0047] In all applications the adjacent blocks **10** sit on the thin high tensile ribs **9** of the geogrid **2** across the full bed face of the blocks **10** so there is no tilting or rotation of the blocks **10** since the bed faces of the blocks **10** remain parallel.

[0048] The connectors **1** can also be used with woven or knitted geogrids **2** usually made from polyester fibres coated in PVC. The strength of the pull out resistance of the connection will depend on the junction strength of the geogrids warp and weft fibres.

[0049] FIGS. **12***a*-**12***d* illustrate a solid segmental block **20** with the connection profile shared between the upper and lower bed faces of the blocks and also the rib topped block used in the system for courses where there is no geogrid requirement.

[0050] FIG. **13** shows a typical reinforced soil structure with the blocks and connectors shown in FIGS. **12***a*-**12***d* and **8**.

[0051] Thus, it can be seen that the connector according to the present invention achieves the above aim and objects since it can be firmly coupled to a geogrid without any possibilities of accidental disconnection.

[0052] Therefore, an injection moulded one or two or three finger clip is supplied which is inserted through the apertures of the geogrid and by its unique design clips over the thick transverse bar of the geogrid. Thus the two are connected together and can only be separated by deliberate manual intervention.

[0053] In addition, the connector can be accommodated inside recesses defined in the blocks between which the geogrid is placed.

[0054] Another advantage of the connector of the invention over the prior art is that it can be used in blocks where a groove can be placed at the top of the block, only the bottom of the

mating block being substantially flat. In this case a method of providing shear connection between the blocks must be arranged.

[0055] A further advantage is that the connector of the invention can be used with hollow blocks with a groove correctly placed in the top only.

[0056] A further advantage is that the present connector does not require a second groove in the top or bottom of the block to accommodate the thick transverse (warp) bar of the grid since it is housed within the connector itself.

[0057] Also unlike another plastic finger connector which does not clip onto the grid or can act as an inter block shear connector, the present clip-on connector can also act as an inter block shear connector by locating the top block to the bottom block.

[0058] In addition, the present connector also keeps the grid in a horizontal plane so that the pull out forces are kept horizontal and hence the disturbing forces between the blocks are at a minimum.

[0059] Whether the connector is housed in grooves in the top and bottom of the blocks or in the top of the block only the thin tensile fingers of the grid can be carried forward to the front of the block as well as to the rear of the block so that the blocks remain parallel in both planes.

[0060] The described invention is susceptible of numerous other modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0061] The disclosures in United Kingdom Patent Application no. 0609204.3, from which this application claims priority, are incorporated herein by reference.

[0062] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

1-7. (canceled)

8. A clip-on connector adapted to be connected to a geogrid, comprising a base portion wherefrom at least one finger portion extends toward an opposite edge of the base portion, such finger portion defining, with the edge of the base portion, a clip said clip having two arms respectively defined by said finger portion and by said base portion, the spacing between said two arms being smaller than the thickness of a portion of a geogrid whereon the connector has to be coupled, but such that said geogrid portion can be inserted between said two arms.

9. The clip-on connector of claim **8**, wherein said spacing between the two arms is variable due to the flexibility of said finger portion.

10. The clip-on connector of claim **8**, comprising two finger portions that extend from the base portion, substantially parallel one with respect to the other.

11. The clip-on connector of claim **8**, wherein said base portion is provided with at least one hole for the passage of connecting Wires.

12. The clip-on connector of claim **8**, wherein said connector can be made by injection, compression or rotation moulding or by casting or from single or composite materials.

13. A block to be used with a clip-on connector according to claim **8**, comprising at least on one of bed faces at least one recess adapted to partly or totally accommodate said connector.

14. A combination of a geogrid and at least one connector, wherein said connector is a connector according to claim **8**.

* * * * *