



(11) Publication number : **0 678 627 A1**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number : **95201030.4**

(51) Int. Cl.⁶ : **E02D 5/16, B28B 7/34**

(22) Date of filing : **21.04.95**

(30) Priority : **22.04.94 NL 9400649**

(43) Date of publication of application :
25.10.95 Bulletin 95/43

(84) Designated Contracting States :
BE DE FR GB NL

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(54) **A cover section of U-shaped cross section for a sheet-pile wall consisting of wavy panels.**

(57) Concrete cover section (12) of U-shaped cross section for a sheet-pile wall (1), which cover section (12) comprises on at least one leg (21) of the prefabricated U-shaped section (21, 22, 23) one or more retaining projections (13), whose shape corresponds approximately with the waveform of the sheet-pile wall (1).

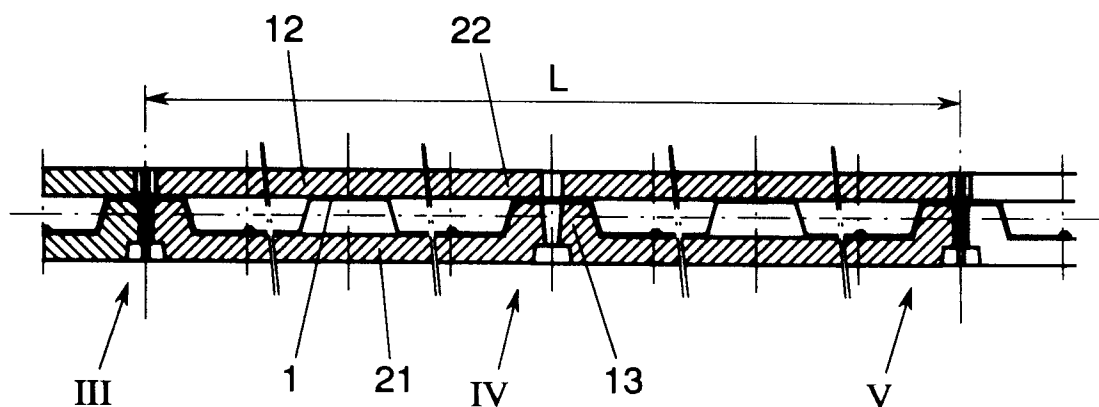


FIG. 2

For strengthening banks or forming quay walls, frequently use is made of sheet-pile walls, which are built up from wavy panels whose side edges are interconnected. The panels are often driven into the ground at an inclination, for instance of 10:1. Normally, on top of the upper end of the sheet-pile wall a steel cover or cap section of U-shaped cross section is arranged, which is connected to the sheet-pile wall in a suitable manner, for instance by welding. On the land-side of the bank or the quay wall, normally a horizontally extending steel purlin is arranged at a short distance under the cover section, for the purpose of increasing the longitudinal rigidity of the sheet-pile wall. At intervals of a few meters ground anchors are arranged, which engage this steel purlin and prevent the sheet-pile wall from being pushed over into the water. A sheet-pile wall of this type which is known from practice is shown in Figure 1.

It has already been attempted in practice to combine the functions of the cover section and the stiffening purlin by fitting the top end of the sheet-pile wall with a concrete beam poured thereon. However, the arrangement of formwork adapted to the shape of the sheet-pile wall is labor intensive, and the supply of ready-to-pour concrete often presents problems in view of the low bearing capacity of the soil in the vicinity of the sheet-pile wall or the cumbersome supply over water.

The object of the invention is to obviate these drawbacks and to that effect the invention is characterized in that the cover section consists of a prefabricated concrete beam which comprises on the inside surface of at least one leg of the U-shaped cross-section at least one retaining projection, whose shape corresponds approximately with the waveform of the sheet-pile wall.

Because the sheet-pile wall is normally longer than the prefabricated concrete cover section, and adjacent cover sections should reproducibly connect to each other, in accordance with a preferred embodiment the length of a prefabricated concrete beam is a multiple of the wavelength of a sheet-pile wall panel, the retaining projection(s) being provided in such a manner that the axial ends of the concrete beam are located in a plane going through a wave trough of the sheet-pile wall.

Placing the cover section on the upper end of the sheet-pile wall is facilitated by giving the retaining projections and the opposite leg of the cover section a locating or piloting shape as described in claims 4 and 5.

For the mutual coupling of cover sections connecting to each other in longitudinal direction and for connecting them to anchor rods, preferably use is made of the measures described in claims 6 to 9.

An accurately form-closing connection between the cover section and the top end of the sheet-pile wall can be obtained by giving the cover section a

shape as described in claim 10. A cover section of this shape can be manufactured by the method as described in claim 12.

Embodiments of the cover section according to the invention, as well as a method for manufacturing same, are further explained hereinafter with reference to the drawing.

In the drawing:

Fig. 1 shows a sheet piling construction known from practice;

Fig. 2 shows a horizontal cross section of a sheet-pile wall with a cover section according to the invention;

Fig. 3 shows the detail III of Fig. 2, on an enlarged scale;

Fig. 4 shows the detail IV of Fig. 2, on an enlarged scale;

Fig. 5 shows a cross section taken on line V-V of Fig. 4;

Fig. 6 shows a cross section taken on line VI-VI of Fig. 4;

Fig. 7 shows a side elevational view along line VII-VII of Fig. 3;

Fig. 8 shows a perspective view of a sheet-pile wall with a block of foam material arranged on the top end thereof;

Fig. 9 shows a cross section of an auxiliary molding, in a formwork, together with the block of foam material;

Fig. 10 shows the auxiliary molding of Fig. 9 in a formwork during the pouring of the cover section;

Fig. 11 shows a second embodiment of a cover section;

Fig. 12 shows a third embodiment of a cover section during the arrangement thereof on the sheet-pile wall;

Fig. 13 shows a bottom view of a cover section as shown in Fig. 12;

Fig. 14 shows a cross section of the cover section shown in Fig. 13.

Fig. 1 shows a prior art sheet pile construction which is built up from wavy panels whose side edges are interconnected. The panels have been driven into the ground at a gradient of, for instance, 10:1. The top of the sheet-pile wall 1 is covered by a steel cover section 2 of U-shaped cross section, which in some manner or other is connected with the sheet-pile wall 1. Arranged on the landside of the sheet-pile wall is a horizontally extending steel purlin 3, 4, consisting of two U-shaped sections which may be connected to each other, with the bridging legs of the U-shape directed towards each other, by spacers 5 arranged at certain intervals between the U-sections 3, 4. Because the sheet-pile wall 1 normally has a greater length than the length of the U-sections 3, 4, at the ends of the U-sections coupling plates 6 are arranged, which are suitably connected to the U-sections 3, 4 and a spacer 5 if any is interposed. At desired intervals,

screw anchors 7 are arranged, which at one end comprise a screw blade 8, grout anchor or the like and whose other end is pressed against the sheet-pile wall 1 by means of a nut 11. Normally, a clamping plate 9 is arranged under the nut 11, while on the rear side of the U-sections 3, 4 a washer plate 10 is provided. The anchor rod 7 is secured in the ground at a suitable inclination, for instance 1:6.

Figs. 2-7 show a first embodiment of a cover section, consisting of a cross-sectionally U-shaped prefabricated concrete beam 12, made up of two opposite legs 21, 22 and a bridging leg 23 (see Fig. 5). The length L of the concrete cover section is a multiple of the wavelength of a sheet-pile wall panel. Provided on the inside surface of the leg 21, at suitable intervals, are retaining projections 13, whose shape corresponds approximately with the waveform of sheet-pile wall 1. The retaining projections 13 are provided in such a manner that the end faces of the concrete beam of length L are located in a plane going through a wave trough of the sheet-pile wall 1. At the ends of the concrete cover section 12, on the inside surface of the leg 21, "half" retaining projections 16, 17 are provided, in such a manner that the two "half" retaining projections 16, 17 jointly have the shape of a retaining projection 13. At the location of the retaining projections 13, a recess 14 is provided, going through the two legs 21, 22 of the concrete cover section for the purpose of passing an anchor rod 26 there-through. At the location of the "half" retaining projections 16, 17, "half" recesses 18 are provided, jointly having the shape of a recess 14 for receiving an anchor or coupling rod 27. Provided in the leg 21 of the concrete cover section 12 at the location of the retaining projections 13 is a widened chamber 15 for receiving therein a lock nut 28 as well as a washer. Provided at the location of the ends of the concrete cover section 12 are "half" chambers 19, jointly having the shape of a recess 15 and also serving for receiving therein a lock nut 28 with a washer plate. The lateral flanks of the retaining projections 13, 16, 17 are designed to converge from the inside surface of the bridging leg 23 of the beam 12, as indicated in Fig. 4 by the broken line 24, in order to give the retaining projections 13, 16, 17 a "piloting" profile to facilitate fitting the concrete cover section on the top end of the sheet-pile wall 1. The inside surface 25 of the leg 22 is also designed to slope, so as to give this leg 22 a "piloting" profile as well. The recess 14, 18 is preferably provided at a slight inclination in the cover section 12, as is indicated by the direction of the center-line 20 in Fig. 6. The leg 22 may optionally have a shorter length than the leg 21 of the cover section 12. In Fig. 7 the end face of the cover section 12 is shown.

Figs. 8-11 show a second embodiment of a cover section for a sheet-pile wall, as well as a method for manufacturing same. The particular aspect of this cover section, also referred to as sheet-pile capping

piece or head beam, resides in the fact that a perfect retaining fit is obtained between the sheet-pile head beam and the top end of the sheet-pile wall.

Fig. 8 depicts a sheet-pile wall 31 whose separate panels are provided with edge jaws 39 for the mutual coupling thereof. The relative position of these sheet-pile panels may vary as a result of tolerances which may arise during the manufacture of the panels or when they are being driven into the ground. A block of foam material 33 is pressed on the top end of the sheet-pile wall 31, yielding an accurate impression of the sheet-pile wall in the foam material 33. This block of foam material 33 is then placed in a formwork 34, whereafter a molding material is poured into the recess of the foam block 33 for the purpose of forming an auxiliary mold. As molding material, for instance plaster can be used (see Fig. 9). The auxiliary mold 35 and the foam material 33 are then removed from the formwork 34, whereafter the auxiliary mold 35 is placed on the bottom 40 of the formwork 34 and this formwork is poured full of concrete 36 for forming the sheet-pile head beam. If desired, a reinforcement can be arranged in the formwork 34, as shown in Fig. 14. Upon removal of the formwork 34 and the auxiliary mold 35, a sheet-pile head beam is obtained which fits perfectly onto a particular part of the sheet-pile wall 31, as shown in Fig. 11. The slot 37 present therein is a perfect match for a specific part of the sheet-pile wall 31.

The advantage of such a sheet-pile head beam is that it forms a perfect fit for the upper edge of the sheet-pile wall. The disadvantage is that a cast must be made of each part of the sheet-pile wall.

Figs. 12-14 show a third embodiment of the sheet-pile head beam 42 according to the invention. To allow for the tolerances in the sheet-pile wall, a prefabricated sheet-pile head beam is manufactured, the slot 43 of which is made to widen gradually from one end of the sheet-pile head beam 42 in the direction of the other end, as shown in Fig. 13 by slot width a ... d. In principle, the length of such a sheet-piling head beam 42 will have to be shorter than the lengths according to the first and second embodiments. Fig. 12 shows the arrangement of such a sheet-pile head beam 42 on a sheet-pile wall 31. Fig. 14 shows a cross section of a reinforced sheet-pile head beam 42 according to this third embodiment.

Claims

1. A cover section of U-shaped cross section for a sheet-pile wall consisting of wavy panels, characterized in that the cover section (12) consists of a prefabricated concrete beam which comprises on the inside surface of at least one leg (21) of the U-shaped cross section (21, 22, 23) at least one retaining projection (13), whose shape corresponds approximate-

ly with the waveform of the sheet-pile wall (1).

2. A cover section according to claim 1, characterized in that the length (L) of the prefabricated concrete beam (12) is a multiple of the wavelength of a sheet-pile wall panel, with the retaining projection(s) (13) being provided in such a manner that the axial ends of the concrete beam (12) are located in a plane passing through a wave trough of the sheet-pile wall (1).

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3. A cover section according to claims 1-2, characterized in that the ends of the prefabricated concrete beam (12) each comprise a retaining projection (16, 17) whose shape corresponds approximately with a part of the waveform of the sheet-pile wall (1).

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4. A cover section according to claims 1-3, characterized in that each retaining projection (13, 16, 17) has a piloting shape (24) decreasing from the inside surface of the bridging leg (23) of the U-shaped cross section.

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5. A cover section according to claims 1-4, characterized in that the inside surface of the leg (22) of the U-shaped cross section located opposite the retaining projections (13, 16, 17) has an outwardly sloping (25) configuration.

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6. A cover section according to any one of claims 1-5, characterized in that the two legs (21, 22) of the prefabricated concrete beam (12) are provided, at the location of the retaining projections (13, 16, 17), with recesses (14, 18) for passing anchoring or coupling rods (26, 27) therethrough.

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7. A cover section according to claim 6, characterized in that each recess (14, 18) on the outside of the leg (21) of the U-shape terminates, at the location of the retaining projection (13, 16, 17), in a chamber (15, 19) for receiving therein a nut (28) for tensioning the anchoring rod or coupling rod (26, 27).

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8. A cover section according to claims 6-8, characterized in that the recesses (18) and chambers (19) provided at the beam ends have a complementary shape.

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10. A cover section according to claim 1, characterized in that retaining projections (13) are provided on the inside surfaces of both legs (21, 22) of the U-shaped cross section (32), with the retaining projections (13) on one leg (21) being offset half a wavelength relative to the retaining projections (13) provided on the opposite leg (22).

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11. A cover section according to claim 10, characterized in that the slot width (A-D) of the slot (43) provided in the cover section (42) increases gradually from one end in the direction of the other end.

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12. A method for manufacturing a cover section according to claim 10, characterized by

- making a cast of the top end of a sheet-pile wall (31) using a deformable material (33);
- placing it in a formwork (34) for manufacturing an auxiliary mold (35) by casting;
- placing this auxiliary mold (35) in a formwork

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(34); and

- then filling this formwork (34) with concrete (36) for forming the cover section (32).

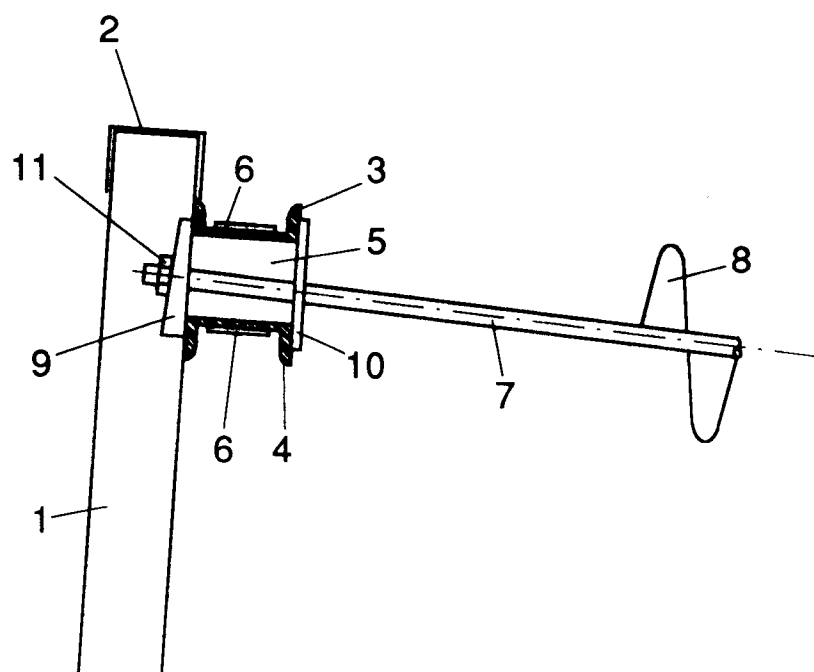


FIG. 1

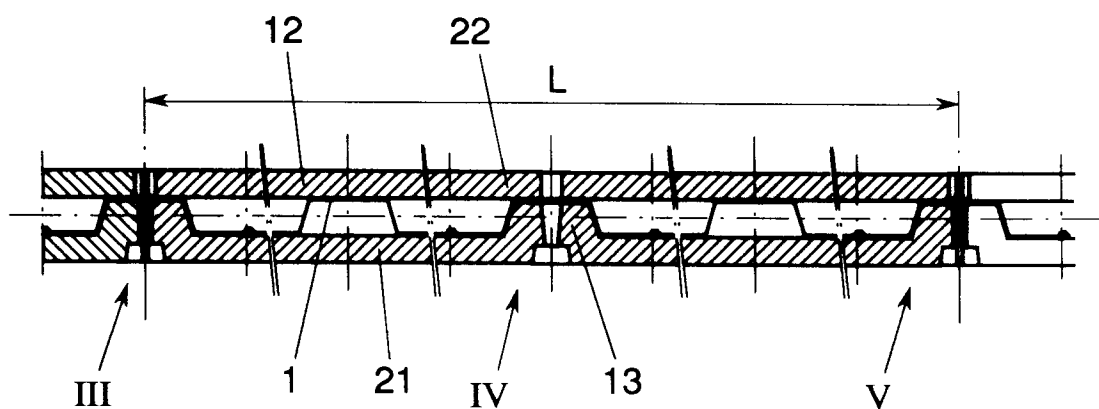


FIG. 2

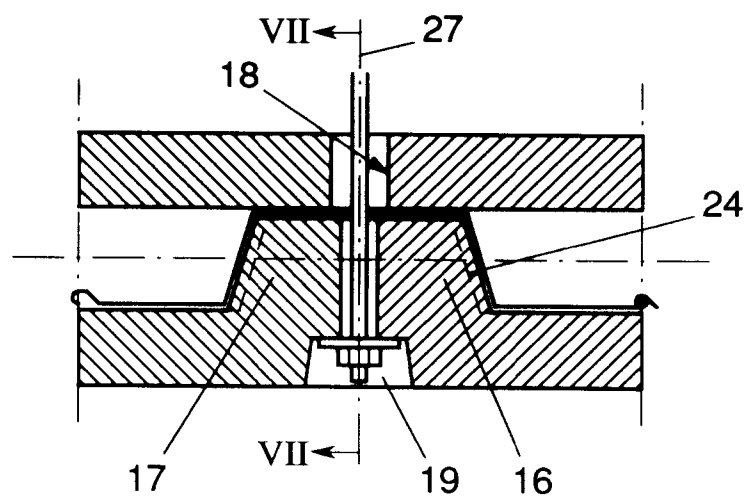


FIG. 3

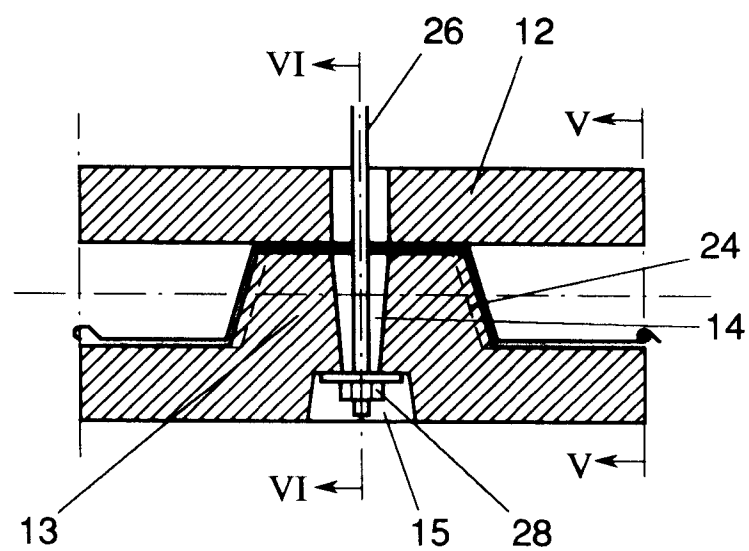


FIG. 4

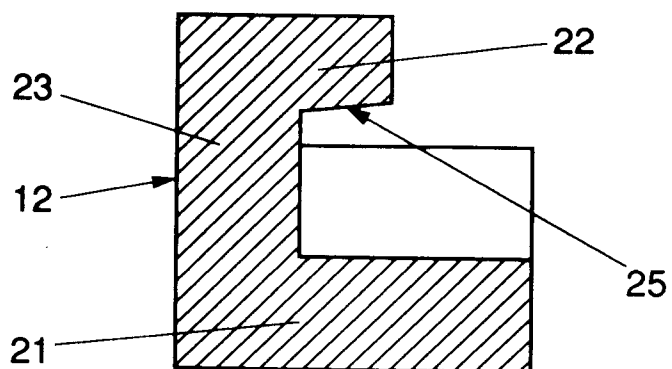


FIG. 5

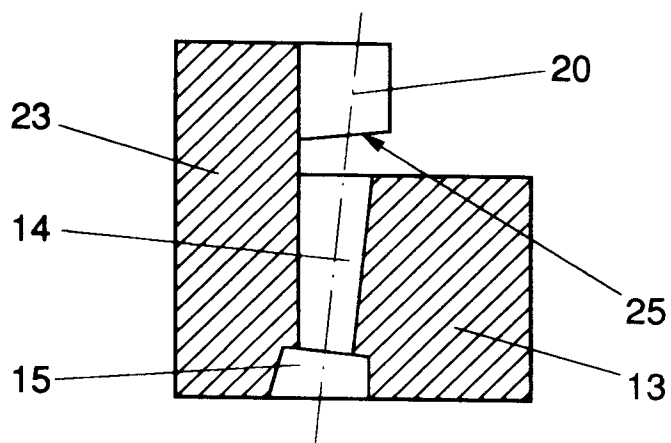


FIG. 6

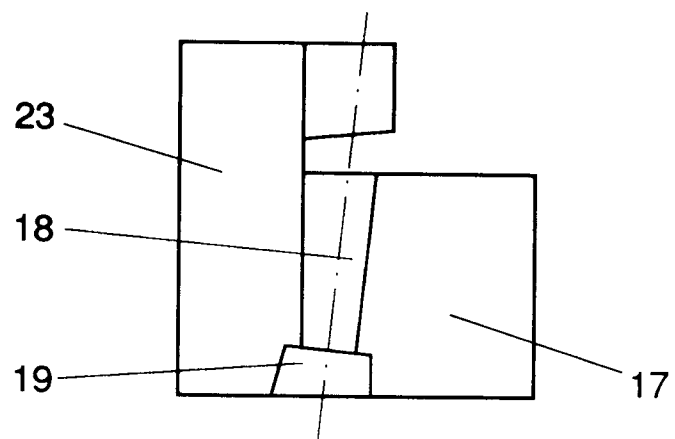


FIG. 7

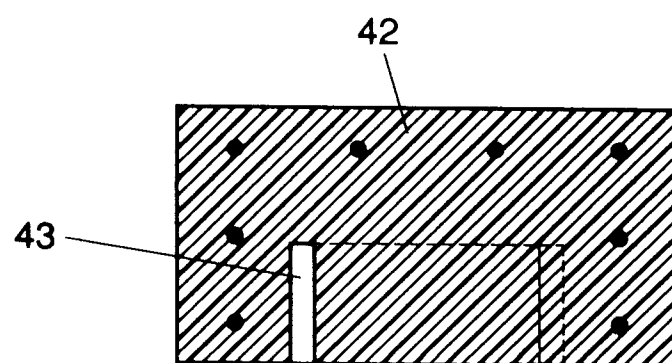


FIG. 14

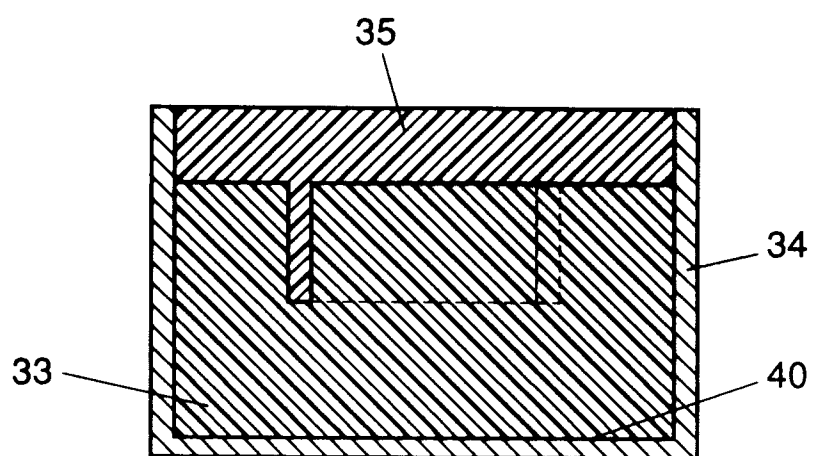


FIG. 9

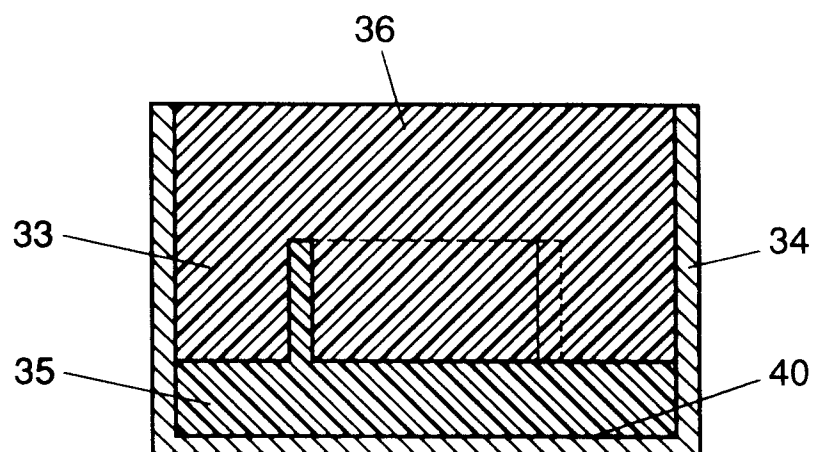


FIG. 10

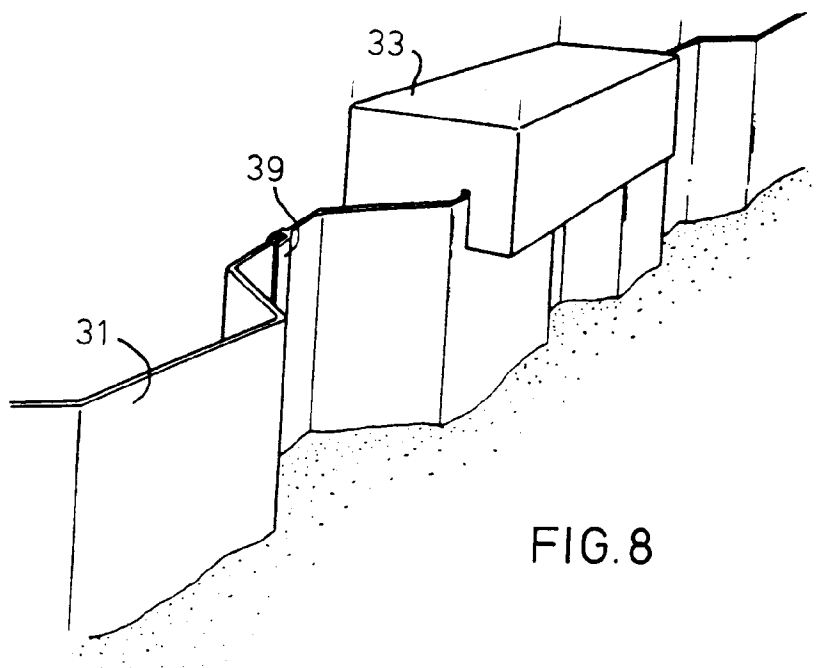


FIG. 8

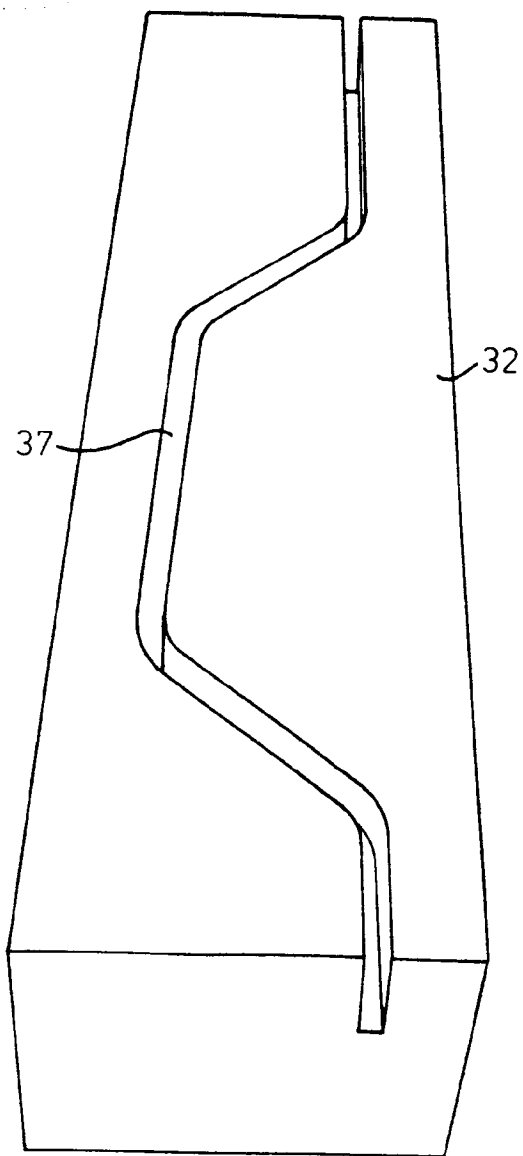


FIG. 11

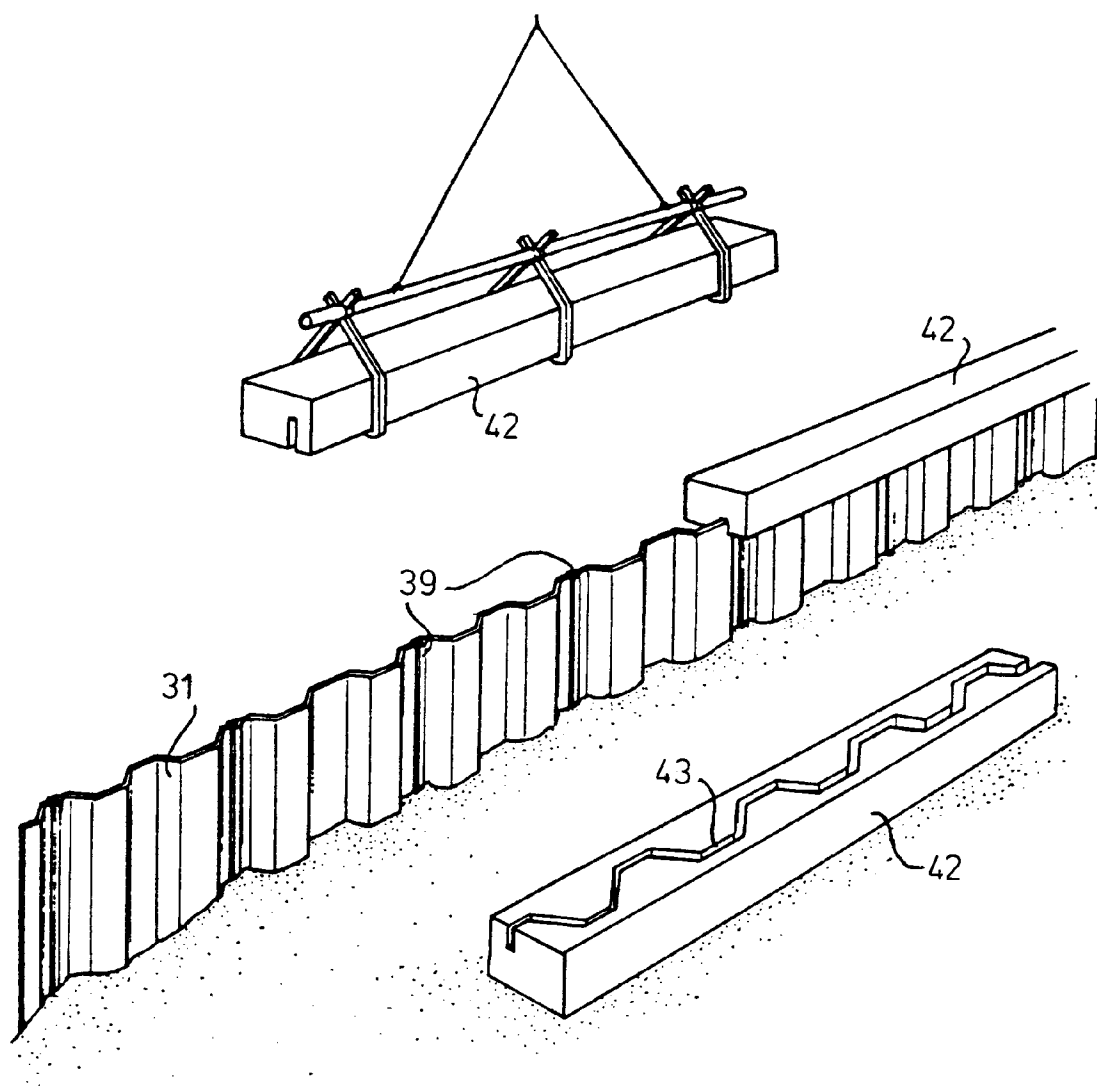


FIG. 12

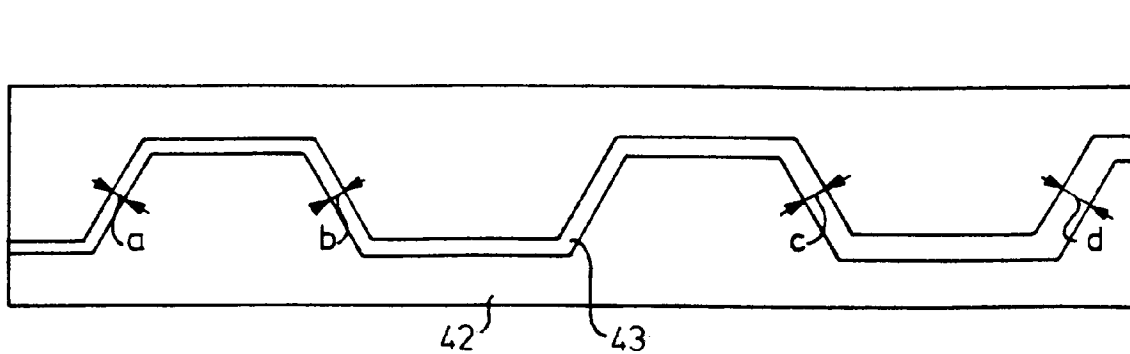


FIG. 13



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 1030

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	BAUMASCHINE + BAUTECHNIK, no.10, October 1990 pages 377 - 383 STALMAN PEINE 'Besonderheitender Spündwandbauweise beim Ausbau von Vorflutern' ---	1,6	E02D5/16 B28B7/34
A	EP-A-0 341 193 (HOESCH STAHL AKT.) * column 2, line 47 - column 3, line 5; figures 1,2 *	1	
A	FR-A-2 232 418 (HEV BAUTECHNIK) * page 3, line 13 - page 5, line 6; figures 1-7 * -----	12	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			E02D B28B E02B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 10 July 1995	Examiner Kergueno, J
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