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(54) **Method for inserting an essentially vertical screen in the ground.**

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Description

The invention relates to a method for placing an essentially vertical screen in the ground comprising:

- digging a trench in the ground,
- feeding a mixture into said trench, such as a bentonite-water mixture or a bentonite-cement-water mixture which can form an impenetrable layer,
- connecting a sheeting panel to an insertion sheet,
- lowering the insertion sheet with sheeting panel into the mixture in such a way that a vertical locking edge of said panel and a vertical locking edge of a panel already placed in the trench slide into each other,
- breaking the connection between the insertion sheet and the sheeting panel,
- pulling up the insertion sheet so that the next sheeting panel can be connected to said sheet,

which actions can be repeated until a tight sheeting wall of the desired length and shape is formed from the sheeting panels in the trench.

Such a method is described in DE-A-3540270 and is used for the isolation of polluted ground and groundwater and for well drainage. The flexible sheeting panels are, for example, 2-3 meters wide. The insertion of the panels by means of an insertion sheet takes place in such a way that the locks are placed under little or no load. At the bottom side the bentonite sheeting screen must be connected to a watertight layer, for example of a natural clay or an injected synthetic layer. In particular, in the case of well drainage the screens can be of a great height, for example approximately 30 meters. Problems then occur with unrolling each panel into the vertical position from the rolled-up state and connecting one edge of the panel to the top edge of the insertion sheet.

The object of the invention is to solve these problems, and to this end the method mentioned in the preamble is characterized in that, each sheeting panel is fixed to the insertion sheet near the top edge thereof while said insertion sheet is in the trench, that the sheeting panel is taken into a vertically downward hanging position by pulling said insertion sheet up out of the trench thereby unrolling the sheeting panel from a rolled up state, and that before the combination of insertion sheet and sheeting panel connected to it is lowered in the trench, this combination is moved over approximately the width of the sheeting panel in the longitudinal direction of the trench.

In the application of the invention the function of the insertion sheet is not only to press a panel into the ground, but also to unroll the panel from the rolled-up state into a vertical position, after which it is ready for pressing into the ground trench. In particular in the case of sheeting panels of great height (for example, about 30 meters) the method according to the inven-

tion is of great advantage.

In order to prevent the panel hanging from the insertion sheet above ground level from being beaten to and fro by the wind, when each sheeting panel is being raised above ground level by means of the insertion sheet clips can be fixed a certain vertical distance apart on the sheet, which clips fall round the sheeting panel and protect it from the wind, and which are removed on by one when the panel is being placed in the ground.

A clamping bar fixed to the sheet can be used in order to fix a top edge of each panel to the insertion sheet.

Each sheeting panel can be pulled taut by a device being fitted between the clamping bar and the top side of the insertion sheet, by means of which a limited almost vertical displacement of the clamping bar is possible. This device comprises a cable which is fixed on the clamping bar and runs over a pulley provided on the top edge of the insertion sheet to the rear side of the insertion sheet, where it is tensioned on the insertion sheet. It is further possible for the clamping bar to be guided additionally in the vertical direction through the fact that the clamping bar with guide pins projecting through slotted holes into the clamping bar and fixed on the insertion sheet can move freely over a certain vertical distance if the tensioning device is out of action. Other designs are also possible for tensioning the sheeting panel.

The invention also relates to an insertion sheet intended for placing a screen in the ground, in which a clamping bar is fixed near the top edge of said sheet and the fixing of the clamping bar can be such that a limited displacement of the clamping bar towards and away from the top edge of the sheet is possible as disclosed in BE-A-62742.

According to the invention a pulley is provided on the top edge of the insertion sheet for guiding a tensioning cable fixed on the clamping bar.

Finally, the invention also relates to a wind clip for connecting a sheeting panel to an insertion sheet during carrying out of the above mentioned method, in which the clip has two flanges lying opposite each other which are intended for insertion through openings in transverse members in the insertion sheet, and in which at least one of the side parts of the clip is made slidable or hinged, and securing means are present for the purpose of securing said slidable or hinged side part.

The invention will now be explained in greater detail with reference to the figures.

Figure 1 shows a vertical section through a sheeting panel fitted in a ground trench, with anchor and insertion sheet projecting into it.

Figure 2 shows a vertical section of said ground trench during unrolling of the next sheeting panel.

Figure 3 shows a vertical section of the sheeting panel hanging from the top edge of the sheet above

ground level and above the trench.

Figure 4 shows a top view of a ground trench with sheeting panels to be placed in the ground according to the invention.

Figure 5 shows a detail of the insertion sheet with clamping bar on a larger scale.

Figure 6 shows a cross-section of a screen with insertion sheet at the position of a wind clip.

Figures 1 to 4 illustrate the way in which the sheeting panels of a vertical ground screen are inserted in succession in a ground trench 1 filled with a bentonite-containing mixture. A sheeting panel 3 is indicated by 3a in Figure 1, and the next sheeting panel is indicated by 3b in Figures 2 and 3. Each of the panels has on the two vertical side edges a locking part, in which case a locking part 2a on a side edge of a panel can be connected, for example in the manner described in Dutch patent applications 8301918 or 8901423, to a locking part 2b on the other side edge of the next panel. The panels have at their bottom edge a thickened part 4 projecting into a steel anchor 5.

When a panel is being pressed into the ground use is made of a steel insertion sheet 6 which with its bottom edge also projects into the anchor 5. The anchor is provided with slanting plates 7a and 7b which centre the panel in the ground trench when it is being pressed down.

After a panel 3 (for example panel 3a) has been pressed fully into the ground trench (Figure 1), the insertion sheet 6 is pulled up.

The edge of the next panel 3b, which is in the rolled-up state, is then fixed by means of a clamping bar 8 to the top part of the insertion sheet 6, and the insertion sheet is pulled out of the ground trench by means of a hoisting structure (not shown), during which the panel 3b unrolls. In the fully raised position of the panel 3b, as shown in Figure 3, the panel 3b hangs down along the sheet 6. If there is wind of any significance, during the raising of the sheet and unrolling of the panel, clips 9 are provided spaced apart and are fixed to the sheet and clamp the panel against the insertion sheet. Details of the clips will be explained.

After a new anchor 5 is fitted on the bottom edge of the panel 3b and the sheet 6, the sheet 6 is first moved in the lengthwise direction of the trench over about the width of a panel, and only then is the panel 3b pushed into the ground trench by the sheet 6, it being ensured that the locking parts facing each other on the panels 3a and 3b engage with each other. The clips 9 are also removed in succession at ground level. Finally, the panel 3b assumes the position which is shown with regard to panel 3a in Figure 1, and the placing in the ground of the next panel in accordance with the cycle described above can begin. It will be clear that the wall formed from the panels can be of any desired length.

In order to be able to tension a panel and pull it flat and thereby, inter alia, to reduce the influence of the wind even further, the clamping bar 8 can be fixed in such a way to the insertion sheet 6 that the latter can undergo a limited vertical displacement, and a tensioning cable 10 can be fixed to the clamping bar 8, which cable is guided over a pulley 11 fitted on the insertion sheet 6 to a mechanical, hydraulic or pneumatic cable tensioning device of known design (not shown). Tensioning the cable 10 pulls the panel taut.

The clamping bar 8 has two clamping jaws 8a, 8b between which the top edge of a panel 3 can be clamped. The clamping jaws 8a, 8b can be operated by mechanical, hydraulic or pneumatic devices. In order to give the bar its limited vertical displacement possibilities relative to the insertion sheet, two or more pins 13 projecting through the vertical slotted holes 14 into the clamping bar are welded to the sheet. Heads 15 welded to the pins 13 prevent the pins from coming out of the slotted holes.

An embodiment of the insertion sheet 6 with a wind clip 9 is shown in Figure 6. The U-shaped clip has two flanges 16a, 16b which lie opposite each other and project through openings in transverse plates 17a, 17b of the insertion sheet 6. In this case parts 17a, 17b, 17c and 17d are components of the reinforcement structure 17 of insertion sheet 6. At the position of the corner pieces the member 6 has semi-cylindrical vertical rods 18a, 18b which are fitted on it and can engage on a panel 3 and clamp it against spacers 19a, 19b welded on the wind clip 9 concerned.

One of the side parts of the clip 9 is hinged by means of a rotary pin 20 and can be secured in the position shown by means of a removable securing pin 21. When the securing pin is removed the end part can be turned away to the position shown by means of a removable securing pin 21. When the securing pin is removed the end part can be turned away to the position shown by dotted and dashed lines in Figure 6, and the side part of the clip can be pivoted into a position in which the flange 16b projects through an opening of the transverse plate 17b.

For the performance of the invention it is essential that a sheeting panel 3 can be taken by the insertion sheet 6 into a vertical position above ground level and that sheeting panel 3 can subsequently be pulled taut, following which insertion sheet 6 places this sheeting panel next to the previous panel 3 after being slid along over a panel width in the lengthwise direction of the trench.

Claims

1. Method for placing an essentially vertical screen in the ground comprising:
 - digging a trench (1) in the ground,

- feeding a mixture into said trench, such as a bentonite-water mixture or a bentonite-cement-water mixture which can form an impenetrable layer,
- connecting a sheeting panel (3) to an insertion sheet (6),
- lowering the insertion sheet with sheeting panel into the mixture in such a way that a vertical locking edge (2) of said panel and a vertical locking edge of a panel already placed in the trench slide into each other,
- breaking the connection between the insertion sheet and the sheeting panel,
- pulling up the insertion sheet so that the next sheeting panel can be connected to said insertion sheet,

which actions can be repeated until a tight sheeting wall of the desired length and shape is formed from the sheeting panels in the trench, characterized in that each sheeting panel (3) is fixed to the insertion sheet (6) near the top edge thereof while said insertion sheet is in the trench, that the sheeting panel is taken into a vertically downward hanging position by pulling said insertion sheet up out of the trench thereby unrolling the sheeting panel from a rolled up state, and that before the combination of insertion sheet and sheeting panel connected to it is lowered in the trench, this combination is moved over approximately the width of the sheeting panel in the longitudinal direction of the trench.

2. Method according to claim 1, characterized in that, when each sheeting panel (3) is being raised above ground level by means of the insertion sheet, clips (9) are fixed a vertical distance apart on the insertion sheet, which clips fall round the sheeting panel in order to protect it from the wind, and which clips are removed one by one when the panel is being placed in the ground.
3. Method according to claim 1 or 2, characterized in that a clamping bar (8) fixed to the insertion sheet (6) is used for fixing an edge of each sheeting panel (3) to the insertion sheet, and that pins (13) projecting through vertical slotted holes (14) in the insertion sheet or the clamping bar extend between the clamping bar and the insertion sheet and permit a limited vertical displacement of the clamping bar relative to the insertion sheet, and that the clamping bar is pulled upwards over a limited distance by a cable (10) running over a pulley (11) provided on the top edge of the insertion sheet for pulling the sheeting panel in question taut.
4. Insertion member (6) intended for placing a screen in the ground according to the method of

claim 3, wherein at the top edge of the insertion sheet a clamping bar (8) is fixed in such a way that the limited displacement of the clamping bar towards and away from the top edge of the insertion sheet is possible, characterized in that a pulley (11) is provided on the top edge of the insertion sheet for guiding a tensioning cable (10) fixed on the clamping bar.

5. Wind clip (9) for connecting a sheeting panel to an insertion sheet when carrying out the method according to claim 2, characterized in that the clip has two flanges (16a, 16b) lying opposite each other which are intended for insertion through openings in transverse members (17a, 17b) of the insertion sheet, and in that at least one of the side parts of the clips is made slidable or hinged, while securing means (21) are present for the purpose of securing said slidable or hinged side part.

Patentansprüche

1. Verfahren zum Einbringen eines im wesentlichen vertikalen Schirms in den Erdboden, welches aufweist:
 - Ausheben eines Grabens (1) im Erdboden;
 - Einbringen eines Gemisches in den Graben, wie ein Bentonit-Wasser-Gemisch oder ein Bentonit-Zement-Wasser-Gemisch, welches eine undurchlässige Schicht bildet,
 - Verbinden einer Verbauplatte (3) mit einem Einführungsflächengebilde (6),
 - Absenken des Einführungsflächengebildes mit der Verbauplatte in das Gemisch derart, daß ein vertikaler, eingreifender Rand (2) der Platte und ein vertikaler, eingreifender Rand einer bereits in den Graben verlegten Platte ineinander gleiten,
 - Trennen der Verbindung zwischen dem Einführungsflächengebilde und der Verbauplatte,
 - Hochziehen des Einführungsflächengebildes derart, daß die nächste Verbauplatte mit dem Einführungsflächengebilde verbunden werden kann,

wobei die Verfahrensschritte wiederholt werden können, bis eine dichte Verbauwand mit gewünschter Länge und Form aus den Verbauplatten im Graben gebildet wird,

dadurch **gekennzeichnet**, daß jede Verbauplatte (3) mit dem Einführungsflächengebilde (6) in der Nähe des oberen Randes desselben fest verbunden ist, während das Einführungsflächengebilde im Graben ist, daß die Verbauplatte in eine vertikal nach unten hängen-

de Position dadurch gebracht wird, daß das Einführungsflächengebilde aus dem Graben nach oben gezogen wird, wodurch die Verbauplatte aus einem aufgerollten Zustand entfaltet wird, und daß vor der Verknüpfung von Einführungsflächengebilde und Verbauplatte, welche mit diesem verbunden ist, diese in den Graben abgesenkt wird, wobei diese Verknüpfung über etwa die Breite der Verbauplatte in der Längsrichtung des Grabens bewegt wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß, wenn jede Verbauplatte (3) über die Erdbodenhöhe mit Hilfe des Einführungsflächengebildes angehoben wird, Befestigungsteile (9) in einem vertikalen Abstand entfernt von dem Einführungsflächengebilde festgelegt werden, wobei die Befestigungsteile um die Verbauplatte fallen, um diese vor dem Wind zu schützen, und wobei die Befestigungsteile einzeln entfernt werden, wenn die Platte in den Erdboden eingebracht wird.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß ein Klemmteil (8), welches an dem Einführungsflächengebilde befestigt ist, zum Fixieren eines Randes jeder Verbauplatte (3) an dem Einführungsflächengebilde eingesetzt wird, und daß Bolzen (13), die durch vertikale, schlitzförmige Öffnungen (14) in dem Einführungsflächengebilde vorstehen oder das Klemmteil zwischen dem Klemmteil und dem Einführungsflächengebilde verläuft, eine begrenzte vertikale Verschiebung des Klemmteils relativ zu dem Einführungsflächengebilde gestatten, und daß das Klemmteil über einen begrenzten Weg mittels eines Seiles (10) nach oben gezogen wird, welches über eine Seilscheibe (11) läuft, welche am oberen Rand des Einführungsflächengebildes vorgesehen ist, um die betreffende Verbauplatte durch Ziehen zu spannen.

4. Einführungsteil (6), welches dazu bestimmt ist, daß ein Schirm in den Erdboden nach dem Verfahren gemäß Anspruch 3 eingebracht wird, wobei am oberen Rand des Einführungsflächengebildes ein Klemmteil (8) derart befestigt ist, daß eine begrenzte Verschiebung des Klemmteils in Richtung auf den oberen Rand des Einführungsflächengebildes (2) und von diesem weg möglich ist, dadurch gekennzeichnet, daß eine Seilscheibe (11) am oberen Rand des Einführungsflächengebildes vorgesehen ist, um ein Zugteil (10) zu führen, welches an dem Klemmteil befestigt ist.

5. Windbefestigungsteil (9) zum Verbinden einer Verbauplatte mit einem Einführungsflächengebilde bei der Durchführung des Verfahrens nach

Anspruch 2, dadurch gekennzeichnet, daß das Halteteil zwei Flansche (16a, 16b) hat, welche einander gegenüberliegen und die dazu bestimmt sind, daß sie durch Öffnungen in Querteilen (17a, 17b) des Einführungsflächengebildes durchgeführt werden, und daß wenigstens eines der Seitenteile des Halteteils gleitbeweglich oder schwenkbeweglich ausgelegt ist, während Befestigungseinrichtungen (21) vorgesehen sind, um das gleitbewegliche oder schwenkbewegliche Seitenteil festzulegen.

Revendications

1. Procédé pour placer un rideau sensiblement vertical dans le sol, qui comporte les étapes consistant à :

- creuser une tranchée (1) dans le sol,
- envoyer dans ladite tranchée un mélange comme un mélange de bentonite et d'eau ou un mélange de bentonite, de ciment et d'eau qui peut former une couche impénétrable,
- relier un panneau écran (3) à une tôle d'insertion (6),
- abaisser la tôle d'insertion avec le panneau écran dans le mélange de telle façon qu'un bord vertical de verrouillage (2) dudit panneau et un bord vertical de verrouillage d'un panneau déjà en place dans la tranchée coulisent l'un dans l'autre,
- briser la liaison entre la tôle d'insertion et le panneau écran,
- retirer la tôle d'insertion pour pouvoir relier le panneau écran suivant à ladite tôle d'insertion,

ces actions pouvant être répétées jusqu'à ce qu'une paroi formant écran étanche de la longueur et de la forme souhaitées soit formée par les panneaux écrans dans la tranchée, caractérisé en ce que chaque panneau écran (3) est fixé à la tôle d'insertion (6) près de son bord supérieur alors que la feuille d'insertion se trouve dans la tranchée, en ce que le panneau écran est amené dans une position de suspension verticale vers le bas en retirant ladite tôle d'insertion de la tranchée, ce qui déroule le panneau écran de son état enroulé, et en ce que, avant que la combinaison de la tôle d'insertion et du panneau écran qui lui est relié soit abaissée dans la tranchée, cette combinaison est déplacée d'approximativement la largeur du panneau écran dans le sens longitudinal de la tranchée.

2. Procédé selon la revendication 1, caractérisé en ce que, lorsque chaque panneau écran (3) est soulevé au-dessus du niveau du sol au moyen

de la tôle d'insertion, des dispositifs de fixation (9) sont installés sur la tôle d'insertion, suivant un certain espacement vertical, ces dispositifs de fixation (9) descendant autour du panneau écran pour le protéger du vent, et ces dispositifs de fixation étant retirés un par un quand le panneau est introduit dans le sol.

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3. Procédé selon la revendication 1 ou 2, caractérisé en ce qu'une barre de serrage (8) fixée à la tôle d'insertion (6) est utilisée pour fixer un bord de chaque panneau écran (3) à la tôle d'insertion, en ce que des tiges (13) qui dépassent par des trous (14) en forme de fentes verticales dans la tôle d'insertion ou dans la barre de serrage s'étendent entre la barre de serrage et la tôle d'insertion et permettent un déplacement vertical limité de la barre de serrage par rapport à la tôle d'insertion, et en ce que la barre de serrage est tirée vers le haut sur une distance limitée par un câble (10) passant sur une poulie (11) placée sur le bord supérieur de la tôle d'insertion pour tirer le panneau écran et le tendre.

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4. Élément d'insertion (6) destiné à placer un rideau dans le sol selon le procédé de la revendication 3, dans lequel, au niveau du bord supérieur de la tôle d'insertion, est fixée une barre de serrage (8) de telle façon que le déplacement limité de la barre de serrage pour s'éloigner et se rapprocher du bord supérieur de la tôle d'insertion soit possible, caractérisé en ce qu'une poulie (11) est placée sur le bord supérieur de la tôle d'insertion pour guider un câble tenseur (10) fixé à la barre de serrage.

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5. Élément de fixation (9) anti-vent destiné à fixer un panneau écran à une tôle d'insertion quand on met en oeuvre le procédé de la revendication 2, caractérisé en ce que l'élément de fixation comporte deux brides (16a, 16b) situées à l'opposé l'une de l'autre qui sont destinées à pénétrer dans des orifices d'éléments transversaux (17a, 17b) de la tôle d'insertion et en ce que l'une au moins des parties latérales des éléments de fixation est coulissante ou articulée, des moyens d'immobilisation (21) étant prévus pour immobiliser ladite partie coulissante ou articulée.

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fig-1 fig-2

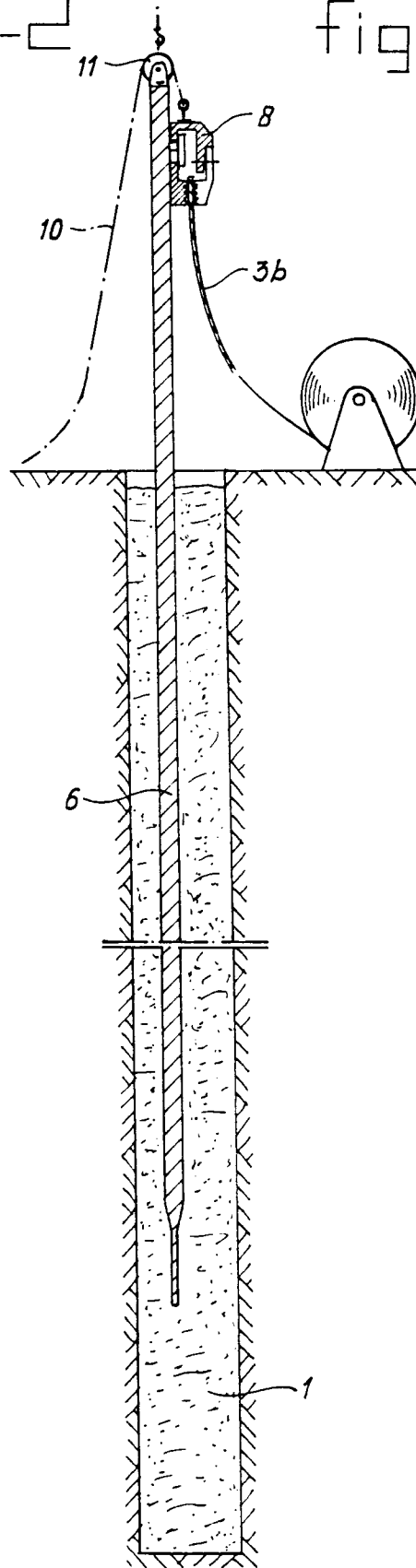
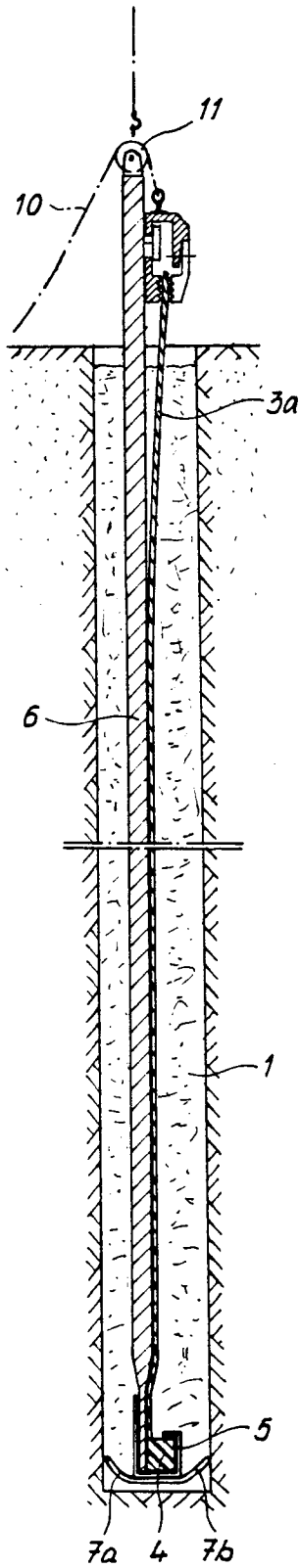


fig-3

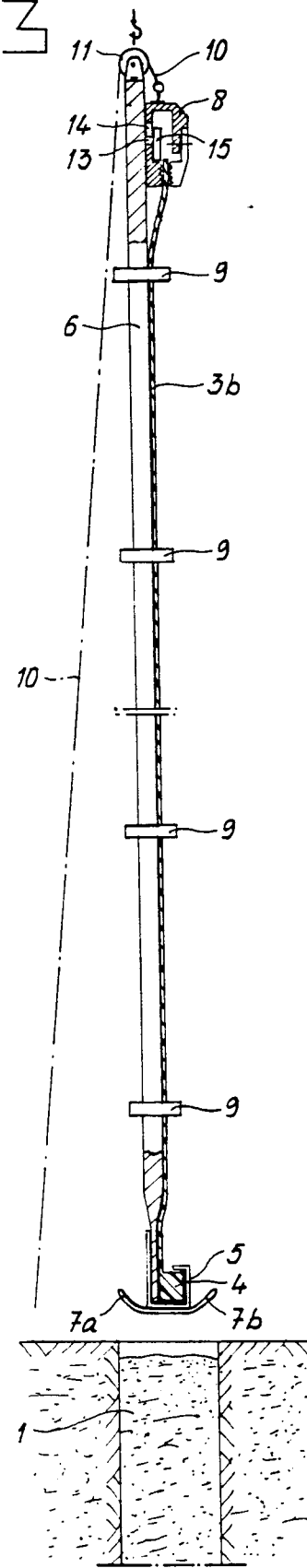


fig-4

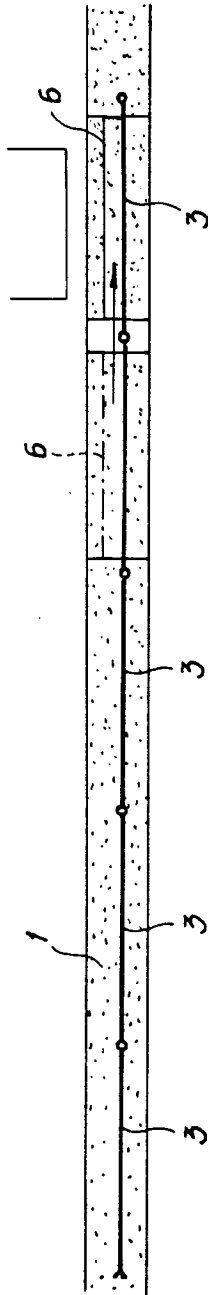


fig-5

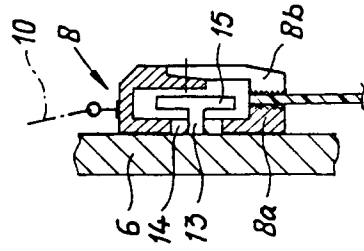


fig-6

