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(54) **DEVICE FOR TRENCHLESS FORMING OF CONCRETE PARTITIONS IN THE GROUND, IN PARTICULAR HEAT ACCUMULATING TANKS**

VORRICHTUNG ZUM GRABENLOSEN FORMEN VON BETONTEILEN IM BODEN,
INSBESONDERE WÄRMESPEICHERTANKS

DISPOSITIF POUR LA FORMATION SANS TRANCHÉE DE CLOISONS EN BÉTON DANS LE SOL,
EN PARTICULIER DES RÉSERVOIRS À ACCUMULATION DE CHALEUR

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EP 3 592 934 B1

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Description

[0001] The subject of the invention is a device for trenchless forming of concrete partitions in the ground, in particular heat accumulating tanks, using horizontal directional drilling (HDD) techniques.

[0002] The construction of a heat energy accumulating tank is known from Polish patent application No. 414847. The tank is designed for cooperation with the solar heat acquisition system and the system of heat receivers in the building. The tank has at least one chamber made of concrete or other structural material, containing a heat energy carrier. As a thermal energy carrier, it is used a two-phase mixture consisting of a liquid mobile phase and a substantially immobile phase, which is a sand fraction. Grains of the stationary phase create a porous structure separating the interior space of the chamber with the formation of numerous connected microspheres filled with a mobile phase, with the limitation of convective heat exchange within the mobile phase. The liquid mobile phase may contain conditioning and stabilizing additives, e.g. ethylene or propylene glycol. The tank can be provided with other chambers. The lateral walls and bottoms of the tank should be tight and provided with a layer of thermally insulating material. Such tanks are usually made in the open space in close proximity to the building. In some locations, it is possible to use the natural geological layers of the ground at the tank site. It is a prerequisite for the native soil to have parameters allowing relatively free flow (percolation) of water through the entire volume of the future tank. The decision on the location of the reservoir must be preceded by geological surveys.

[0003] There are known methods of making watertight baffles made of concrete or other materials by trenchless method in the ground, using horizontal directional or microtunneling techniques, consisting of drilling parallel channels and filling them with appropriate mortar, which after curing is part of the baffle.

[0004] In the description of the patent EP2009225 a method for manufacturing an underground plate partition is shown. Firstly, a horizontal drilling is carried out running underground to the outlet opening, and the injection head is dragged through the channel made, which fills at least part of the channel with the appropriate mortar. Then similar channels filled with mortar are made in parallel. The channels are made at a certain distance from each other so that the filling of the channels is in contact with each other and after hardening it forms a tight plate.

[0005] The patent application DE 3424545 describes a method for producing underground concrete slabs formed by mining methods as concrete strips departing from horizontal parallel tunnels with a circular cross-section. To produce these slabs, a machine for tunneling was used with a drilling disk and lateral wings equipped in the front part with a scraper conveyor excavating the ground. At the rear of the wings there are channels supplying the concrete mortar to the outlets.

[0006] From the description of the patent DE 4226643

a method for underground forming of sealing baffles is disclosed, which consists in excavating the soil through an excavating device consisting of a series of flat modular working segments connected to each other with a height not exceeding 300 mm. Each working segment is equipped with a head part with a cutting head, and a hydraulic impulse actuator or electric powering is located inside the segment body. The head can be equipped with adjustable blades with small powerings, with the possibility of remote switching. In addition, the body is provided with power lines for the powering assembly and horizontal supply channels connected to the outlet openings in the rear wall of the body, through which the material forming the baffle is fed to the cavity hollowed behind the device. All segments are connected by lateral walls with the same spacing of the power lines and channels connections. In lateral ditches on both sides of the device there are lateral powering units forcing the feed drive, as well as guides and devices supplying the material to the supply channels. The cutting head can be provided with water nozzles. The device is laid in a starting trench and by means of lateral powering units, pressed through the ground up to a target trench. This is done by compacting the soil without removing the spoil. This limits the use of the device to light loose or plastic soils. In addition, the use of lateral powering for a larger number of working segments is associated with the occurrence of high stress on joints, particularly in the middle segments, and the possibility of failure in the case of work performed in compact soils or increased local resistance when pressing through the ground.

[0007] Device for trenchless forming of concrete partitions in the ground, equipped with a forming arm comprising modular working segments, where each segment has supply channel for feeding concrete mortar through a supply manifold and outlet openings in the segments rear wall to space hollowed in the ground, which arm is moved in the ground using tension ropes arranged in parallel in the ground in casing tubes and ends of the arm are connected with guides and feed drive powering in line with the direction of action of tension ropes is characterized in that the forming arm is U-shaped, and the forming arm consists of at least two lateral working segments connected to a lower working segment through underground lateral and lower driving segments, and each driving segment has a holder of tension rope, a rotating cutting head for milling the casing tube, a powering assembly of the cutting head and a rinser channel, wherein each segment of the forming arm has a return duct for extracting the spoil, located between the rinser channel and the supply channel, and in the working segments the return duct is connected via a collector receiving spoil with inlet openings located at the head portion of the segment, and the head portion of the working segments is provided with movable longitudinal excavating elements and rinser nozzles, and further an electrical connector is installed in the lateral walls of each segment.

[0008] It is advantageous if the forming arm comprises

corner working segments positioned between lateral working segments and lower working segments, in which corner segments the rinser channel, the return channel and the supply channel have the channels end holes located in two perpendicular planes.

[0009] It is advantageous if in the working segments the rinser nozzles are connected to the rinser channel through a rinser collector and a rinser electrovalve, the collector receiving spoil is connected to the return duct through an output electrovalve, the supply channel is connected to the supply manifold through a supply electrovalve, and a pressure sensor is mounted in the rear wall of the segment.

[0010] It is advantageous if at least one underground driving segment is connected to a flexible rinser duct, flexible return duct for removing the spoil, and a flexible supply duct for supplying concrete mortar, and the ducts are led through the casing tube and connected through a hole in a fixing nipple to the corresponding ducts made in this segment.

[0011] It is also advantageous if the longitudinal excavating elements are provided with force sensors, in particular strain gauges, connected via an electrical connector to a monitoring and control system.

[0012] The device according to the invention makes it possible to construct a partition entering the tank by a trenchless method and to use the ground layer above the partition as the stationary phase of the heat accumulating tank. Execution of two partitions with a similar outline at different depths of the ground makes it possible to use the natural geological layer of the soil located between the partitions as a stationary phase. The use of above-ground and underground driving segments powering the forming arm and the adaptation of working segments for the extraction of soil increases the ability to overcome the resistance of the soil, and thus increases the scope of application of the device. The use of force sensors, a pressure sensor in the zone forming the partition, a supply electrovalve regulating the outflow of the mortar and an output electrovalve, allows monitoring and changing the process parameters depending on the sensor's indications.

[0013] The invention is explained in the embodiment in the drawing, in which fig. 1 shows the forming arm in a rear view, fig. 1a shows the forming arm in section A-A of fig. 1; fig. 2a, 2b schematically shows the trajectory of drilling at the first stage of work using the HDD technique, fig. 2c-2h show the successive stages of the work using the forming arm, fig. 2i shows the outline of the partition with added lateral walls, fig. 2j schematically shows two partitions in a front view, fig. 3 shows a lower working segment of the forming arm in perspective, fig. 5 - lower working segment in longitudinal section, fig. 6 - driving segment in cross-section, fig. 6a - casing tube in section B-B of fig. 6, fig. 7 - another driving segment with attached flexible ducts in cross-section, fig. 7a - a casing tube in section C-C of fig. 7, and fig. 8 shows a driving segment connected to the working segments in

perspective.

[0014] As shown in fig. 1, the apparatus for trenchless forming of concrete partitions is provided with a U-shaped forming arm 2. The forming arm 2 comprises working segments 2a, 2b, 2c, lateral, lower, and corner, and underground driving segments 4, 5, lateral and lower. The lower driving segments 5 are connected to the lower working segment 2b and the corner working segment 2c, and the lateral working segments 2a are connected to the corner working segment 2c via the lateral driving segment 4. At the ends 13 of the forming arm 2 above-ground driving segments 3 are mounted. Working segments 2a, 2b, 2c, have the supply channel 33, shown in figs. 4, 5, feeding the concrete mortar through the supply manifold 35 and the outlet openings 24 in the rear wall to the space hollowed in the ground.

[0015] As shown in fig. 3, the lower working segment 2b has a connector 19 of return channel 30 for extracting the spoil, a connector 20 of supply channel 33, a connector 18 of rinser channel 26, and an electrical connector 21. The body 16 of the lower working segment 2b has a constriction between the front part and a flat part in which inlet openings 23 receive spoil from the excavation zone. In the rear wall of the body, outlet openings 24 are made, through which the concrete mortar is fed into the hollow space. In addition, a pressure sensor 25 for controlling the pressure in the zone forming the partition is mounted in the rear wall. The working segments have the same spacing of connectors 18, 19, 20 on the lateral walls, which allows them to be combined in various configurations, depending on the width of the partition being designed and its depth in the ground. The electrical connectors 21 are hermetic. All segments of the forming arm 2 are connected to each other by lateral surfaces 17 in a manner ensuring the tightness of the connection of the channels.

[0016] As shown in figs. 4, 5, the head portion of the lower working segment 2b has movable longitudinal hollow elements 22 forming an arcuate rake face. In addition, the rinser nozzles 29 are connected to the rinser collector 28 in a head portion of the body 16. The rinser collector 28 is connected through a rinser electrovalve 27 to the rinser channel 26 terminated by the connector 18 in the lateral walls of the body 16. The inlet openings 23 are connected to the collector 32 receiving spoil, which is connected via an output electrovalve 31 to a return channel 30 terminated by the connector 19 in the lateral walls of the body 16. Outlet openings 24 are connected to a supply manifold 35 which is connected by a supply electrovalve 34 to a supply channel 33 terminated by the connector 20 in the lateral walls of the body 16.

[0017] As shown in figs. 6, 6a, the driving segments 4, 5, lateral and lower, have a holder of tension rope, a rotating cutting head 40 for milling the casing tube 42, a powering assembly 44 of the cutting head 40 with a powering shaft 45, a return channel 30 to the supply channel 33, the rinser channel 26, and the electrical connector 21. The cutting head 40 has a conical head portion with

circumferentially attached blades 41, and the head base is pivotally mounted in the bearing 43. The ring gear 46, attached to the head base, is powered by a powering shaft 45 connected to a powering assembly 44 incorporated in the body 36. The guide sleeve 39 of the tension rope 38 is mounted in the axis of the cutting head 40 and secured to the body 36 by a fastening 37.

[0018] The driving segment 4, 5 in the embodiment shown in figs. 7, 7a differs from that of fig. 6, that inside the casing tube 42 there is arranged the flexible rinser duct 47 feeding the rinse flux to the rinser channel 26, the flexible return duct 48 for removing the spoil and the flexible supply duct 49 for supplying the concrete mortar. The guide sleeve 39 of fig. 7 has a larger diameter and includes a tension rope 38 end and ends of three flexible ducts 47, 48, 49, the ends parts of which are attached to the fixing connector 50. The flexible ducts in the casing tube 42 are connected through openings in the fastening connector 50 with corresponding channels made in the body 51 of this segment. The driving segment 4, 5 thus provided can feed other segments of the forming arm 2, regardless of the feed through the upper ends 13, especially when the number of lower working segments 2b is increased, and when pressure drops in the channels can affect the device malfunction.

[0019] Fig. 8 shows the lower part of the forming arm 2 with the lower driving segment 5 attached to the lower working segments 2b. All segments have the same spacing of connectors 18, 19, 20 on the lateral walls, which allows them to combine in different configurations, depending on the designed width of the partition.

[0020] The construction of the tank consists in making a watertight concrete partition with a U-shaped forming arm moving through the ground. The operation of the arm consists in removing the soil from its front zone, defined by arcuate rake faces, and filling the resulting space with concrete mortar or other mixture with watertight properties and with increased thermal insulation. The shape of the forming arm 2 forms a surface defining the shape of the partition. The U-shaped forming arm 2 creates a trough-shaped partition with open laterals. The walls closing the laterals of the channel are made in the last stage in a traditional manner from the surface of the earth, as a narrow-space excavation filled with a concrete mix.

[0021] As shown in figs. 2a, 2b, in the first stage of the execution works under the surface 1 of the ground, drillings 6 with the use of horizontal directional drilling (HDD) are performed. Drilling is performed along the first trajectory 7 corresponding to the position of the lateral powering segments 4, and along the second parallel trajectory 8 corresponding to the position of the lower driving segments 5. The trajectory 7, 8 of the drillings corresponds to the future position of the longitudinal walls and the base of the formed divider. Steel tensioning ropes 38 in plastic casing tubes 42 are inserted into the drills. The inner surface of the casing tube 42 can be coated with a lubricant to reduce friction.

[0022] As shown in figs. 2c-2h, on the outlet side of the drills the tension ropes 38 are fastened to the respective driving segments 4, 5 of the forming arm 2, so that the casing tube 42 abuts the cutting head 40. The upper ends 13 of the forming arm 2 are fastened above the ground surface 1 to the guides 9 by means of above-ground driving segments 3. The guides 9 are provided with a mechanism for powering the forming arm 2. On the entry side, the tensioning ropes 38 are fastened to the driving device 10, for example a winch. The simultaneous tensioning of the tension ropes 38 and the cutting of the casing tube 42 through the rotating cutting head 40 results in a transfer of force from the tension ropes 38 to the forming arm 2. The upper ends 13 of the forming arm 2 above the ground surface are powered by a driving mechanism, for example by a toothed or tractive gear. A flexible pressure line supplying a rinser, a flexible pressure duct supplying concrete mortar, a flexible vacuum duct receiving a rinser, electric conduits for powering the cutting heads 40 and energizing electrovalves, and electric conduits of the monitoring and control system are connected to each upper end 13 of the forming arm 2. The forming arm 2 is then drawn in the ground by means of a driving device 10 along a trajectory 7, 8 of drillings, the upper ends 13 of the forming arm 2 being guided by means of guides 9. In order to move the guide arm 2 evenly, both the overground and the underground powering must be operate in a synchronized manner. The shifting of the forming arm 2 in the soil occurs as a result of the simultaneous exertion of force by the above-ground driving segments 3 and underground driving segments 4, 5, while feeding the rinser, reciprocating motion of the excavating elements 22 and collecting the rinser with the spoil. The rinser and spoil are collected from the return duct 30 via a vacuum line.

[0023] Initially, until the planned depth is reached, the forming arm 2 penetrates into the ground without introducing the mortar. The space created behind the arm can be filled with bentonite. After the forming arm 2 has reached the position corresponding to the beginning of the formed partition 11, the concrete mortar is pumped to the supply channel 33.

[0024] In each working segment there is an output electrovalve 31 and a supply electrovalve 34 located between the respective channel and collector. The valves can be opened simultaneously - when the forming arm 2 moves unimpeded by the continuous outflow of the concrete mortar forming the partition 11. It is possible to separately control each electrovalve, for example in a situation where the outflow of the concrete mortar from the selected segment of the forming arm 2 is not indicated.

[0025] The pressure sensor 25 allows measurement of the pressure at which the concrete mortar is located in the rear zone of the forming arm 2. Pressure monitoring from all segments of the forming arm 2 gives the operator the opportunity to assess the regularity or disturbance in the forming of the partition. It should be added that the

pressure of the concrete mortar exerts an additional force on the forming arm 2, thus facilitating its advancement to the front.

[0026] The longitudinal excavating elements 22 are fastened in the front part of the working segments 2a, 2b, 2c of the forming arm 2 in a manner allowing the measurement of the mechanical load resulting from the soil cutting process. By means of force sensors mounted in the front part, in particular tensiometric ones, loads in the direction of movement of the longitudinal excavating elements 22 and in the perpendicular direction are measured according to the travel direction of the forming arm 2. Signals from individual force sensors are transmitted to the monitoring and control system. Thanks to this, it is possible to locate a possible obstacle preventing further movement of the arm, for example a large stone. The location is accurate to the dimension of the longitudinal excavating element 22, whose motion has been hindered or stopped, and whose sensor transmits a signal indicating an increase in the mechanical load. Such information allows you to make a decision on how to overcome the obstacle. This can be, for example, drilling a vertical well and removing obstacles.

[0027] As shown in fig. 2i, lateral walls 12 are added to the formed partition 11 in the final step. The heat accumulating tank then constructed makes it possible to use the natural geological layer of the soil from the formed partition 11 as a stationary phase.

[0028] As shown in fig. 2j, a second partition 14 of greater width may be formed below the first formed partition 11 to which the side walls 15 having a greater height are added. The technology of making the second partition 14 is the same as the first partition 11. The number of partitions made in this technology can be greater. The heat accumulating tank constructed in this way enables the use of natural geological layers of soil located between the partitions as a stationary phase.

Claims

1. A device for trenchless forming of concrete partitions in the ground, equipped with a forming arm (2) comprising modular working segments (2a, 2b), where each segment has a supply channel (33) for feeding concrete mortar through a supply manifold (35) and outlet openings (24) in the segments rear wall to a space hollowed in the ground, which arm is moved in the ground using tension ropes (38) arranged in parallel in the ground in casing tubes (42) and ends (13) of the arm (2) are connected with guides (9) and a feed drive powering in line with the direction of action of the tension ropes (38), **characterized in that** the forming arm (2) is U-shaped, and the forming arm (2) consists of at least two lateral working segments (2a) connected to a lower working segment (2b) through underground lateral and lower driving segments (4, 5), and wherein each driving segment

(4, 5) has a holder of tension rope, a rotating cutting head (40) for milling the casing tube (42), a powering assembly (44) of the cutting head (40) and a rinser channel (26), wherein each segment of the forming arm (2) has a return duct (30) for extracting the spoil, located between the rinser channel (26) and the supply channel (33), and in the working segments (2a, 2b) the return duct (30) is connected via a collector (32) receiving spoil with inlet openings (23) located at the head portion of the segment, and the head portion of the working segments (2a, 2b) is provided with movable longitudinal excavating elements (22) and rinser nozzles (29), and further an electrical connector (21) is installed in lateral walls of each segment.

2. The device according to claim 1, wherein the forming arm (2) comprises corner working segments (2c) positioned between lateral working segments (2a) and lower working segments (2b), in which corner segments (2c) the rinser channel (26), the return channel (30) and the supply channel (33) have the channels end holes located in two perpendicular planes.
3. The device according to claim 1, wherein in the working segments (2a, 2b) the rinser nozzles (29) are connected to the rinser channel (26) through a rinser collector (28) and a rinser electrovalve (27), the collector (32) receiving spoil is connected to the return duct (30) through an output electrovalve (31), the supply channel (33) is connected to the supply manifold (35) through a supply electrovalve (34), and a pressure sensor (25) is mounted in the rear wall of the segment.
4. The device according to claim 1, wherein at least one underground driving segment (4, 5) is connected to a flexible rinser duct (47), flexible return duct (48) for removing the spoil, and a flexible supply duct (49) for supplying concrete mortar, and the ducts are led through the casing tube (42) and connected through a hole in a fixing nipple (50) to the corresponding ducts made in this segment.
5. The device according to claim 1, wherein the longitudinal excavating elements (22) are provided with force sensors, in particular strain gauges, connected via the electrical connector (21) to a monitoring and control system.

Patentansprüche

1. Eine Vorrichtung zum grabenlosen Formen von Bontrennwänden im Erdreich, ausgestattet mit einem Formungsarm (2), der mit modularen Arbeitssegmenten (2a, 2b) ausgestattet ist, wobei jedes Segment einen Zufuhrkanal (33) zum Zuführen von Be-

- tonmörtel durch einen Zufuhrverteiler (35) und Auslassöffnungen (24) in der Segmentrückwand zu einem im Boden ausgehöhlten Raum aufweist, wobei der Arm im Boden mit Hilfe von Zugseilen (38) bewegt wird, die parallel im Boden in Futterrohren (42) angeordnet sind, und die Enden (13) des Arms (2) sind mit Führungen (9) und einem Vorschubantrieb verbunden, der in der Wirkungsrichtung der Zugseile (38) angetrieben wird, **dadurch gekennzeichnet, dass** der Formungsarm (2) U-förmig ist und der Formungsarm (2) aus mindestens zwei seitlichen Arbeitssegmenten (2a) besteht, die über unterirdische seitliche und untere Antriebssegmente (4, 5) mit einem unteren Arbeitssegment (2b) verbunden sind, und wobei jedes Antriebssegment (4, 5) einen Halter für ein Spannseil, einen rotierenden Schneidkopf (40) zum Fräsen des Futterrohrs (42), eine Antriebseinheit (44) des Schneidkopfs (40) und einen Spülkanal (26) aufweist, wobei jedes Segment des Formungsarms (2) einen Rückführungskanal (30) zum Abziehen des Abfalls aufweist, der zwischen dem Spülkanal (26) und dem Zufuhrkanal (33) angeordnet ist, und in den Arbeitssegmenten (2a, 2b) der Rückführungskanal (30) über einen Abfallsammler (32) mit Einlassöffnungen (23) verbunden ist, die sich am Kopfteil des Segments befinden, und der Kopfteil der Arbeitssegmente (2a, 2b) ist mit beweglichen, längsgerichteten Aushubelementen (22) und Spüldüsen (29) versehen, und außerdem ist in den Seitenwänden jedes Segments ein elektrischer Anschluss (21) installiert.
2. Vorrichtung nach Anspruch 1, wobei der Formungsarm (2) Eck-Arbeitssegmente (2c) umfasst, die zwischen den seitlichen Arbeitssegmenten (2a) und den unteren Arbeitssegmenten (2b) angeordnet sind, wobei die Endlöcher der Ecksegmente (2c) des Spülkanals (26), des Rücklaufkanals (30) und des Zufuhrkanals (33) in zwei senkrecht zueinander verlaufenden Ebenen liegen.
3. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** in den Arbeitssegmenten (2a, 2b) die Spüldüsen (29) über einen Spülsammler (28) und ein Spülelektroventil (27) mit dem Spülkanal (26) verbunden sind, der Sammler (32), der den Abraum aufnimmt, ist über ein Ausgangselektroventil (31) mit dem Rücklaufkanal (30) verbunden, der Zufuhrkanal (33) ist über ein Zufuhrelektroventil (34) mit dem Zufuhrverteiler (35) verbunden, und in der Rückwand des Segments ist ein Drucksensor (25) angebracht.
4. Vorrichtung nach Anspruch 1, bei der mindestens ein unterirdisches Antriebssegment (4, 5) mit einer flexiblen Spülleitung (47), einer flexiblen Rückführung (48) zum Entfernen des Aushubs und einer flexiblen Zufuhrleitung (49) zum Zuführen von Betonmörtel verbunden ist und die Leitungen durch das

Hüllrohr (42) geführt und durch ein Loch in einem Befestigungsrippe (50) mit den entsprechenden in diesem Segment hergestellten Leitungen verbunden sind.

5. Vorrichtung nach Anspruch 1, wobei die Längsaushubelemente (22) mit Kraftsensoren, insbesondere Dehnungsmessstreifen, versehen sind, die über den elektrischen Anschluss (21) mit einem Überwachungs- und Steuerungssystem verbunden sind.

Revendications

1. L'invention concerne un dispositif pour le coffrage sans tranchée de cloisons en béton dans le sol, équipé d'un bras de coffrage (2) comprenant des segments de travail modulaires (2a, 2b), chaque segment comprenant un canal d'alimentation (33) pour alimenter du mortier à travers un collecteur d'alimentation (35) et des ouvertures (24) dans la paroi arrière des segments vers un espace creusé dans le sol, lequel bras est déplacé dans le sol à l'aide de câbles de tension (38) disposés en parallèle dans le sol dans des tubes (42) et des extrémités (13) du bras (2) sont reliées à des guides (9) et à une alimentation en énergie en ligne avec la direction d'action des câbles de tension (38), **caractérisé en ce que** le bras de coffrage (2) est en forme de U, et **en ce que** le bras de coffrage (2) est constitué d'au moins deux segments de travail latéraux (2a) reliés à un segment de travail inférieur (2b) par l'intermédiaire de segments d'entraînement latéraux et inférieurs (4, 5), et **en ce que** chaque segment d'entraînement (4, 5) comporte un support de câble de traction, une tête de coupe rotative (40) pour fraiser le tube (42), un ensemble d'alimentation (44) de la tête de coupe (40) et un canal de rinçage (26), chaque segment du bras de coffrage (2) comportant un canal de retour (30) pour extraire le déblai, situé entre le canal de rinçage (26) et le canal d'alimentation (33), et dans les segments de travail (2a, 2b), le conduit de retour (30) est connecté par l'intermédiaire d'un collecteur (32) recevant les déblais avec des ouvertures d'entrée (23) situées au niveau de la partie de tête du segment, et la partie de tête des segments de travail (2a, 2b) est pourvue d'éléments d'excavation longitudinaux mobiles (22) et de buses de rinçage (29), en outre un connecteur électrique (21) est installé dans les parois latérales de chaque segment.
2. Dispositif selon la revendication 1, dans lequel le bras de coffrage (2) comprend des segments de travail d'angle (2c) positionnés entre les segments de travail latéraux (2a) et les segments de travail inférieurs (2b), dans lesquels les segments d'angle (2c) le canal de rinçage (26), le canal de retour (30) et le canal d'alimentation (33) ont les trous d'extrémité de

canaux situés dans deux plans perpendiculaires.

3. Dispositif selon la revendication 1, dans lequel, dans les segments de travail (2a, 2b), les buses de rinçage (29) sont reliées au canal de rinçage (26) par l'intermédiaire d'un collecteur de rinçage (28) et d'une électrovanne de rinçage (27), le collecteur (32) recevant les déchets est relié au canal de retour (30) par l'intermédiaire d'une électrovanne de sortie (31), le canal d'alimentation (33) est relié au collecteur d'alimentation (35) par l'intermédiaire d'une électrovanne d'alimentation (34), et un capteur de pression (25) est monté dans la paroi arrière du segment. 5 10
4. Dispositif selon la revendication 1, dans lequel au moins un segment d'entraînement souterrain (4, 5) est raccordé à un conduit de rinçage flexible (47), un conduit de retour flexible (48) pour enlever les déblais, et un conduit d'alimentation flexible (49) pour fournir du mortier, et les conduits sont conduits à travers le tube (42) et raccordés à travers un trou dans un point de fixation (50) aux conduits correspondants réalisés dans ce segment. 15 20
5. Dispositif selon la revendication 1, dans lequel les éléments d'excavation longitudinaux (22) sont munis de capteurs de force, en particulier de jauges de contrainte, reliés par l'intermédiaire du connecteur électrique (21) à un système de surveillance et de commande. 25 30

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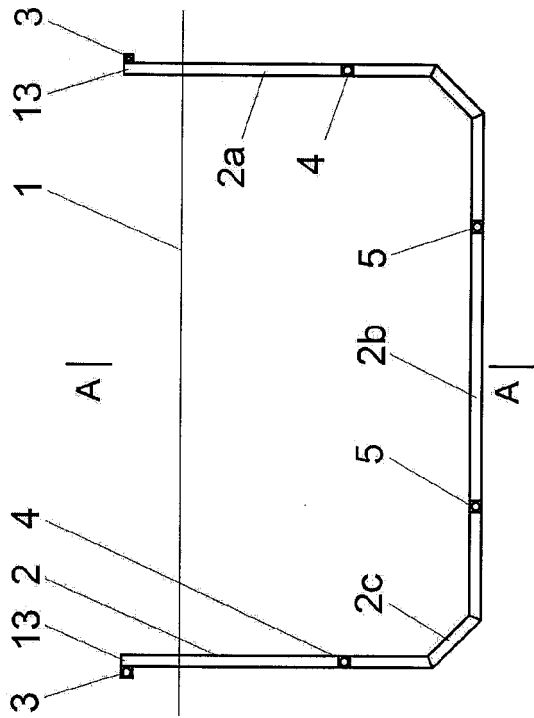


Fig. 1

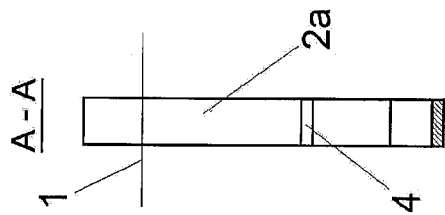


Fig. 1a

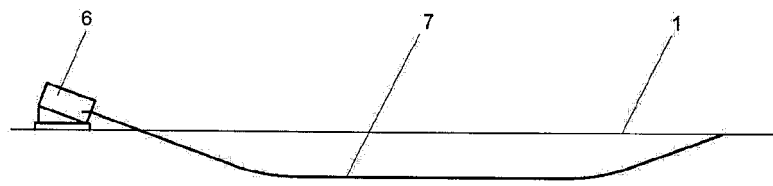


Fig. 2a

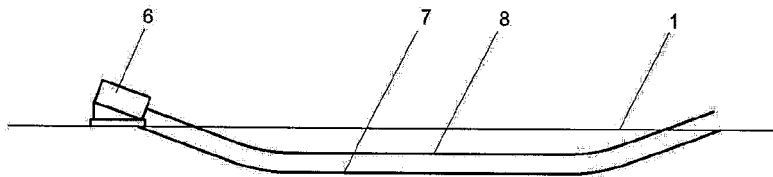


Fig. 2b

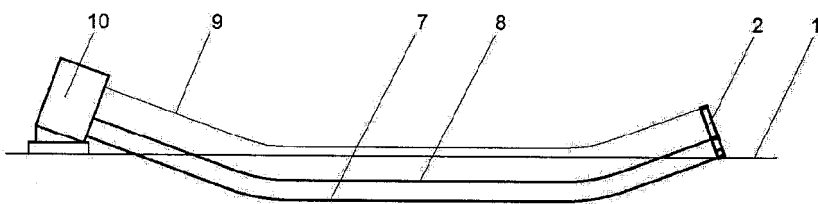


Fig. 2c

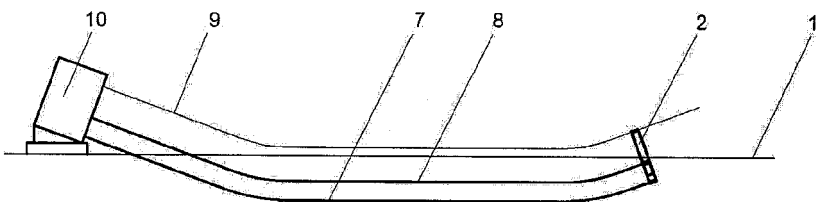


Fig. 2d

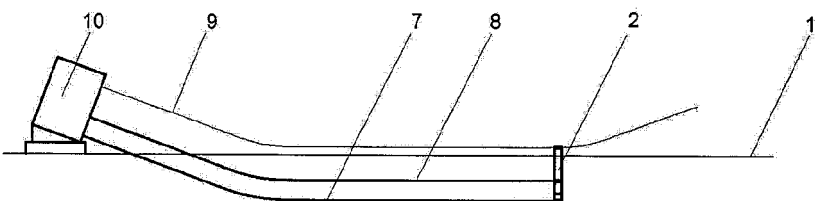


Fig. 2e

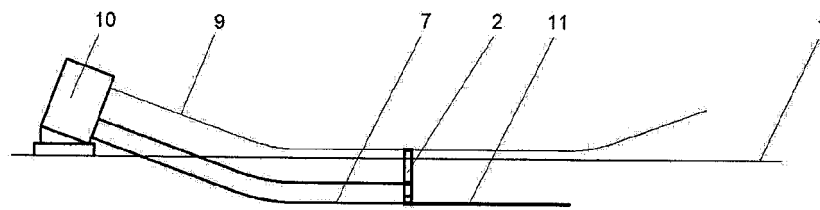


Fig. 2f

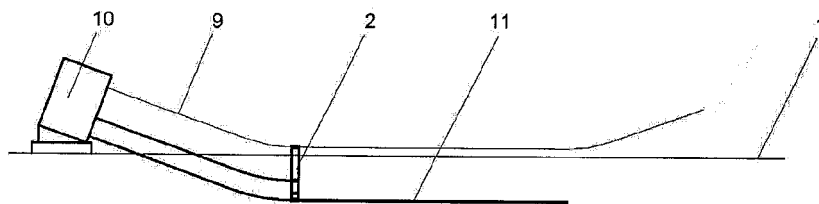


Fig. 2g

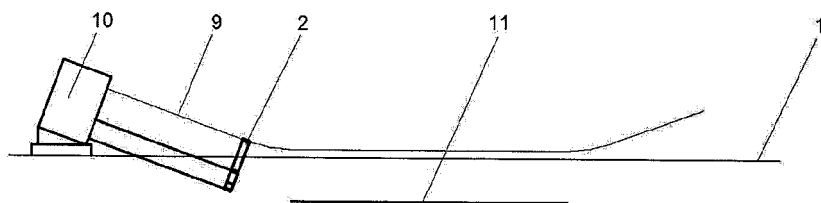


Fig. 2h

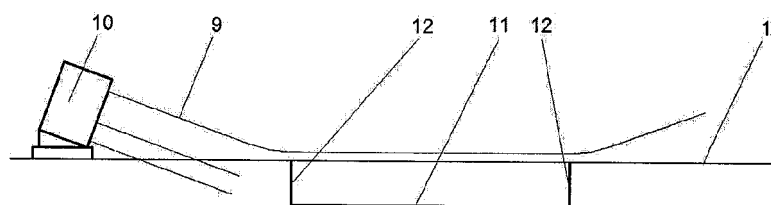


Fig. 2i

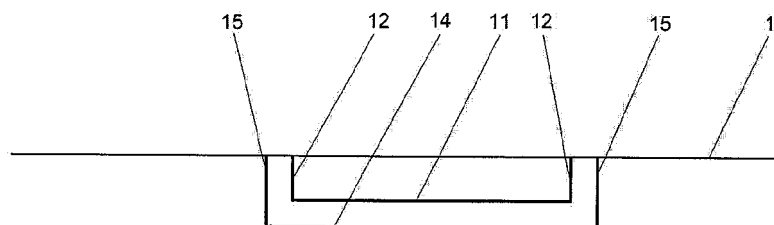


Fig. 2j

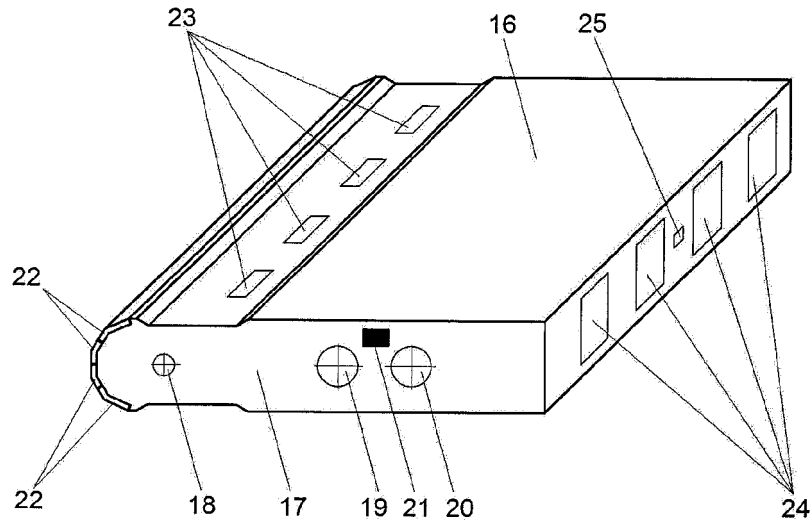


Fig. 3

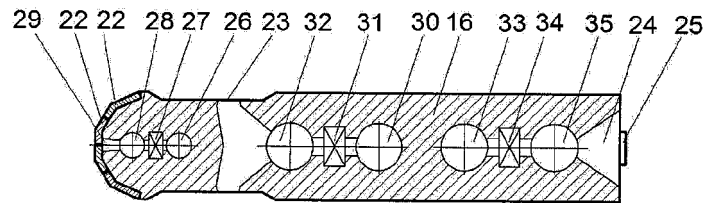


Fig. 4

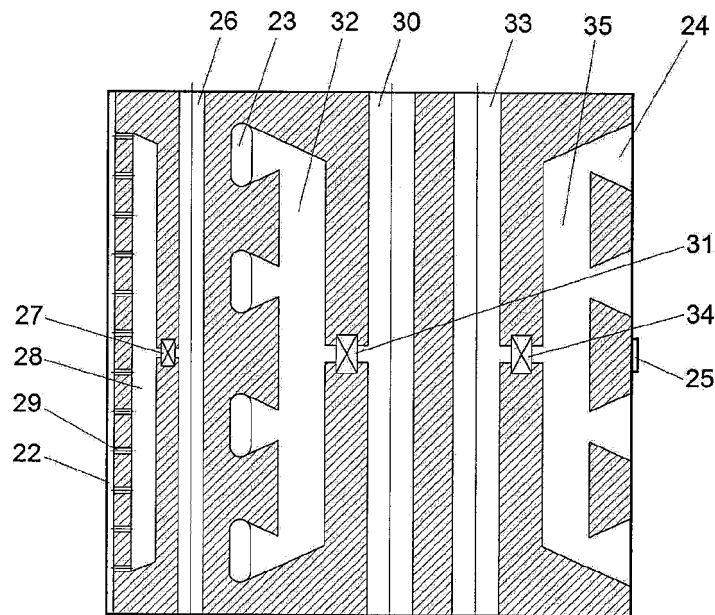


Fig. 5

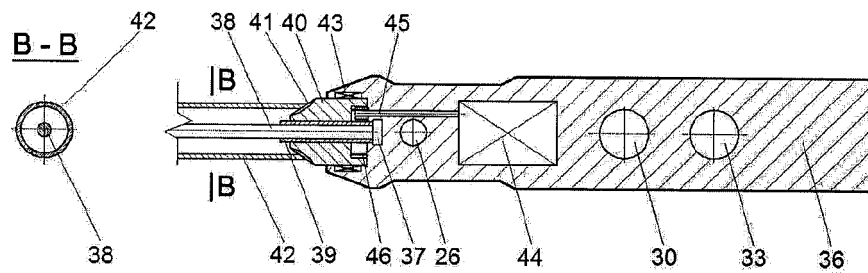


Fig. 6a

Fig. 6

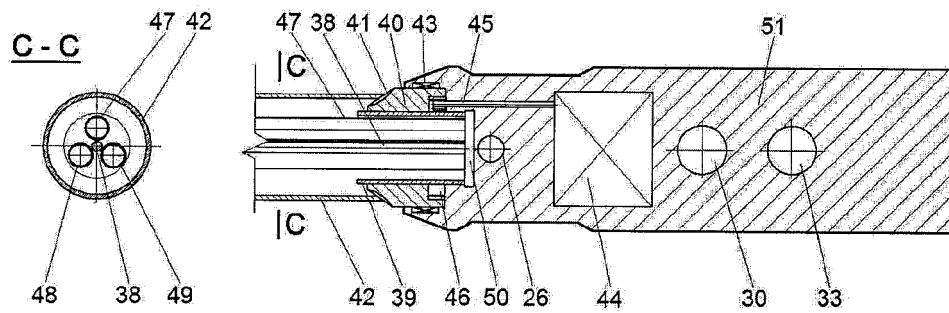


Fig. 7a

Fig. 7

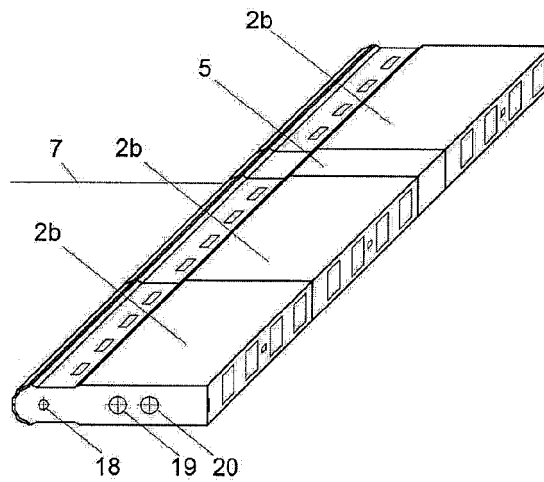


Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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