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(54) **Method and equipment for accurately positioning items in shafts or piles.**

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EP-A- 0 126 656
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Description

On certain types of constructions there is a requirement for an item such as a uniform straight column to be located within a shaft, pile or caisson. Generally the requirement is for the item to be positioned vertically, although other specific orientations may be required from time to time. The item is often a steel section or stanchion and can, for example, be a universal column. It can be of any cross-section. It can be made of steel, as mentioned above but can also be of reinforced concrete or plastic, or a combination of one or more of these. As an example, where cast in place piles are constructed there is sometimes a requirement to position a steel column within or extending into a pile before the concrete sets. Subsequently the steel column may be used to support loads from a structure to be built above the pile. The steel column may also be used to support horizontal beams and/or concrete slabs which may be constructed to prop the walls of a basement construction. This type of construction is known as 'top-down' construction and has time saving advantages to building contractors.

Several methods have been used in the past for positioning vertical items such as the columns mentioned above. For example, during the construction of a cast in place pile a shaft lining tube, usually either of steel or reinforced concrete, is installed. The bore is then partly filled with concrete. Subsequently when concrete has set a man is lowered down the hole to clean the concrete surface and to fix a base plate or similar device to the head of the concrete. The column is then lowered into position and fixed at the lower level to the base plate using surveying techniques to adjust the column as close as possible to a truly vertical position. The upper section of the column is positioned at or near to ground level. The empty bore is often filled with sand or gravel, although this is not always essential. Frequently the dimensions of the bore make it very difficult to work within the available confines.

In an alternative method, the steel column is supported at or near ground level on a knife-edge arrangement, and the lower end is embedded in the concrete. Still another method is to survey the (generally temporary) casing or shaft bore and to then fix distance pieces to the column such that these distance pieces account for the inaccuracies in positioning the casing or shaft bore, and thereafter to insert the steel column.

Still further methods have been described for use with pre-cast caissons, as described for example in FR-A-2 481 726, in which a template is used at the head of the caisson. The template can be adjusted but only through a limited and pre-set range of adjustments. Furthermore, by its very nature the template does not permit any control of the position of the lower end of a column which is to pass through the template.

The above methods suffer from one or more of the following drawbacks: excessive time required to install the column; uncertainty of its initial positioning; uncertainty of maintaining the column in position while the concrete sets; the requirement generally for long casings (steel or concrete) which often are difficult or impossible to recover; and additional difficulties if the bore is flooded with water or bentonite suspension.

In order to ameliorate the problems inherent in prior techniques, we have devised a method which enables accurate positioning of items such as columns and stanchions to be achieved. More particularly, in one aspect the present invention provides a method of accurately locating an elongate element in a desired position in a borehole, which comprises (a) placing into the lined borehole a locating frame having at its upper end a first pair of adjustable guide frames and having at its lower end a second pair of adjustable guide frames; (b) adjusting the first pair of adjustable guide frames to define an entry point for the element which is to be located in the borehole; (c) adjusting the second pair of adjustable guide frames to define a locus for receiving said element; and (d) lowering the element through said first pair and said second pair of guide frames to achieve the desired accurate location of the elongate element.

In a preferred embodiment, at least the upper part of the borehole is lined with a shaft lining tube before the locating frame is put into place.

According to another aspect of the present invention there is provided a locating frame for use in locating an element in a borehole, which frame comprises (i) a space frame of rectangular cross-section substantially free throughout its interior (axial) space; and (ii) at each end of said space frame, a pair of adjustable guide frames spaced apart axially from one another and each comprising a movable bar parallel to one side of the space frame and in a radial plane, and drive means for moving said movable bar across the interior of the space frame, the respective movable bars of the two adjustable guide frames being oriented mutually orthogonally. Preferably the movable bar of each adjustable guide frame is part of a movable, planar rectangular unit which can be moved by the drive means from a first position adjacent to one side of the space frame to a second position adjacent the opposite side of the space frame. A modification can also be envisaged in which there is just a single guide frame unit carrying orthogonally oriented adjustment bars with their respective drive means.

A locating frame in accordance with this invention may have a further adjustable guide frame or pair of such guide frames at the opposite end (top end) of the frame; this is not essential, however, since a separate but analogously functioning unit can be fitted over the top of the locating frame to define an entry point for the element which is to be located within the borehole.

Conventional surveying techniques may be used to ensure alignment of the entry point and lower end locus in practising this invention.

One preferred technique in accordance with the invention will now be described with reference to the accompanying drawings, in which :

FIGURE 1 shows a vertical section through a borehole ;

FIGURES 2a-2c illustrate (not to scale) part of a temporary lining tube ;

FIGURE 3 illustrates a locating orientation board for use together with the arrangement of Figures 2a-2c ;

FIGURE 4 shows the borehole of Figure 1 containing apparatus in accordance with this invention ;

FIGURES 5a-5c illustrate sectional views of part of the apparatus shown in Figure 4 ;

FIGURE 6 illustrates the mode of operation of part of the apparatus shown in Figure 4 ;

FIGURE 7 illustrates a sectional view through an adjustable guide frame forming part of the apparatus of Figure 4 ; and

FIGURE 8 illustrates a typical construction project in which the present invention finds application.

A presently preferred embodiment of the method of this invention, as applied to the type of pile construction outlined above, will now be described with reference to the drawings.

(1) As shown in Fig. 1, a temporary casing or shaft lining tube 1 is installed in the normal manner in a borehole 2. As shown in Fig. 2a, the tube 1 has at its upper end a pair of radially opposed locating shoes 4 the construction of which is as shown in Figures 2b (a sectional view along lines A-A of Fig. 2a) and 2c (a sectional view along lines B-B of Fig. 2a). Arranged orthogonally with respect to locating shoes 4 is a pair of support shoes 5. The casing is generally of tubular steel often 3-7 metres long, but which may exceptionally be 20 metres or more in length.

(2) The pile is bored conventionally, either dry or under water or bentonite.

(3) Concrete is placed either at this point in time or later, generally up to a position several metres below the top of the temporary casing 1 but above the intended column base level.

(4) A locating device 3 (see Fig 3) is accurately placed on the top of the casing 1. This device 3 comprises a rectangular frame containing a plurality of parallel sight lines 30, typically spaced apart by 25 mm, by means of which the orientation of locating shoes 4 may be adjusted.

(5) A locating frame 6 is lowered into the casing 1 and accurately orientated by means of the device 3 (see Figs. 4 and 5). The frame has a top support unit 6a which overlaps the uppermost

section of lining tube 1 as shown in Figure 5a. The method of locating the upper end of frame 6 is illustrated in Figure 5b, which is a section along the lines C-C of Fig. 5a. Locating shoe 4 comprises a peg-like portion 40 which sits on top of the lining tube 1, and which has a dowel 41 arranged to cooperate with a bracket 42 through locating slot 43. Frame 6 is generally 3-7 metres long, although greater lengths can be used to obtain even greater accuracies of location if desired. The frame 6 may project above the casing 1 into which it is lowered, but it is often substantially or completely located within the casing. Top section 6a (see Figures 4 and 5a) serves to retain the frame 6 in relation to tube 1. Frame 6 is a rectangular space frame the interior space (along and about the longitudinal axis) of which is open. Within the frame 6 there are four adjustable guide frames arranged in two adjacent pairs, those close to the top of frame 6 being identified in Figure 4 as 7 and 8, while those close to the bottom of the frame 6 being identified as 9 and 10.

(6) The frame 6 is then firmly located in position by means of expanding shoes 11 which thrust on to the casing wall 1 (Fig. 5c) or the unlined bore 2. These shoes are located at two or more levels, and may be actuated mechanically, electrically, pneumatically, hydraulically, or by a combination of one or more of these methods.

(7) The frame 6 contains two or more pairs of adjustable guide frames (see Figs. 4 and 7). One pair 7 and 8 is located near the upper end of the frame 6, and another pair 9 and 10 near the base of the frame. The guide frames are generally rectangular and are positioned such that the plane of the guide is normal to the axis of frame 6. For each pair of guides, one is located slightly above the other (Figs. 4 and 7) ; again, for each pair, one includes a movable bar 15 which can be moved in a predetermined direction, say a north-south direction, whereas the other includes a movable bar which can be moved in a direction orthogonal to that of the first bar, e.g. in an east-west direction (see Fig. 6). Each individual guide frame can be remotely operated, either mechanically, electrically, pneumatically or hydraulically, or by a combination of one or more of these methods. Once the bars 15 of the adjustable guide frames have been adjusted they cannot be displaced by means of an external force. As illustrated in Fig. 7, each of the adjustable guide frames includes a worm drive 12 driven by a hydraulic motor 13 through a drive gear 14. The movable bar 15 is, in this embodiment, in the form of a rectangular unit 20 carried along the worm drive (12) by shoes 16. That side 22 of unit 20 opposite bar 15 is free to slide along a bar 17 by means of shoes 18. The overall permissible movement of rectangular unit

20 is between the limits set by opposite sides 10 and 21 of the adjustable guide frame.

(8) After the frame 6 has been positioned as described above, the steel column 19 is lowered through the guides 7-10 at the top and bottom of the frame. The position of the steel column at or slightly above the top of the frame is then adjusted by means of the upper guide frames 7 and 8, until the column is in the desired position, this being confirmed for example by means of surveying equipment. The lower guide frames 9 and 10 are then adjusted until the column is at the correct inclination (generally vertical). Confirmation of the inclination may be by means of either surveying techniques or by means of spirit levels.

(9) The steel column 19 is then lowered further into its final position and kept at this level by means of, for example, a crane or a separate clamping arrangement. Concrete may have already been placed (see (3) above) or may be placed after the installation of the frame 6, or even after the final positioning of the steel column 19. The concrete may be placed by means of a chute, a tremmie pipe or it may be pumped down the pile. Generally the concrete level will be below the lower limits of frame 6.

(10) Once the concrete has set the frame 6 is removed. The empty bore may be filled with a suitable backfill material and the casing 1 withdrawn.

The above is an example of the use of this type of frame in a shaft or bore, in which case it would be usual for the frame to be inserted a substantial depth into the shaft/bore. However it is not essential for the frame to be inserted into the shaft/bore. Similarly, whereas it is usual for the steel column to be placed vertically, this system can be used to place the column at any desired inclination. As already mentioned the system can be used to place items such as steel columns and also other items, possibly of different steel sections, but also of concrete (either reinforced or not) or of plastic, or a combination of one or more of these.

This type of frame can also be used to place similar items into other types of pile, for example into piles of the continuous flight auger type. With this technique the frame is generally used above ground, and is accurately located in plan by the use of a heavy base (either of steel or concrete, or a combination) or by means of separate piles (which may be works piles or supernumary piles). The means of obtaining correct orientation is similar to that already described, as is the means of adjusting the frame to obtain the correct plan position and inclination of the steel column or similar.

Preferred embodiments of the present invention may offer one or more of the following advantages :

1. Precise control of the insertion and positioning of a column (or similar) which is to be partly

embedded into a cast in place bored pile.

2. The adjustable guide(s) can have controlled clearances within each guide such as to give a predetermined precision of location within a borehole.

3. Robust construction of the device is feasible ; this allows insertion of a column without deformation to the device.

4. Precise orientation of the reference frame, and maintenance of the orientation during use, are possible.

5. Accurate positioning both in plan, orientation and inclination from ground level or above.

6. Suitability for use in constructing cast in place piles where the bore is flooded (either partially or wholly) with water or bentonite suspension.

7. Suitability for use where a column or the like is to be embedded partly or wholly into a continuous flight auger pile, and sufficient robustness for the location step to take place above ground.

Claims

1. A method of accurately locating an elongate element (19) in a desired position within a borehole (2), which comprises

(a) placing into the borehole a locating frame (6) having at its upper end a first pair of adjustable guide frames (7, 8) and having at its lower end a second pair of adjustable guide frames (9, 10) ;

(b) adjusting the first pair of adjustable guide frames (7, 8) to define an entry point for the element which is to be located in the borehole ;

(c) adjusting the second pair of adjustable guide frames (9, 10) to define a locus for receiving said element (19) ; and

(d) lowering the elongate element through said first pair and said second pair of guide frames to achieve the desired accurate location of the elongate element.

2. A method according to claim 1, wherein at least the upper part of the borehole (2) is lined with a shaft lining tube (1) prior to the locating frame (6) being placed into the lined borehole.

3. A locating frame (6) for use in locating an element (19) in a borehole (2), which frame comprises (i) a space frame (6) of rectangular cross-section substantially free throughout its interior (axial) space ; and (ii) at each end of said space frame, a pair of adjustable guide frames (7, 8 ; 9, 10) spaced apart axially from one another and each comprising a movable bar (15) parallel to one side (10) of the space frame (6) and in a radial plane, and drive means (12, 13, 14) for moving said movable bar (15) across the interior of the space frame, the respective movable bars (15) of the two adjustable guide frames (9, 10) being oriented mutually orthogonally.

4. A locating frame as claimed in claim 3, characterised in that the movable bar (15) of each adjustable guide frame is part of a movable, planar rectangular unit (20) which can be moved by the drive means (12, 13, 14) from a first position adjacent to one side (21) of the space frame to a second position adjacent the opposite side (10) of the space frame (6).

5. A locating frame as claimed in claim 3 or 4, wherein the locating frame (6) is provided with a further guide frame or pair of guide frames (7, 8) at the end thereof opposite said one end.

6. A locating frame as claimed in claim 3, 4 or 5, wherein said drive means comprises a hydraulic motor (13), a worm drive (12) and worm gear (14).

7. Apparatus for use in locating a structural element (19) in a borehole (2), which comprises a locating frame (6) as claimed in claim 3, 4, 5 or 6 and a temporary casing or shaft lining tube (1).

8. Apparatus as claimed in claim 7, wherein said shaft lining tube (1) is provided with locating shoes (4) and support shoes (5).

9. Apparatus as claimed in claim 8, wherein said locating shoes comprise a peg-like portion (40) including a dowel (41) which cooperates via a locating slot (43) with a bracket (42).

Ansprüche

1. Verfahren zum genauen Anordnen eines langgestreckten Elementes (19) in einer gewünschten Position innerhalb eines Bohrlochs (2), welches Verfahren umfaßt:

(a) Einsetzen eines Einstellrahmens (6) mit einem ersten Paar verstellbarer Führungsrahmen (7, 8) an seinem oberen Ende und einem zweiten Paar verstellbarer Führungsrahmen (9, 10) an seinem unteren Ende in das Bohrloch;

(b) Verstellen des ersten Paares verstellbarer Führungsrahmen (7, 8), um eine Eintrittsstelle für das im Bohrloch anzuordnende Element zu definieren,

(c) Verstellen des zweiten Paares verstellbarer Führungsrahmen (9, 10), um eine Stelle zur Aufnahme des Elementes (19) zu definieren, und

(d) Absenken des langgestreckten Elementes durch das erste Paar und das zweite Paar Führungsrahmen hindurch, um die gewünschte genaue Lage des langgestreckten Elementes zu erzielen.

2. Verfahren nach Anspruch 1, in welchem wenigstens der obere Teil des Bohrlochs (2) mit einem Schachtauskleidungsrohr (1) ausgekleidet wird, bevor der Einstellrahmen (6) in das ausgekleidete Bohrloch eingesetzt wird.

3. Einstellrahmen (6) zur Verwendung beim Anordnen eines Elementes (19) in einem Bohrloch (2), mit (i) einem Abstandsrahmen (6) von rechtecki-

gem Querschnitt, dessen innerer (axialer) Raum im wesentlichen vollständig frei ist, und (ii) an jedem Ende des Abstandsrahmens einem Paar verstellbare Führungsrahmen (7, 8; 9, 10), die axial mit gegenseitigem Abstand angeordnet sind und je eine bewegbare Schiene (15) umfassen, die parallel zu einer Seite (10) des Abstandsrahmens (6) und in einer radialen Ebene angeordnet ist, sowie einer Antriebseinrichtung (12, 13, 14) zum Bewegen der bewegbaren Schiene (15) quer zum Inneren des Abstandsrahmens, wobei die jeweiligen bewegbaren Schienen (15) der zwei verstellbaren Führungsrahmen (9, 10) zueinander im rechten Winkel orientiert sind.

4. Einstellrahmen nach Anspruch 3, dadurch gekennzeichnet, daß die bewegbare Schiene (15) jedes verstellbaren Führungsrahmens Teil einer bewegbaren, ebenen, rechteckigen Einheit (20) ist, die durch die Antriebseinrichtung (12, 13, 14) von einer ersten Position angrenzend an eine Seite (21) des Abstandsrahmens in eine zweite Position angrenzend an die gegenüberliegende Seite (10) des Abstandsrahmens (6) bewegt werden kann.

5. Einstellrahmen nach Anspruch 3 oder 4, in welchem der Einstellrahmen (6) mit einem weiteren Führungsrahmen oder Paar Führungsrahmen (7, 8) an seinem dem genannten einen Ende abgewandten Ende ausgerüstet ist.

6. Einstellrahmen nach Anspruch 3, 4 oder 5, in welchem die Antriebseinrichtung einen Hydraulikmotor (13), einen Schneckenantrieb (12) und ein Schneckenrad (14) umfaßt.

7. Vorrichtung zur Verwendung beim Anordnen eines Bauelementes (19) in einem Bohrloch (2), welche einen Einstellrahmen (6) nach Anspruch 3, 4, 5 oder 6 und eine temporäre Auskleidung oder ein Schachtauskleidungsrohr (1) umfaßt.

8. Vorrichtung nach Anspruch 7, in welcher das Schachtauskleidungsrohr (1) mit Einstellschuhen (4) und Stützschuhen (5) ausgerüstet ist.

9. Vorrichtung nach Anspruch 8, in welcher die Einstellschuhe einen zapfenähnlichen Abschnitt (40) mit einem Stift (41) umfassen, der über einen Einstellschlitz (43) mit einem Träger (42) zusammenwirkt.

Revendications

1. Un procédé de mise en place précise d'un élément allongé (19) dans un emplacement désiré à l'intérieur d'un trou de sonde (2), qui comprend le fait de

(a) placer dans le trou de sonde un cadre de mise en place (6) présentant à son extrémité supérieure une première paire de cadres de guidage réglables (7, 8) et présentant à son extrémité inférieure une seconde paire de cadres de guidage réglables (9, 10);

- (b) régler la première paire de cadres de guidage réglables (7, 8) pour définir un point d'entrée pour l'élément qui doit être mis en place dans le trou de sonde ;
- (c) régler la seconde paire de cadres de guidage réglables (9, 10) pour définir un lieu de réception dudit élément (19) ; et
- (d) abaisser l'élément allongé par ladite première paire et ladite seconde paire de cadres de guidage pour obtenir la mise en place précise désirée de l'élément allongé.
2. Un procédé selon la revendication 1, dans lequel au moins la partie supérieure du trou de sonde (2) est revêtue par un tube (1) de garnissage de puits avant que le cadre de mise en place (6) soit introduit dans le trou de sonde revêtu.
3. Un cadre de mise en place (6) utilisable dans la mise en place d'un élément (19) dans un trou de sonde (2), cadre qui comprend (i) un cadre d'espacement (6) de section droite rectangulaire sensiblement libre sur tout son espace interne (axial) ; et (ii) à chaque extrémité dudit cadre d'espacement, une paire de cadres de guidage réglables (7, 8 ; 9, 10) écartés axialement l'un de l'autre et comprenant chacun une barre mobile (15) parallèle à un côté (10) du cadre d'espacement (6) et dans un plan radial, ainsi que des moyens d'entraînement (12, 13, 14) pour déplacer ladite barre mobile (15) transversalement à l'intérieur du cadre d'espacement, les barres mobiles respectives (15) des deux cadres de guidage réglables (9, 10) étant mutuellement orientées de manière orthogonale.
4. Un cadre de mise en place comme revendiqué à la revendication 3, caractérisé en ce que la barre mobile (15) de chaque cadre de guidage réglable fait partie d'un ensemble rectangulaire plan mobile (20) qui peut être déplacé par les moyens d'entraînement (12, 13, 14) depuis une première position adjacente à un côté (21) du cadre d'espacement jusqu'à une seconde position adjacente aux côtés opposés (10) du cadre d'espacement (6).
5. Un cadre de mise en place comme revendiqué à la revendication 3 ou 4, dans lequel le cadre de mise en place (6) est muni d'un cadre de guidage supplémentaire ou d'une paire supplémentaire de cadres de guidage (7, 8) à son extrémité opposée à ladite première extrémité.
6. Un cadre de mise en place comme revendiqué à la revendication 3, 4 ou 5, dans lequel les moyens d'entraînement comprennent un moteur hydraulique (13), un entraînement par vis sans fin (12) et un engrenage à vis sans fin (14).
7. Appareil utilisable dans la mise en place d'un élément de structure (19) dans un trou de sonde (2), qui comprend un cadre de mise en place (6) comme revendiqué à la revendication 3, 4, 5 ou 6 et un boîtier ou tube (1) de garnissage temporaire de puits.
8. Appareil comme revendiqué à la revendication

7, dans lequel ledit tube (1) de garnissage de puits est muni de patins de mise en place (4) et de patins de support (5).

9. Appareil comme revendiqué à la revendication 8, dans lequel lesdits patins de mise en place comprennent une partie en forme de clavette (40) comportant une cheville (21) qui coopère, par l'intermédiaire d'une fente de mise en place (43), avec une console (42).

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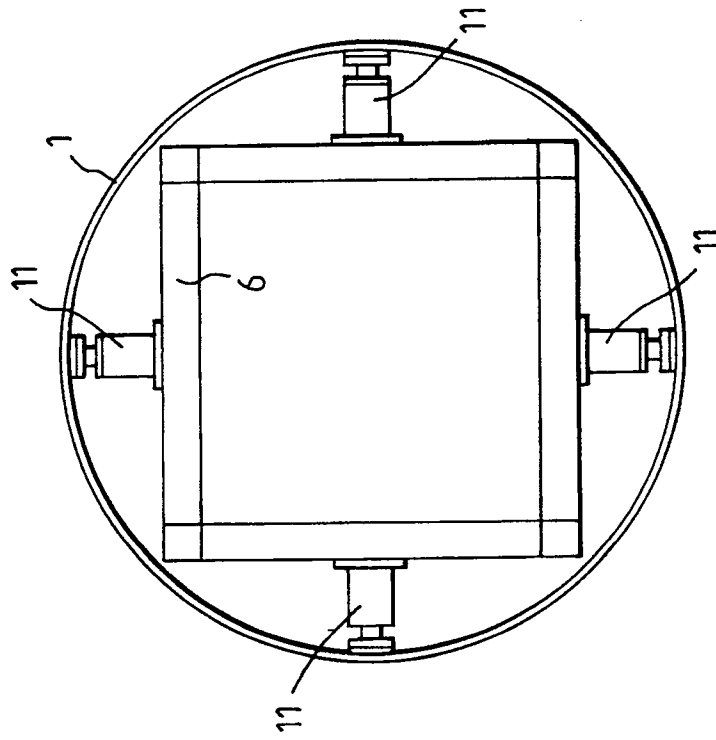
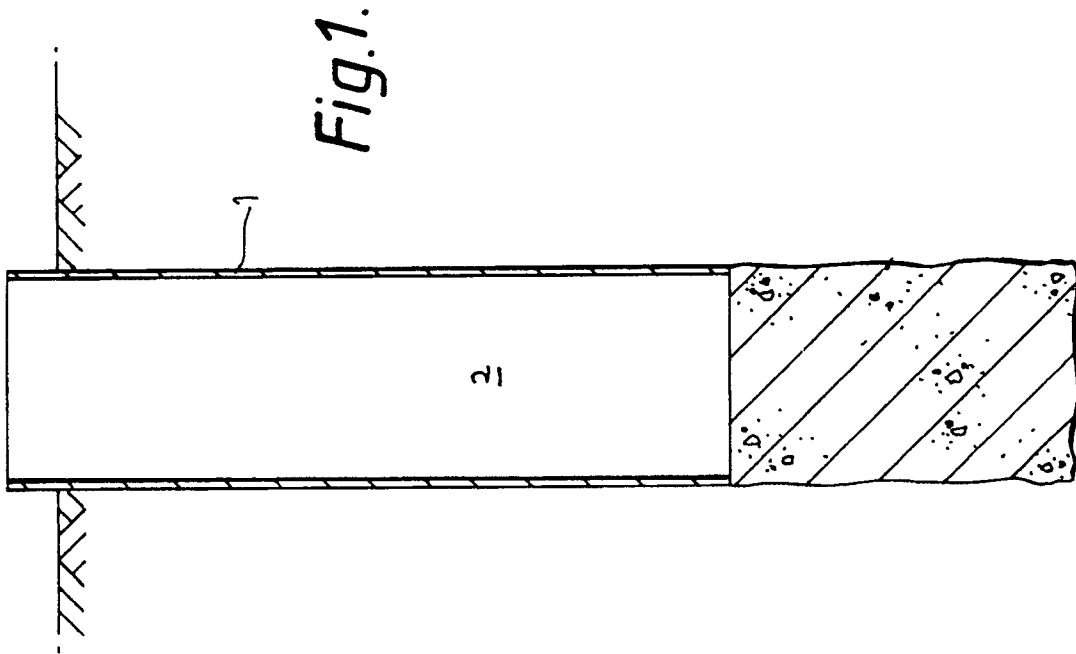


Fig.5c.

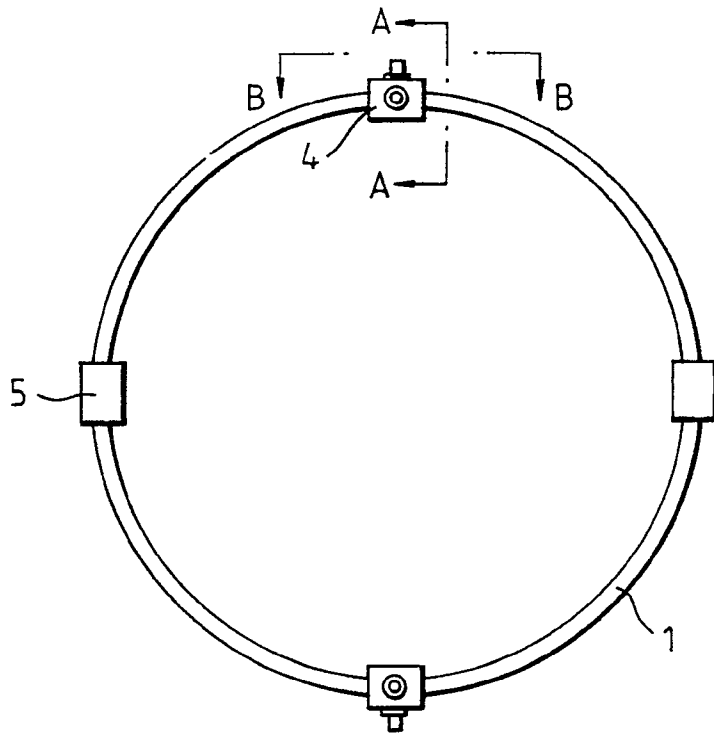


Fig. 2a.

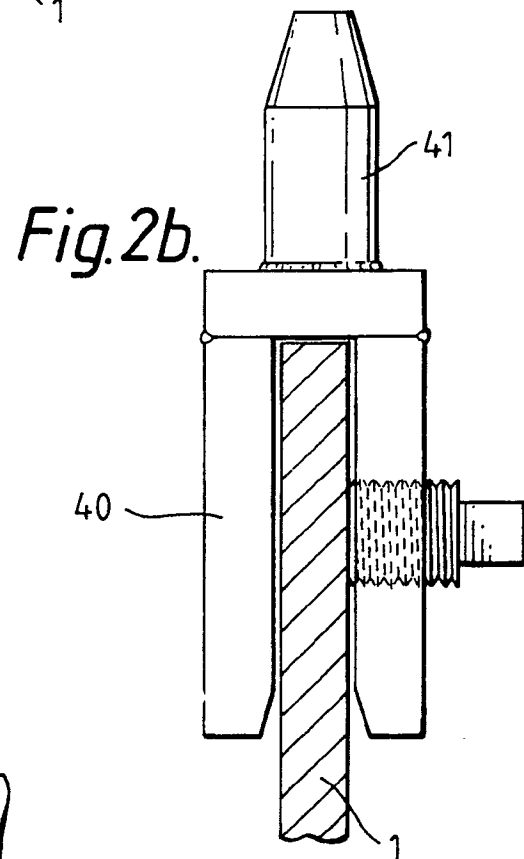


Fig. 2b.

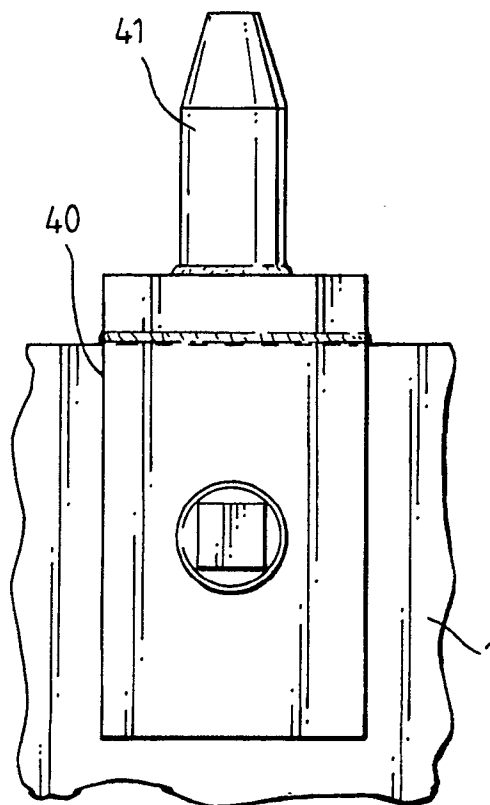


Fig. 2c.

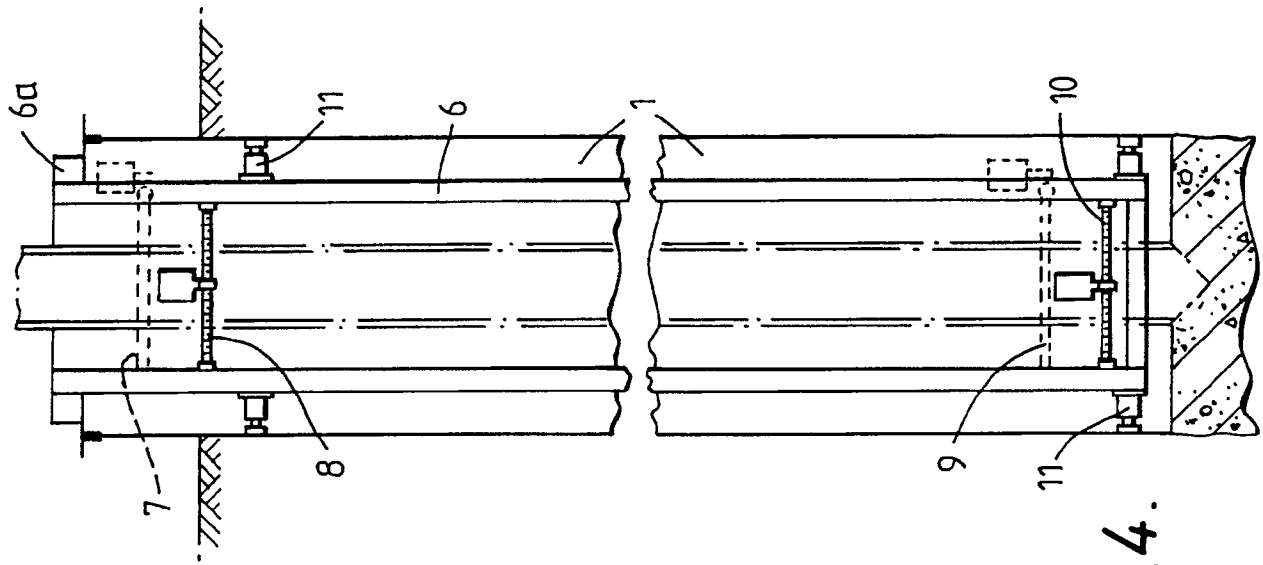


Fig. 4.

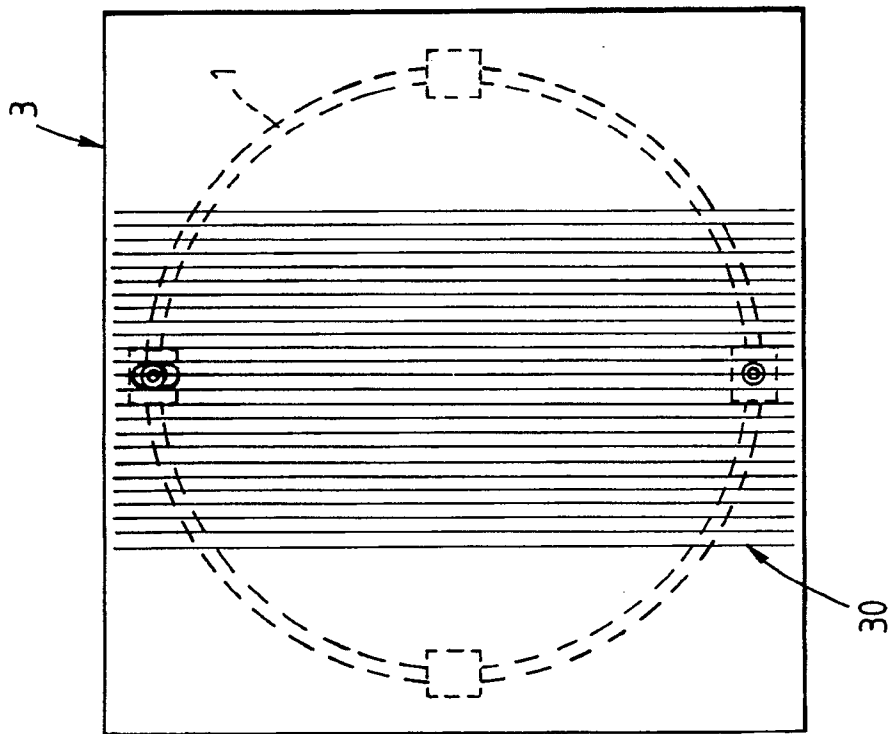


Fig. 3.

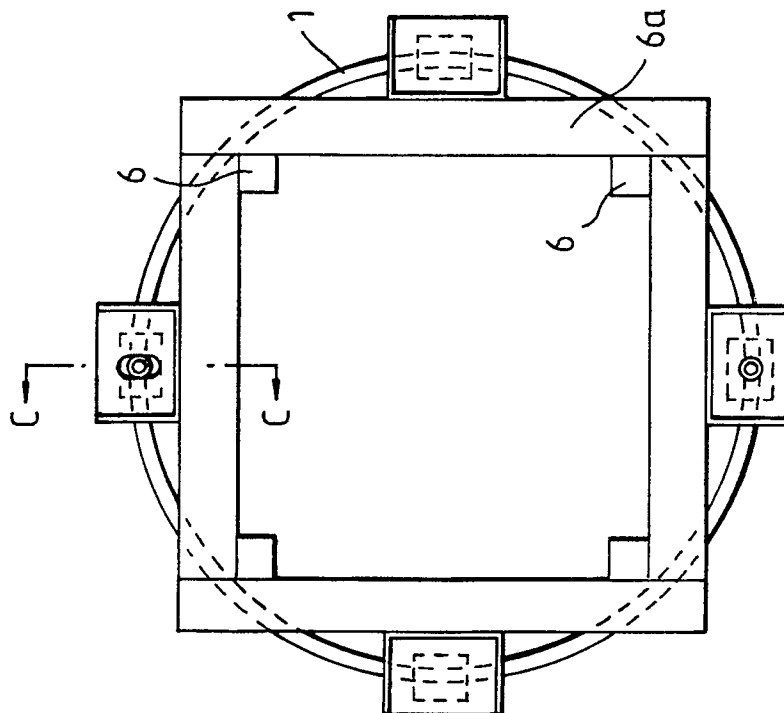


Fig. 5a.

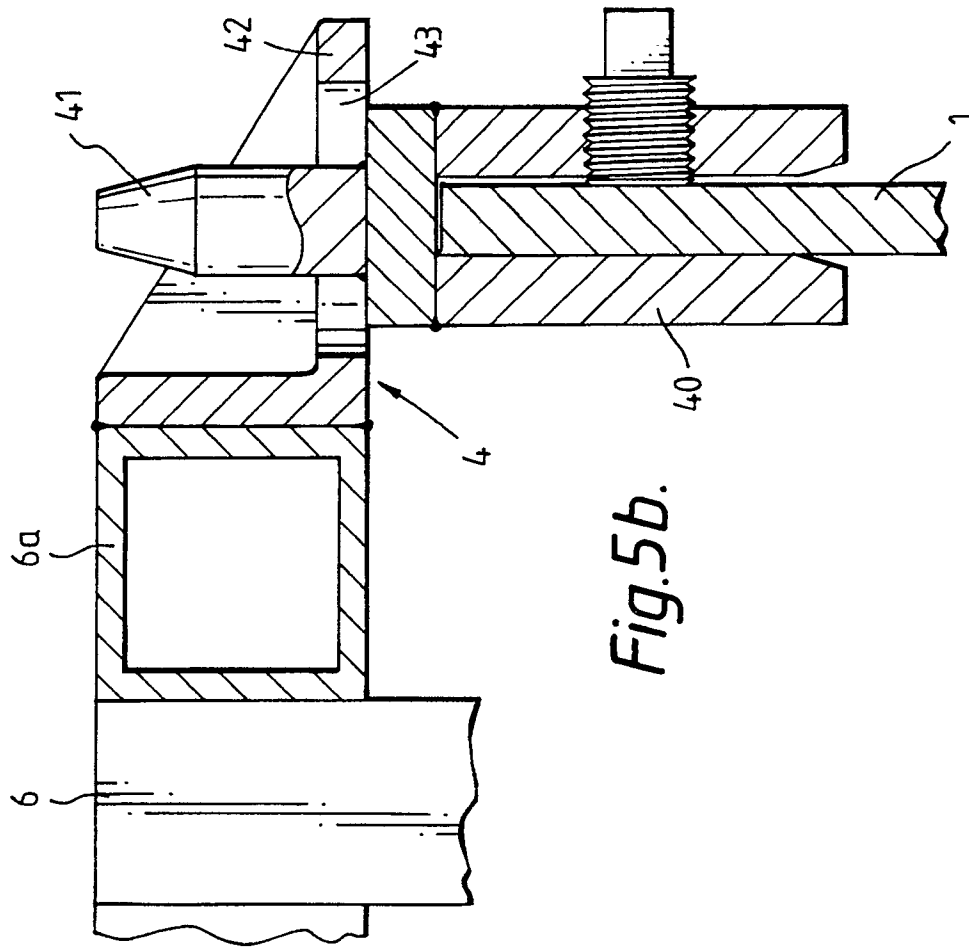


Fig. 5b.

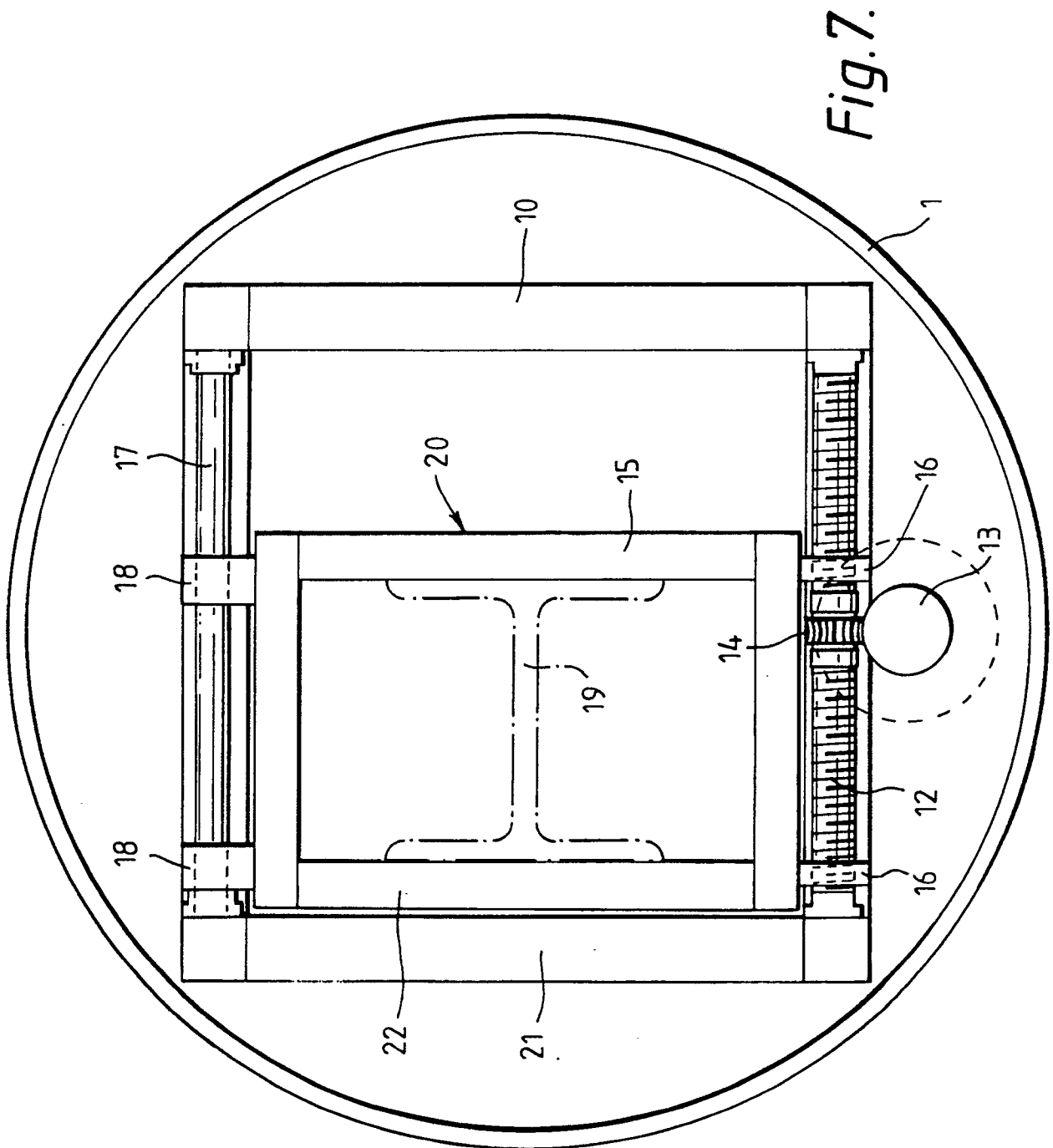
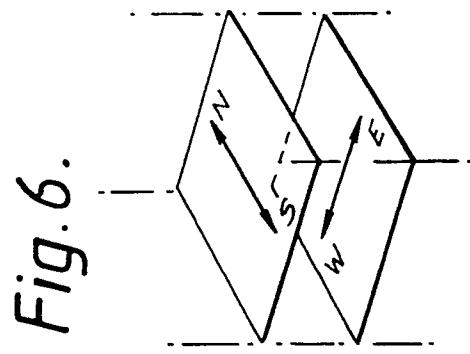


Fig. 8a.

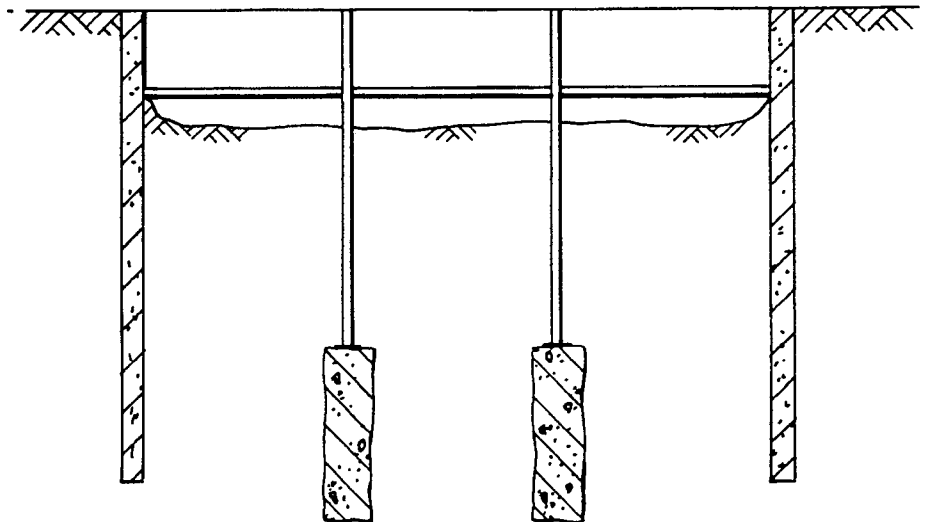
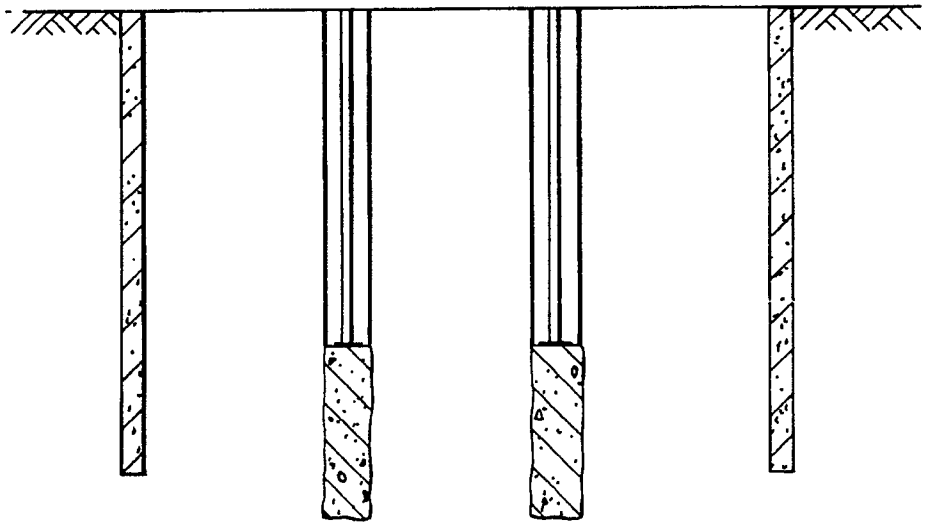


Fig. 8b.