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(54) Pile wall capping

(57) A precast capping beam element comprises a parallel pair of concrete retaining panels connected together by reinforcing rods cast into both panels and projecting into the space therebetween. One panel may be larger than the other. A method is also disclosed for forming a capping beam of a pile wall by placing the capping beam element over a line of piles so that the reinforcing rods of the piles project into the space, and filling the space with concrete.

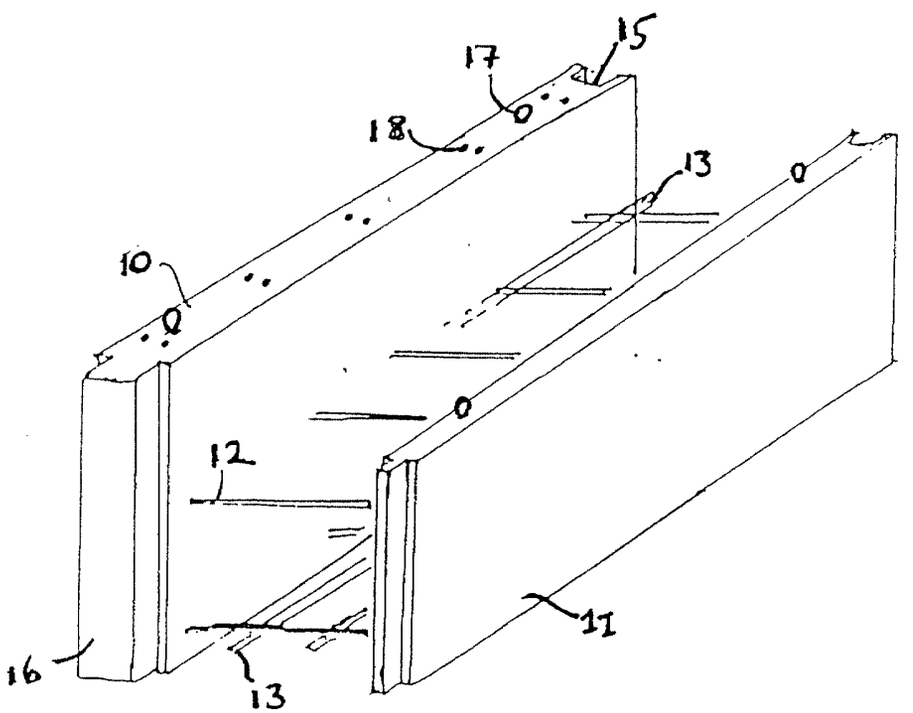

Figure 1

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Description

[0001] The present invention relates to the formation of capping beams for pile walls.

[0002] A pile can either be a pre-formed shaft which is hammered into the ground or be formed by drilling a hole in the ground and pumping concrete into the hole. The latter technique may involve using an auger with a hollow shaft and pumping concrete through the shaft to form the pile as the auger is being withdrawn. Reinforcing rods are usually introduced into the concrete before it sets, with their top ends left projecting from the top of the concrete.

[0003] A pile wall consists of a row of piles, which may be either spaced apart or packed closely together (even to the point of intersecting each other in what is termed a secant wall). With a secant wall, the piles are necessarily all parallel, and are normally vertical. With non-intersecting piles, some (or even all) may be raked (sloping).

[0004] A pile wall is frequently completed by forming a horizontal capping beam along its top edge. The capping beam serves, among other things, to link the piles together and spread any loading on the piles evenly between them. It is normally formed by levelling the tops of the piles (and any ground in between them), placing shuttering to define the sides of the beam, and pouring concrete to form the beam. Reinforcing rods will normally be introduced into the concrete of the beam. The poured concrete will also surround the reinforcing rods projecting from the top ends of the piles, so firmly linking the piles with the beam.

[0005] The general object of the present invention is to provide an improved way of forming a capping beam of a pile wall.

[0006] According to one aspect there is provided a method of forming a pile wall comprising forming a line of piles with projecting reinforcing rods, placing thereover a capping beam element comprising a parallel pair of concrete retaining panels connected together and each having transverse reinforcing rods projecting therefrom towards the other panel, and pouring concrete or grout into the space between the two panels. Preferably one panel has a larger cross-section than the other. The panels are preferably tongued and grooved at their ends. The panels may have lifting eyes or the like cast or formed in their upper edges. One or both panels may also have fixing holes or studs cast into it for a railing formed in their upper edges.

[0007] According to another aspect there is provided a pre-cast capping beam element comprising a pair of panels as just defined and connected together by transverse reinforcing rods each cast into both panels.

[0008] By means of the invention the need for fabrication of form-work on site is avoided. This results in decreased costs, particularly on-site labour costs, and a quicker installation, as well as an increase in quality of the resulting capping beam.

[0009] The present panels will normally be manufactured in a factory, which allows considerably better control of quality than operations on site, and gives an improved finish to the sides of the capping beam. The amount of operations on site is substantially reduced, so that the time, labour, and expense on site is reduced, and adverse weather conditions have reduced effect.

[0010] Further features of the invention will become apparent from the following description of a pile wall capping beam element, a method of forming a pile wall, and modifications of the method, all in accordance with the invention, given by way of example and with reference to the drawings, in which:

Fig. 1 is a diagrammatic perspective view of the capping beam element;
Figs. 2 to 6 show successive stages in forming a pile wall using the capping beam element;
Fig. 7 shows a modified capping beam element;
Figs. 8, 8A, and 9 to 11 show various stages in modified methods of forming a pile wall; and
Fig. 12 shows a section through a beam element in greater detail.

[0011] Referring to Fig. 1, the capping beam element consists of a pair of concrete retaining panels 10 and 11 linked to each other by transverse reinforcing rods 12. Panel 10 is generally higher and thicker than panel 11, and is intended for the outer side of the pile wall, as described later. Panel 10 has a short projecting tongue 16 at one end and a groove or recess 15 at the other end, so that a series of capping beam elements placed end to end will engage with each other and so avoid misalignment. Panel 11 is similarly tongued and grooved at its ends.

[0012] The pair of connected panels 10 and 11 are formed in a steel mould with a core. The core shutters have slots to allow the reinforcing rods to pass through them when the beam is removed from the mould once the concrete has set.

[0013] Before filling the mould with concrete, a retarding agent is painted onto the core. When the panels are removed from the mould the surface layer affected by the retarding agent is removed by pressure washing leaving an exposed aggregate finish on the inner faces of the panels, to encourage a good bond between them and the concrete poured between them during construction of the capping beam.

[0014] It may be desirable or necessary for the capping beam to have an angle in it. Standard angles such as 90° can be achieved by forming each of the two panels with the appropriate angle in it. Similarly, a third panel across one end of the pair of panels can be included as a beam terminating element.

[0015] The rods 12 are in the form of rectangular loops in the vertical plane, as discussed in more detail later. Further longitudinal reinforcing rods 13 are attached to the rods 12 in the space between the panels and parallel

to the panels. These rods 13 project beyond the ends of the panels, so that they overlap when two pairs of panels are placed adjacent to each other. The panels 10 and 11 contain internal longitudinal and vertical reinforcing rods; as shown in Fig. 5, the vertical rods in panel 10 are in the form of loops.

[0016] The pairs of panels are normally closely butted together. However, it may be necessary to provide an expansion joint in the beam or wall formed by them. For this, the two pairs of panels are placed with a slight gap between them (less than the depth of the grooves 15), and a separating sheet of compressible material is placed across the gap between the panels to produce a discontinuity between the two sections of the beam on the two sides of the joint. The longitudinal reinforcing rods 13 must also be cut short, to allow the separating sheet to be placed in position. If desired, the gaps between the panels on each side of the beam can be sealed, eg with a waterproof and flexible mastic material.

[0017] If desired, the longitudinal joints between the panels and the top of the infilling concrete may be treated to prevent water ingress. There are various known techniques for this; for example, a rebate can be formed along each joint and subsequently filled with mastic, or a hydrophilic water bar material can be inserted along the upper edge of the inside faces of the beams before the infilling with concrete.

[0018] The panels 10 and 11 have eyes 17 set in them as shown to allow the capping beam element to be lifted. Panel 10 also has a series of pairs of railing fixing holes 18 formed in it.

[0019] Figs. 2 to 6 show end views of various stages in the formation of a pile wall and its capping beam. Fig. 2 shows the ground 25 with vertical piles 26 and raked piles 27. The piles may typically be of around 300 mm diameter, with a spacing of 1 m, alternately vertical and raked. As shown, the piles 26 and 27 have reinforcing rods 28 and 29 respectively projecting from them. The area is then levelled as shown in Fig. 3, with the ground 25 being levelled. The tops of the piles are broken down if necessary, and their exposed ends suitably prepared ("scabbled") for good engagement with the concrete to be poured over them. The reinforcing rods 29 of the raked piles 27 are bent to the vertical and their ends are bent over as shown.

[0020] The capping beam element is then placed over the tops of the piles, as shown in Fig. 4, with the larger panel 10 on the outside of the pile wall, and with the tops of the piles approximately centrally located between the panels 10 and 11. A crane or the like can conveniently be used for this, lifting the pairs of panels by means of the cast-in lifting eyes.

[0021] Concrete 30 is then poured into the region between the two panels, as shown in Fig. 5, by any convenient method, eg via a chute direct from a delivery truck. If the base of this region is smooth and level and the joints between the pairs of panels have been pushed tight, it will not be necessary to make any particular provision against concrete loss during pouring and placement. It is good construction practice to vibrate the concrete. The surface of the concrete can be finished as desired, eg tamped or smoothed by a float.

[0022] Fig. 5 also shows further details of the reinforcing rods of the capping beam element. The loops 12 of rods connecting the two panels together are shown; also shown are longitudinal reinforcing rods 19 and 20 in the panels 10 and 11 respectively and vertical rod loops 21 in panel 10.

[0023] The wall is finally finished as shown in Fig. 6 by back-filling the region behind it with earth 31 to the level of the outer panel 10, attaching a handrail 32, and re-grading the earth in front of the wall as shown at 33.

[0024] Instead of a capping beam element consisting of two panels 10' and 11' interconnected by reinforcing rods 12, two separate panels may be used, as shown in Fig. 7. Panel 11' is formed with rods 12' projecting from the inner face; panel 10' is similar. The rods 12' are of a length slightly less than the intended distance between the panels, so that when the panels are placed in position, their projecting rods overlap. Each panel also has dovetail grooves 35, so that the spacing between the panels can be set by connecting them, e.g. by halfen connecting rods.

[0025] A modified technique is shown in Figs. 8 to 11. This technique is particularly suitable if the pile reinforcing rods are of large diameter. The parts corresponding to those in the above embodiment are shown by the same identifying number followed by a prime (').

[0026] The process starts with the sinking of vertical and raked piles 26' and 27', as shown in Fig. 8. Next, a concrete blinding strip 36, typically 100-150 mm thick and somewhat wider than the final width (thickness) of the capping beam, is formed at ground level over the tops of the piles. Alternatively, it may be preferred to form the blinding strip 36 first, as shown in Fig. 8A, before forming the piles. The blinding strip will in this case be formed with void formers, such as for example sacrificial cardboard formers, in the positions required for the piles, anchors, etc. The surface of the blinding strip should be at the desired level for the bottom of the capping beam, and is preferably given a smooth finish, eg by a trowel or float.

[0027] The reinforcing bar 29' of the rake pile 27' is terminated in an end plate 37, rather than being bent over as in the previous embodiment, the surface of the blinding strip 36 is cleaned, and the capping beam element is placed in position, as shown in Fig. 10. Finally, as shown in Fig. 11, the concrete 30' is then poured, the railings 32' fixed, and the earth levelled and graded as desired as shown at 31' and 33'.

[0028] Fig. 12 shows the reinforcement elements of the capping beam element in greater detail. The reinforcing rods 12 are placed close enough together along the length of the capping element to provide a degree of redundancy. If there is a conflict between the rods 28

and 29 projecting from the piles 26 and 27 and the bottom mat of rods 12 and 13 of the capping element, some of the rods 12 may be cut, as shown at 12A, and then cranked out of the way of the rods 28 and 29. This will allow more accurate placement of the beam over the pile steel (ie the projecting rods 28 and 29).

[0029] The redundancy of the rods 12 means that some of them can be cut without any need to provide alternative reinforcement. If more rods 12 need to be cut than is permitted by the design limits, however, then separate links 38 may be inserted as shown in Fig. 12. These links will be tied to the top portions of the rods 12 and to the upturned cranked ends 12A of the bottom portions.

Claims

1. A method of forming a pile wall comprising forming a line of piles with projecting reinforcing rods, placing thereover a capping beam element comprising a substantially parallel pair of concrete retaining panels connected together and each having transverse reinforcing rods projecting therefrom towards the other panel, and pouring concrete or grout into the space between the two panels.

2. A method according to claim 1, characterised in that one panel has a larger cross-section than the other.

3. A method according to any previous claim, characterised in that the panels are tongued and grooved at their ends.

4. A method according to any previous claim, characterised in that the panels have lifting eyes or the like formed in their upper edges.

5. A method according to any previous claim, characterised in that at least one panel has fixing holes for a railing formed in its upper edge.

6. A method of forming a pile wall substantially as herein described with reference to Figs. 2 to 6.

7. A pre-cast capping beam element comprising a pair of panels as defined in any previous claim and connected together by transverse reinforcing rods each cast into both panels.

8. A pre-cast capping beam element substantially as herein described with reference to Fig. 1.

9. Any novel and inventive feature or combination of features specifically disclosed herein within the meaning of Article 4H of the International Convention (Paris Convention).

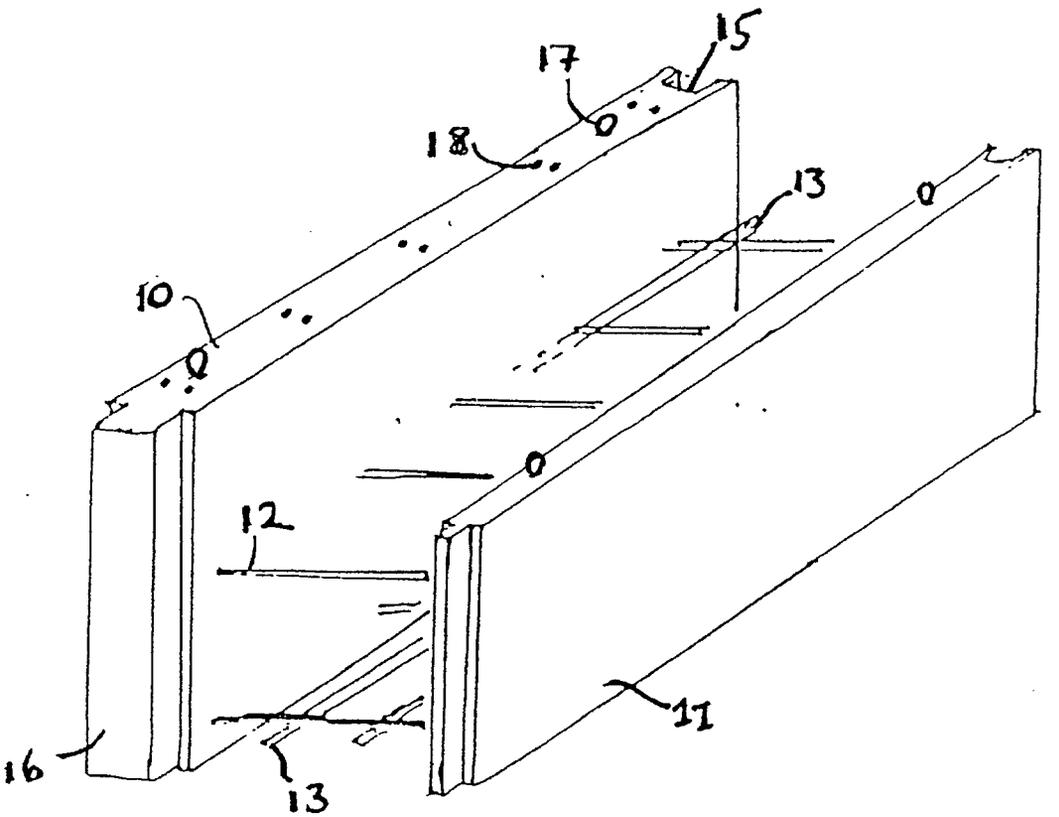


Figure 1

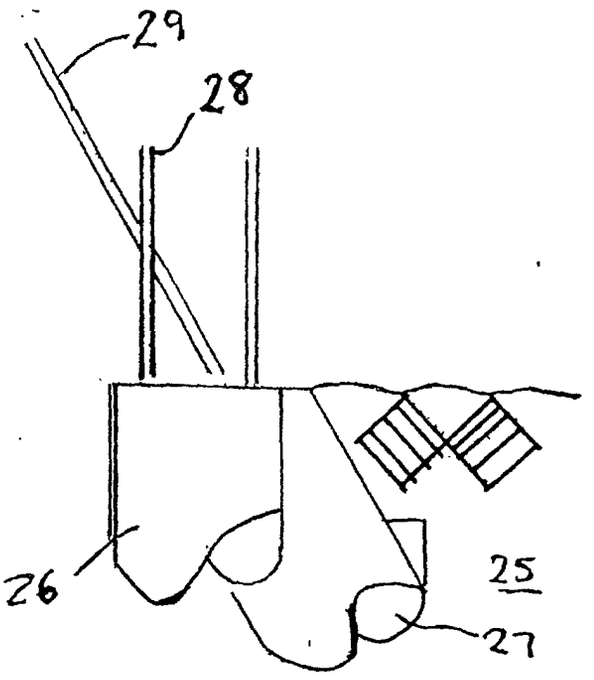


Figure 2

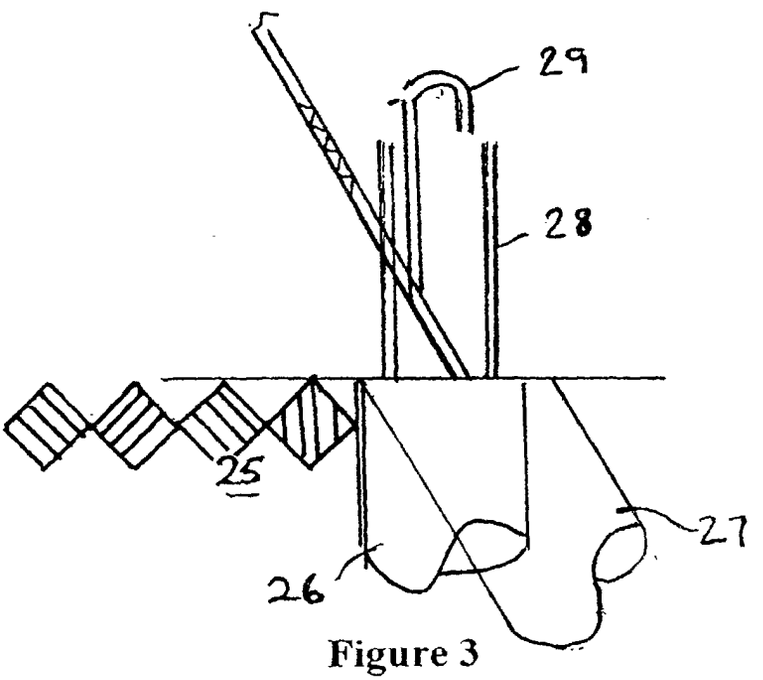


Figure 3

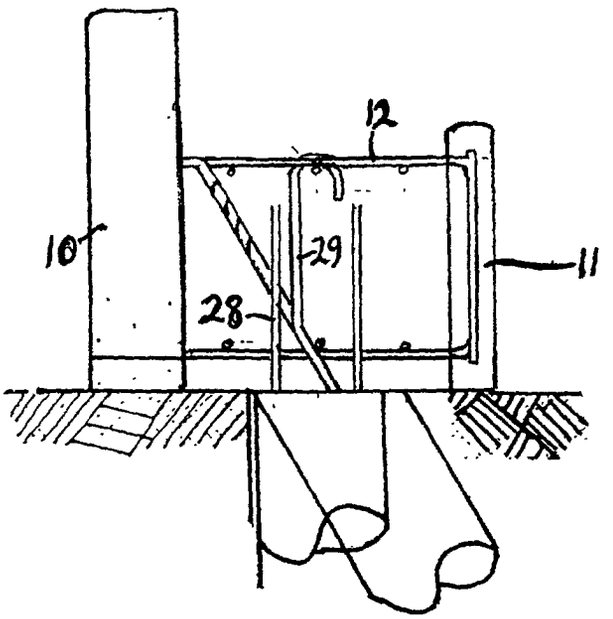


Figure 4

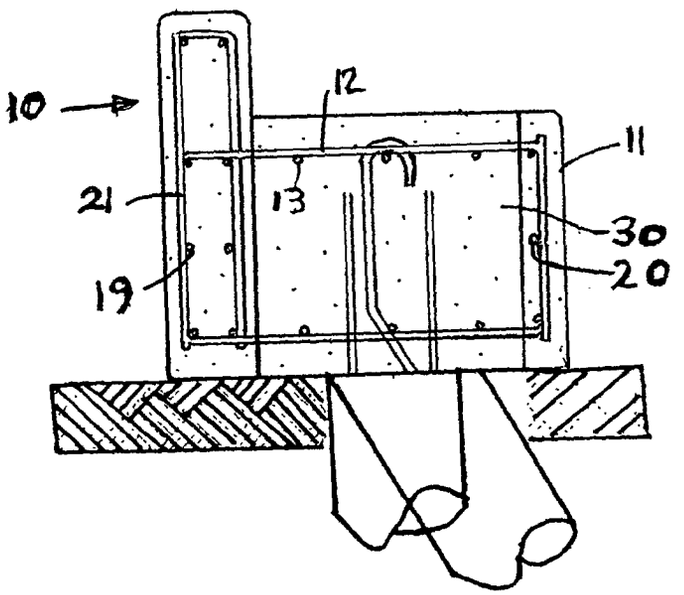


Figure 5

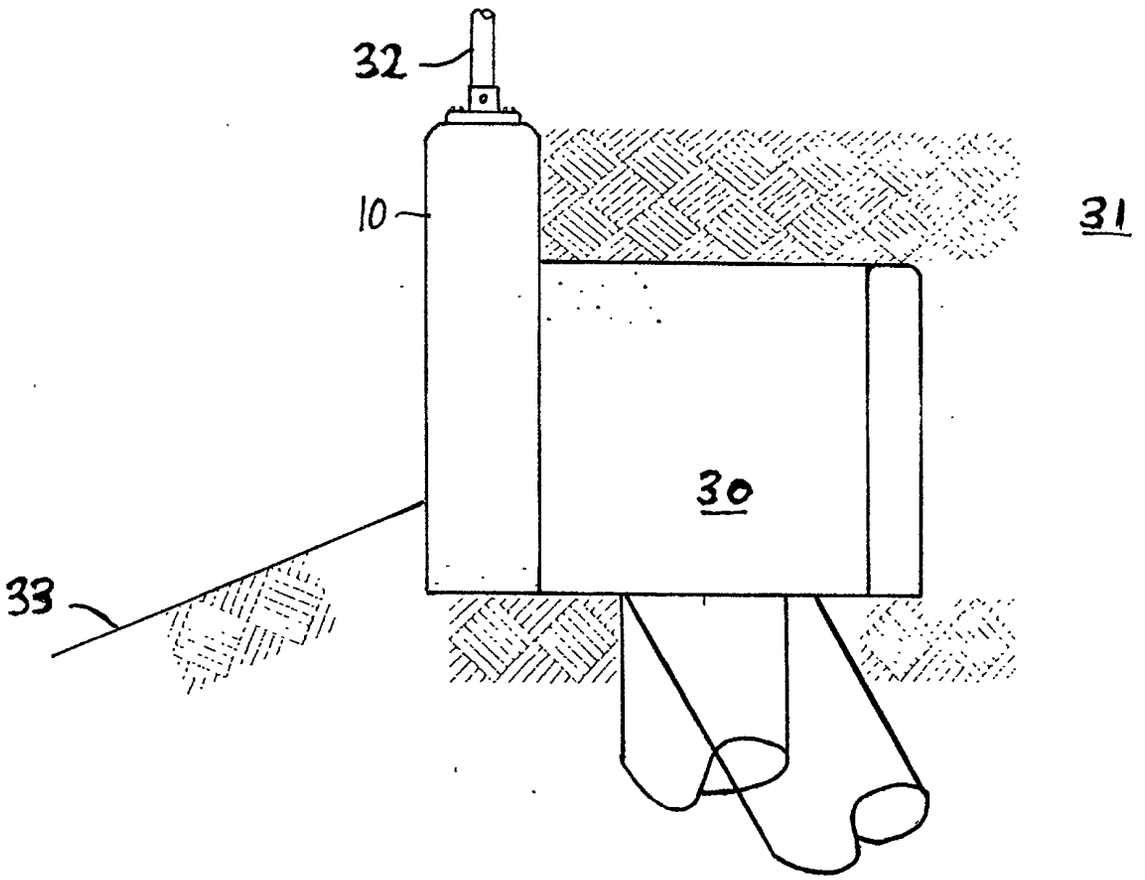


Figure 6

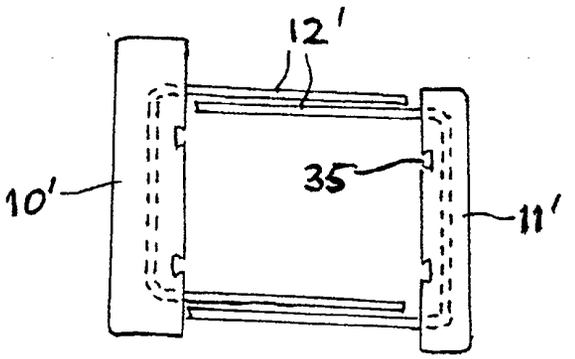


Figure 7

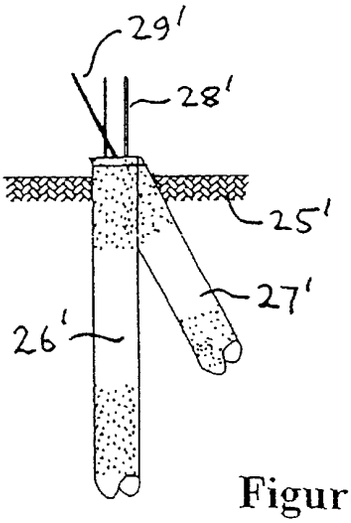


Figure 8

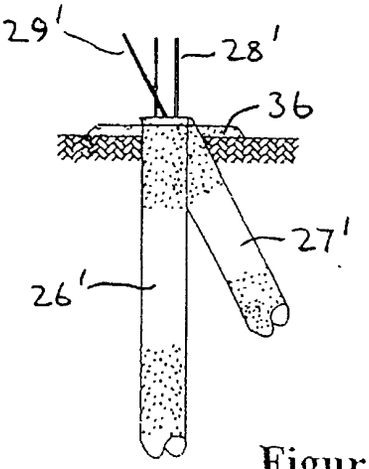


Figure 9

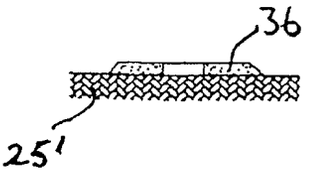


Figure 8A

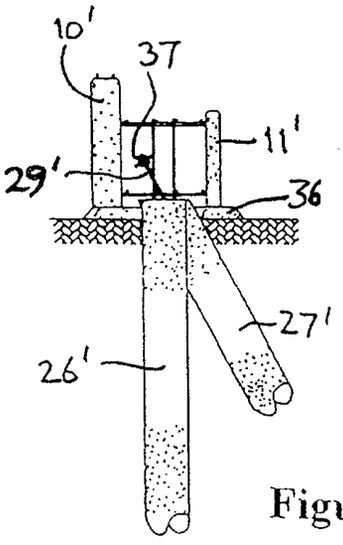


Figure 10

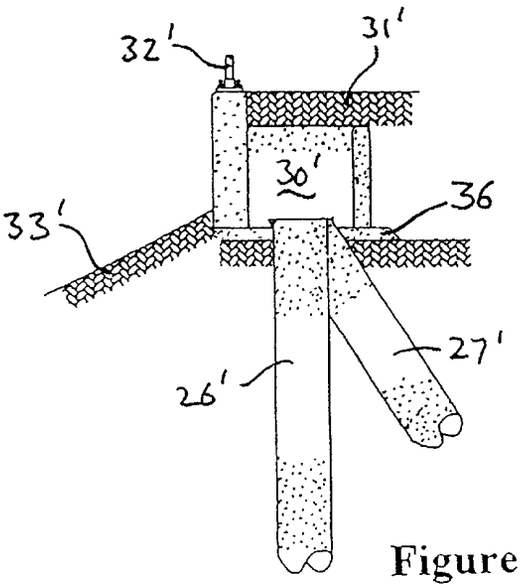
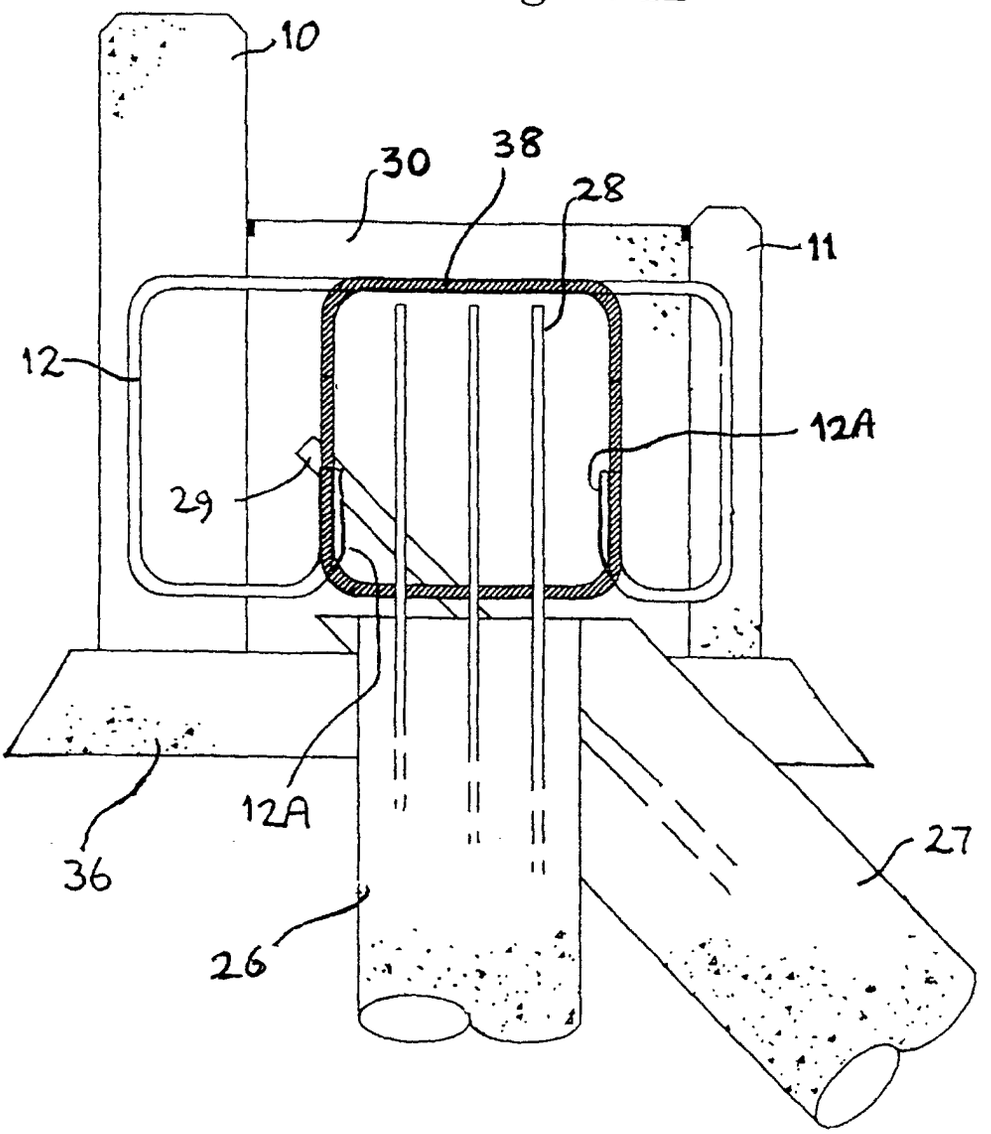


Figure 11

Figure 12



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EUROPEAN SEARCH REPORT

Application Number
EP 00 12 5772

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	* page 5, line 31 - page 6, column 7; figure 6 *	2	
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E02D
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 January 2001	Blommaert, S

CATEGORY OF CITED DOCUMENTS

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