EUROPEAN PATENT SPECIFICATION

Date of publication of patent specification: 13.10.93 Bulletin 93/41

Int. Cl.®: E02D 17/13

Application number: 90113074.0

Date of filing: 09.07.90

Method for executing monolithic continuous straights or circular structural walls and a machine for realizing such a method.

Priority: 10.07.89 IT 355089
10.07.89 IT 355189

Date of publication of application: 16.01.91 Bulletin 91/03

Publication of the grant of the patent: 13.10.93 Bulletin 93/41

Designated Contracting States: AT BE CH DE DK ES FR GB GR IT LI LU NL SE

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Description

The object of the present invention is a method for executing monolithic continuous straight or circular structural walls and a device for realizing said method.

A method is already known which consists of digging a trench for the structural wall, substaining the walls of the trench by introducing mixtures, usually with bentonite, and then inserting a diaphragm made of adjacent prismatic elements with a rectangular section.

The main drawback of such a technique is that the elements of the diaphragm, being simply put near each other, do not guarantee a safe hydraulic sealing nor the complanarity of the various elements with consequent settings when underground stresses occur.

Moreover, when the walls of the trench are kept up by bentonite mixtures, several yard equipment, usually very bulky, are required for making and storing the bentonite mixtures.

A further problem occurs when the excavated soil is polluted with bentonite, so suitable dumps are needed together with transportation means provided with watertight dump boxes.

This technique is not only used for executing straight structural concrete walls, but also for realizing wells and therefore structural walls with a circular shape. In this second case the method consists in executing, along the circumference of the wall, a sequence of reinforced concrete diaphragms. Such diaphragms are casted into trenches that are supported by bentonite mixtures.

The diaphragms are mainly executed in sequences, with opening and closing diaphragms alternatively fitted.

The main drawback of this excavating technique is that the diaphragms are never perfectly vertical, so that it is impossible to execute a structural junction between the single diaphragms. So a further problem is that diaphragms guarantee the well to be functional only down to the level where they are perfectly positioned along the circumference of the wall.

At deeper levels, due to the disalignment with the vertical line, the diaphragms work as isolated elements in the ground, being stressed by bending and shearing stresses.

A device for the casting of structural walls is known from Patent application WO-A-8504210, which discloses a machine that exploits a computer controlled laser system laser system which is pivotally attached to the end of a telescopic hydraulically operated arm and is able to rotate about three perpendicular axes. Because of its structure, this machine has difficulties in the conduction of circular walls, especially large diameter ones, as it involves complicated manoeuvres for driving the excavator along a wide circle. Further difficulties arise when constructing a circular wall with variable depth because four independent rams have to work to maintain the vertical orientation of the work head unit.

The purpose of the present invention is to overcome the above deficiencies by proposing a method and equipment that can realise diaphragms with various thicknesses and without junctions in any kind of ground. Such diaphragms may be straight or circular, and in this second case they are made for executing large diameter wells, overcoming the problems that the techniques known up to now have found. This is realised by executing continuous circular concrete walls that keep vertical for a greater depth guaranteeing the structure to work as a well.

Such purposes are obtained according to the invention by means of a device for the simultaneous excavation and construction of straight or circular continuous monolithic structural walls, comprising a motor driven vehicle provided with first pivoting means for supporting a vertical beam for rotational movement about a vertical axis and second pivoting means for rotating the beam about a horizontal axis; an excavator comprising a chain that is substantially vertical in the operative position; concrete delivery means fitted between formwork means comprised of two parallel plates mounted on each side of of the excavator for delivering concrete to the excavated area following the excavator; characterised in that said first pivoting means comprise a rotary bracket supported by a horizontal thrust bearing connected to a horizontal boom carried by the vehicle; the excavator being supported by sliding means mounted for vertical movement on said beam, and the formwork provided with vibrators.

Other characteristics and benefits of the invention will be evident further on in the description of a particular but not restrictive embodiment of the device and of the method, which are both shown in the annexed drawings, wherein:

fig. 1 is a side view of the equipment that is used to realize the method according to the invention;

figs. 2 and 3 are both plans showing the equipment according to the invention in two different operating conditions;

fig. 4 is a lengthwise diametral section of a well that has been excavated with the method according to this invention.
Referring at first to fig. 1, a motor driven crawler track equipment, indicated as a whole with reference number 1, is used for realizing the method in accordance with the invention. The equipment 1 comprises a motor driven truck 2 provided with crawler tracks and with an operator's workstation 3.

Equipment 1 also comprises a column 4 provided with a boom 5 mounted overhanging to which a rotatable bracket 6 is connected by means of a thrust bearing 7 rotating around a vertical axis A. Bracket 6 supports a beam 8 that can oscillate round point 9 in a vertical plane.

The orientation of beam 8 is realized by means of an hydraulic jack 9 having its cylinder fixed to bracket 6 and its piston rod pivotally connected to the lower end of beam 8.

A slide 10 is mounted on the side of beam 8 which is opposite to the side with the articulated joint; said slide 10 holds a work head unit 11 for the excavator 12. Excavator 12 comprises a chain 13 carrying buckets or picks 14 and it extends itself between a top driving 13 pulley and a driven sheave 15. The ascending part of chain 13 is parallel to the descending part, so to dig a rectangular trench.

A couple of parallel plates 16 are fitted one on each side of excavator 12. Plates 16 have the shape of an upside down right-angled trapezium wherein the longer base 17 and the shorter base 18 are united by oblique side 19 and by the side 20 which is perpendicular to both bases.

A formwork 21 is defined between plates 16 and excavator 12; in said formwork a hose 22 is inserted which goes down along chain 13, and through this hose the concrete is casted into the formwork.

One or more vibrators 23, meant for compacting the casted concrete, are mounted onto the longer bases 17 of plates 16.

The concrete may be prepared and transported nearby the place where the wall has to be casted, by means of a truck mixer 24, connected by a flexible hose 25 to hose 22.

A pump 26 is provided for a better conveyance of the concrete from truck mixer 24 to hose 22.

The method for realizing a continuous monolithic structural wall, substantially straight as shown in fig. 2, is carried on as follows. The excavator 12 is positioned above the extremity of the structural wall to be built and so it is got to slide down along boom 8 and penetrate vertically into the ground, digging a hole as deep as the wall. After the excavator has been advanced for a short bit, the formwork 21 is slipped into the trench and it is fixed to the excavator in such a way that the shorter base 18 is level with sheave 15.

The tube 22 is inserted from the top into the formwork 21; tube 22 is connected, with the outlet of cement pump 26 by means of flexible hose 25, which is fed by truck mixer 24.

The equipment 1, by moving continuously and constantly in direction C, realizes a continuous trench wherein the walls are substanied by formwork 21, and in which the concrete is conveyed and opportunely compacted by the action of vibrators 23 for a better setting and hardening. The process goes on this way until the whole length of the structural wall is realized.

The process for executing a circular structural wall for the realization of large diameter wells, like the one in fig. 3, is brought on as follows.

The excavator 12 is located in a position tangential to the hypothetical circumference of the well that is going to be dug. Then it is slide down along beam 8 and it is forced to penetrate vertically into the ground digging a hole as deep as the well.

The excavator is then forced to move horizontally for a short bit and then the hose 22 is inserted in the hole following chain 13 and parallel to it.

A circular trench is executed by driving the equipment in direction C' and by rotating opportunely the excavator 12 around vertical axis A; the concrete 22 is conveyed through hose 22 into the trench, and such operations go on until the whole circular structural wall is completed.

Once the structural wall is finished, the soil inside the wall may be excavated down to the depth of the wall.

The process hereby described allows to realize circular wells in non reinforced concrete about 40 cm thick and 10 m deep.

As it can be observed in figs. 3 and 4, the well has a diameter D, an excavated deepness H and a thickness S of the wall.

Claims

1. A device for the simultaneous excavation and construction of straight or circular continuous monolithic structural walls, comprising a motor driven vehicle (2) provided with first pivoting means for supporting a vertical beam (8) for rotational movement about a vertical axis (A) and second pivoting means for rotating the beam (8) about a horizontal axis; an excavator (12) comprising a chain (13) that is substantially vertical
in the operative position; concrete delivery means (22) fitted between formwork means comprised of two parallel plates (16) mounted on each side of the excavator (12) for delivering concrete to the excavated area following the excavator, characterised in that said first pivoting means comprise a rotary bracket (6) supported by a horizontal thrust bearing (7) connected to a horizontal boom (5) carried by the vehicle (2); the excavator (12) being supported by sliding means (10) mounted for vertical movement on said beam (8), and the formwork provided with vibrators (23).

2. A device according to claim 1 characterised in that said plates (16) have an upside down right-angled trapezium shape having the upper longer sides fitted with vibrating means (23).

3. A method for simultaneously excavating and constructing straight or circular continuous monolithic structural walls using the device according to claim 1, the method comprising the steps of:
   - providing a motor driven vehicle (2) having a vertically disposed excavator (12) vertically movable thereon;
   - positioning said excavator (12) vertically in the ground at a desired depth;
   - advancing the vehicle (2) so as to form a longitudinal trench by means of said excavator;
   - introducing side plates (16) into said trench on either side of said excavator wherein an excavated area is defined by said excavator and side plates in the trench;
   - fixing the plates (16) to the excavator (12);
   - locating concrete delivery means (22) within said excavated area;
   - pivoting the excavator (12) about a vertical axis (A) so as to define the angle between the direction of the excavator (12) and the direction of the vehicle (2);
   - simultaneously advancing the vehicle (2) and feeding concrete to said concrete delivery means so as to form a vertical wall in the ground.

Patentansprüche

1. Gerät zum gleichzeitigen Ausheben und Bauen von geraden oder kreisförmigen kontinuierlich monolithischen Strukturwänden, das ein motorbetriebenes Fahrzeug (2), welches mit einer ersten Schwenkeinrichtung zum Tragen eines zur Drehbewegung um eine vertikale Achse (A) vorgesehenen vertikalen Trägers (8) und einer zweiten Schwenkeinrichtung zur Drehung des Trägers (8) um eine horizontale Achse ausgestattet ist, einen Bagger (12), der eine in der Arbeitsstellung im wesentlichen vertikale Kette (13) enthält, und eine Betonforderungseinrichtung (22) umfaßt, die zwischen einer Verschalungseinrichtung angebracht ist, welche zwei an jeder Seite des Baggers (12) angebrachte parallele Platten (16) zur Betonförderung an die dem Bagger nachfolgenden ausgehobenen Bereiche enthält, dadurch gekennzeichnet, daß
   - die genannte erste Schwenkeinrichtung eine sich drehende Befestigungsschelle (6) umfaßt, die von einem horizontalen Drucklager (7) getragen wird, wobei dieses mit einem horizontalen Ausleger (5) verbunden ist, der von dem Fahrzeug (2) getragen wird,
   - der Bagger (12) von einer an dem genannten Träger (8) zur Vertikalbewegung angebrachten Gleiteinrichtung (10) getragen wird, und
   - die Verschalung mit Rüttlern (23) versehen ist.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß
die genannten Platten (16) von der Form eines mit der Oberseite nach unten gerichteten rechtwinkligen Trapezes sind, wobei an den oberen längeren Seiten Rüttieleinrichtungen (23) angebracht sind.

3. Verfahren zum gleichzeitigen Ausheben und Bauen von geraden oder kreisförmigen kontinuierlich monolithischen Strukturwänden unter Verwendung des Gerätes nach Anspruch 1, wobei das Verfahren die folgenden Schritte umfaßt:
   - Bereitstellen eines motorbetriebenen Fahrzeuges (2) mit einem vertikal angeordneten Bagger (12), der an dem Fahrzeug vertikal beweglich ist,
   - senkrechtes Positionieren des genannten Baggers (12) in der gewünschten Tiefe im Erdreich,
   - Fortbewegen des Fahrzeuges (2), so daß mit Hilfe des genannten Baggers ein Längsgraben geformt wird,
   - Einführen von Seitenplatten (16) in den genannten Graben auf jeder Seite des genannten Baggers,
wobei in dem Graben von dem genannten Bagger und den Seitenplatten in dem Graben ein ausge-
hobener Bereich definiert wird.
- Fixieren der Platten (16) an dem Bagger (12).
- Plazieren der BetonförderEinrichtung (22) innerhalb des genannten ausgehobenen Bereiches.
- Schwenken des Bagger (12) um eine vertikale Achse (A), so daß der Winkel zwischen der Richtung
  des Bagger (12) und der Richtung des Fahrzeuges (2) definiert wird.
- gleichzeitiges Fortbewegen des Fahrzeuges (2) und Speisen der genannten BetonförderEinrichtung
  mit Beton, so daß im Erdreich eine vertikale Wand geformt wird.

Reventikations

1. Dispositif destiné à l’excavation et à la construction simultanées de parois structurelles monolithiques
   continues droites ou circulaires, comprenant un véhicule motorisé (2) pourvu d’un premier moyen pivotant
   pour supporter une poutre verticale (8) en vue d’un déplacement à rotation autour d’un axe vertical (A)
   et un deuxième moyen pivotant pour faire tourner la poutre (8) autour d’un axe horizontal; une excavatrice
   (12) comprenant une chaîne (13) qui est sensiblement verticale dans la position de fonctionnement; un
   moyen (22) d’aménée de béton agencé entre des moyens de coffrage comprenant deux plaques parallèles
   (16) montées de chaque côté de l’excavatrice (12) pour amener le béton à la zone excavée à la suite de
   l’excavatrice; caractérisé en ce que ledit premier moyen pivotant comprend une console rotative (8)
   supportée par un palier de butée horizontal (7) qui est relié à une flèche horizontale (5), portée par le véhicule
   (2); l’excavatrice (12) étant supportée par un moyen coulissant (10) monté à déplacement vertical sur la
   dite poutre (8), et les moyens de coffrage étant pourvus de vibreurs (23).

2. Dispositif selon la revendication 1, caractérisé en ce que la forme desdites plaques (16) est celle d’un
   trapeze rectangle dont le coté inférieur est le petit coté, les grands cotés supérieurs étant équipés de
   moyens vibrants (23).

3. Procédé d’excavation et de construction simultanées de parois structurelles monolithiques continues droi-
tes ou circulaires utilisant le dispositif selon la revendication 1, le dit procédé comprenant les étapes
   consistant à :
   - mettre en oeuvre un véhicule motorisé (2) sur lequel une excavatrice (12) disposée verticalement
     est mobile verticalement;
   - positionner verticalement dans le sol ladite excavatrice (12) à une profondeur souhaitée;
   - faire avancer le véhicule (12) de façon à former une tranchée longitudinale au moyen de ladite ex-
     cavatrice;
   - introduire dans ladite tranchée des plaques latérales (16) de chaque côté de ladite excavatrice, une
     zone excavée étant ainsi définie dans la tranchée par ladite excavatrice et lesdites plaques;
   - fixer les plaques (16) à l’excavatrice (12);
   - positionner un moyen (22) d’aménée de béton à l’intérieur de ladite zone excavée;
   - faire pivoter l’excavatrice (12) autour d’un axe vertical (A) de façon à définir l’angle entre la direction
     de l’excavatrice (12) et la direction du véhicule (2);
   - simultanément, faire avancer le véhicule (2) et amener le béton audit moyen d’aménée de béton de
     façon à former une paroi verticale dans le sol.