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(54) Cutter to form diaphragm joints.

(57) Cutter to form diaphragm joints in the production of concrete panels (14) cast in position in trenches (11) excavated in the ground (30), the cutter (10) cooperating with the trench (11b) adjacent to the last panel (14a) cast so as to form in the transverse wall (13) of that panel (14a) a vertical joint profile (12a), the cutter (10) comprising a cutting assembly (17) associated with a thrust and guide assembly (18), the cutting assembly (17) and the thrust and guide assembly (18) being positioned longitudinally opposite to each other on a supporting frame.

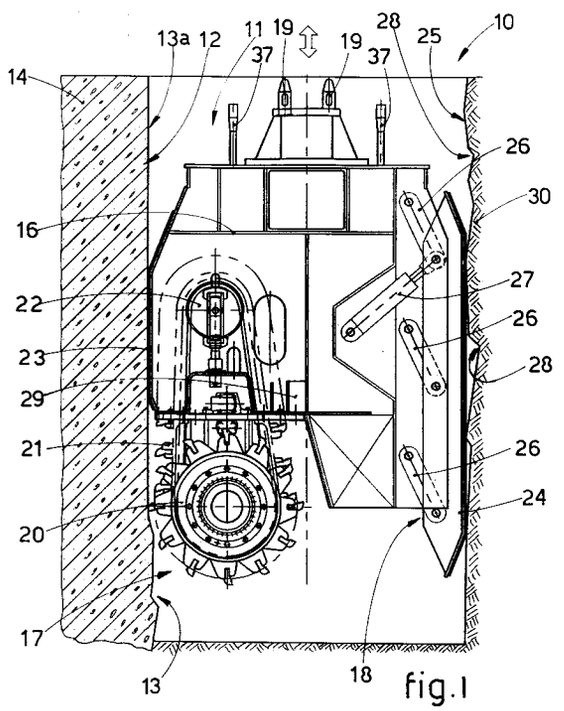

fig.1

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This invention concerns a cutter to form diaphragm joints, as set forth in the main claim.

The cutter to form diaphragm joints according to the invention is applied to the field of constructions and in particular to the making of diaphragms consisting of a plurality of concrete panels cast in position in the excavations or trenches made in the ground, these panels being suitably joined together.

The cutter to form diaphragm joints according to the invention is employed in particular for the trimming and re-working of the terminal transverse wall of the cast panel and creates at the same time a joint profile suitable for connection to the adjacent panel to be cast.

In the field of constructions and in the specific field of the production of diaphragms consisting of a plurality of panels placed side by side and joined together, the state of the art at present arranges to excavate a trench for each single panel and to cast a concrete panel therein after a trench of a determined depth has been made.

In particular, so as to optimise the procedure and to reduce the production times, the state of the art arranges to cast a panel in the trench made after a determined number of adjacent excavations.

When the trench has been made, supporting equipment of a determined shape is caused to cooperate with the initial and final transverse walls of the excavation and has the purpose of creating a profile of a joint in the respective transverse walls of the panel which is cast in the trench.

This joint profile has the purpose of ensuring a strong seal-engagement connection with the adjacent panel which will be cast thereafter.

In fact, the problem is to form a joint between one panel and the adjacent panel, the joint being such as will ensure a proper seal engagement of the joint and a continuous nature of the diaphragm thus cast.

The supporting equipment of the state of the art used for this purpose consists of abutment tubes or sheet piles, which are also called "organ-pipe tubes".

These abutment tubes may be of a cylindrical type or may have a different profile, depending on requirements.

The abutment tubes are inserted into the excavation with one face in contact with the initial or terminal transverse wall of the trench and with their other face facing towards the trench to be filled.

In view of the different depths of the trenches the abutment tubes have to be coupled together as they are inserted into the ground until they reach the length necessary to cover the whole depth of the trench.

When the panel has been cast in position, the abutment tube is withdrawn from the ground and the terminal transverse wall of the panel has a profile that mates with the abutment tube, and this terminal transverse wall forms the joint with which the adjacent panel to be cast cooperates.

Next, a trench is made in which the adjacent panel will be cast with the methods detailed above.

Before the subsequent casting of the adjacent panel and in order to ensure a better seal engagement of the joint, it is necessary to re-work the profile of the joint by means of a cutter or an excavator bucket to which are attached flaps of a shape that mates with the profile of the joint created by the abutment tube.

This technique, besides being costly and burdensome, entails long production times and requires a set of auxiliary equipment for the handling, installation, insertion, extraction and dismantling of the elements forming the abutment tubes.

In fact, seeing that the trenches can be very deep, the abutment tube elements comprise quick-coupling connecting joints which have the purpose of connecting together axially the abutment tube elements.

Deep excavations require the use of a great number of the abutment tube elements, and the work involved in connecting, inserting and withdrawing these abutment tube elements is long and burdensome.

Moreover, so as to make possible these operations of inserting and withdrawing the abutment tube elements, it is necessary to use equipment specially made for the purpose, such as hydraulic extractors and the relative hydraulic drive units, which are used to withdraw the abutment tubes from the ground after the panel has been cast.

The method for use of sheet piles is like that of the abutment tubes and, although it enables joints to be made with a more complex profile, it does not overcome the problems of the long times and high costs involved in the use of the abutment tubes.

The present applicants have designed, tested and embodied this invention to overcome the shortcomings of the state of the art and to achieve further advantages.

This invention is set forth and characterised in the main claim, while the dependent claims describe variants of the idea of the main embodiment.

The purpose of this invention is to provide a cutter for diaphragm joints which is employed to create the profile of the joints in the terminal transverse wall of the panels used for foundations and cast in position so as to form a diaphragm.

In the description that follows, the words "longitudinal" and "transverse" are employed to indicate respectively the direction in which the length and width respectively of the trench excavated in the ground extend.

The cutter according to the invention makes possible the formation, in the terminal transverse wall of the cast panels, a joint profile which ensures a proper seal-engagement of the joint and a continuous diaphragm.

The cutter according to the invention enables the times of production of the diaphragms to be reduced considerably and eliminates the auxiliary equipment employed at present in producing the joint profiles in the panels cast.

The cutter according to the invention enables panels to be cast in position, after the excavation has been made, without having recourse to the insertion of means, such as abutment tubes or sheet piles, to support the initial or terminal transverse wall of the excavated trench.

The cutter according to the invention can be employed on a specially designed supporting and operating structure or else on the same structure used, for instance, to move the bucket employed for the excavation, whether that latter structure be a kelly, the arm of a crane or another known supporting and operating structure.

The cutter according to the invention makes possible the creation, in the terminal transverse wall of the foundation panel cast in position, a joint profile of a desired form with a substantially vertical axis.

The employment of the cutter according to the invention provides for the excavation of a trench adjacent to the terminal part of the panel already cast, to which terminal part the next panel has to be connected.

The cutter according to the invention comprises a supporting frame to which are fitted, on one side, a cutting assembly, and, on the longitudinally opposite side, a thrust and guide assembly.

The thrust and guide assembly performs the task of positioning the cutter correctly in the longitudinal direction and of guiding the cutter during its descent into the trench excavated in the ground.

In this way the thrust and guide assembly ensures that the cutting assembly is always correctly positioned and makes a substantially vertical joint profile.

The thrust and guide assembly is actuated automatically to ensure the vertical position of the terminal transverse wall of the panel and therefore of the joint profile which is created in that wall by the cutting assembly.

The thrust and guide assembly comprises a horizontally movable shield, which is caused to cooperate with the bare transverse earth wall of the trench.

The cutter according to the invention is inserted into the trench with the cutting assembly facing the terminal transverse wall of the panel already cast and with the thrust and guide assembly facing the longitudinally opposite bare terminal transverse earth wall of the trench.

The cutting assembly, which includes cutting sprockets and toothed chains driven, for instance, by a hydraulic motor, is positioned in contact with the terminal transverse wall of the panel in which the profile of the joint has to be formed.

The cutting sprockets and toothed chains advantageously include teeth of a replaceable type and may have an arrangement and conformation of the teeth suitable to form a desired profile of the joint.

During descent of the cutter according to the invention into the trench the thrust and guide assembly cooperates, as we said before, by means of its shield with the bare terminal transverse earth wall of the trench so as to keep the cutting assembly in contact with the terminal transverse wall of the panel in which the joint profile has to be made.

According to a variant the cutter according to the invention can be rotated about its axis on the frame which is attached to the supporting and operating means.

In this way, by rotating the cutter by 180° about its axis, it is possible to make a joint profile on the opposed walls of the trench without having to change the position of the supporting and operating means.

The cutter can be rotated about its axis by hand.

According to a variant the rotation of the cutter is carried out by actuation means, which for instance are of the type of a jack.

The rotation of the cutter about its axis can be performed continuously or in steps, depending on the type of actuation means employed.

To make possible the rotation of the cutter, the latter includes rotary attachments for the hoses of the fluid used for the drive of the cutting assembly and of the thrust and guide assembly.

According to a variant the cutter includes two attachments for the hoses of the drive fluid; these attachments are positioned on opposite sides of the cutter and are connected alternatively to the means that feeds the drive fluid under pressure according to the orientation of the cutting assembly and thrust and guide assembly.

In this case it is necessary to detach the hoses from the first attachments before rotating the cutter and connecting it to the second attachments after the rotation has been performed.

This rotation system makes possible, on the one hand, a considerable reduction in the times of corrective action where work is being done on opposite walls of one excavation and, on the other hand, makes possible the avoidance of work to displace and re-position the supporting means, whether of a stationary or movable type, of the

cutter, for these operations are always long and complicated and lead to possible accidents.

The adjustment of the horizontal position of the shield of the thrust and guide assembly on the supporting frame is such as to be adapted to the irregularities in the bare transverse earth wall of the trench.

This situation ensures the correct vertical positioning of the descending cutter according to the invention in the trench so as to produce a vertical terminal transverse wall of the panel and to form in that wall the desired profile of the joint.

The actuation and adjustment of the thrust and guide assembly can be controlled by an inclinometer associated with the cutter according to the invention.

During descent of the cutter according to the invention in the trench the inclinometer records the deflections of the cutter from the vertical and actuates the thrust and guide assembly in such a way as to compensate these deflections, thus ensuring always a vertical position of the transverse wall of the joint and of the joint profile created in that wall.

Where the diaphragms have greater longitudinal and/or transverse dimensions, the thrust and guide assembly may include auxiliary distancing elements which are caused to cooperate with the shield.

The correction of the trim of the cutter according to the invention during its descent may be continuous and automatic or intermittent.

During descent of the cutter according to the invention into the excavation the cutting assembly generates debris both by the flattening of the transverse wall and by the creation of the joint profile. This debris accumulating in the bottom of the excavation can be removed, for instance, with the bucket excavator itself after the cutter according to the invention has been withdrawn from the excavation.

According to a variant, the cutter according to the invention includes means to remove the debris which comprise, for instance, aspiration means associated with a discharge duct to withdraw directly the debris due to the action of the cutter while such debris forms.

According to another variant the cutting sprockets can rotate in two directions, one of which is the working direction, while the other makes possible a possible disengagement of the cutting sprockets where there are obstacles.

The cutter according to the invention makes possible a considerable reduction in the production times and therefore in the costs of the diaphragms for foundations.

The attached figures are given as a non-restrictive example and show some preferred embodiments of the invention as follows:-

Fig.1
shows a section of a cutter for diaphragm joints according to the invention while in action;

Fig.2
is a plan view of the cutter for diaphragm joints of Fig.1;

Figs.3
are plan views of possible steps in the production of a diaphragm for foundations;

Fig.4
shows a variant of the cutter of Fig. 1;

Figs.5a and 5b
are plan views of the means to actuate rotation of the cutter of Fig.4 in two different positions.

The number 10 in the attached figures denotes generally a cutter for diaphragm joints according to the invention.

The cutter 10 according to the invention is employed in the production of a diaphragm 15 consisting of a plurality of adjacent concrete panels 14, which are cast one by one in sequence and are suitably joined together to form one single structure.

To be more exact, the cutter 10 according to the invention is employed to form a joint profile 12 on the terminal transverse wall 13 of a panel 14a in such a way as to produce a joint with a seal engagement together with an adjacent panel 14b which still has to be cast.

The cutter 10 according to the invention includes a frame 16 on which are installed, on one side, a cutting assembly 17, and, on the longitudinally opposite side, a thrust and guide assembly 18.

The frame 16 includes attachment means 19 for connection to a supporting and operating structure such as a crane, a kelly or another like structure for vertical operation of the frame within a trench 11 excavated in the ground 30.

The cutting assembly 17 is of a known type and comprises cutting sprockets 20 with toothed chains 21, the cutting sprockets being driven by an appropriate motor 22, which is advantageously, but not only, of a hydraulic type.

The cutting sprockets 20 and chains 21 can advantageously be positioned reciprocally to suit the transverse size of the excavation 11.

The cutting sprockets 20 and chains 21 advantageously include teeth of a replaceable type, which can be replaced with other teeth of a different shape and size so as to create a joint profile 12 of a desired form.

The cutting assembly 17 is positioned in the lower part of the frame, 16 and cooperates with the terminal transverse wall 13 of the panel 14 so as to trim any imperfections and to re-work that wall 13 so as to create a joint profile 12 of a desired form.

The frame 16 includes above the cutting assembly 17 a sidewall 23 for sliding and guiding, which cooperates with the re-worked segment 13a of the terminal transverse wall 13 of the panel 14 after the cutting assembly 17 has passed therealong.

The thrust and guide assembly 18 in this case includes a shield 24, the outer face of which is caused to cooperate with the bare transverse earth wall 25 that defines the trench 11 at its rear side.

The shield 24 is driven in the longitudinal direction defined by the trench 11 and therefore perpendicular to the direction of descent of the cutter 10 according to the invention in such a way that it keeps the cutting assembly 17 in contact with the terminal transverse wall 13 of the panel 14.

In this case the shield 24 is fitted to a plurality of oscillatory arms 26 and is moved by hydraulic actuators 27 pivoted on the frame 16.

The actuation of the actuators 27 has the purpose of taking up any irregularities 28 in the bare transverse earth wall 25 of the trench 11 and thus ensures that the cutter 10 according to the invention descends correctly in a vertical direction within the trench 11, thus producing a joint profile 12 with a vertical axis on the vertical terminal transverse wall 13 of the panel 14.

So as to correct the trim of the cutter 10 during its descent into the trench 11, the actuators 27 are associated advantageously with an inclinometer 29 fitted to the frame 16; the inclinometer 29 monitors the deflections of the cutter 10 during descent of the latter and corrects its inclination by acting on the actuators 27. This adjustment can be carried out continuously or intermittently.

The debris produced by the cutting assembly 17 during descent of the cutter 10 while creating the joint profile 12 and accumulating on the bottom of the excavation 11 can be removed, for instance, by the excavator bucket after the cutter 10 according to the invention has been withdrawn from the trench 11.

According to a variant the cutter 10 according to the invention includes an assembly (not shown here), which removes the debris and comprises aspiration means associated with a discharge duct for direct discharge of the debris due to the action of the cutter 10.

According to the variant shown in Figs.4 and 5 the cutter 10 according to the invention can be rotated about its own longitudinal axis in such a way as to cause the cutting assembly 17 and thrust and guide assembly 18 to face alternatively the terminal transverse wall 13 of the trench without having to displace the supporting and operating structure on which the cutter 10 is suspended by means of the attachment means 19.

In this example the cutting assembly 17 and thrust and guide assembly 18 are associated by means of a rotary joint 31 with the frame 16 which comprises at its upper end the attachment means 19.

The rotary joint 31 can be operated by hand to position the the cutting assembly 17 so as to face one wall 13 of the trench or the opposite wall 13.

According to the embodiment shown in Figs.4 and 5 the cutter 10 includes an actuation assembly 32 to perform rotation of the cutting assembly 17 and the thrust and guide assembly 18 in relation to the frame 16. In this case the actuation assembly 32 consists of jack means 33 pivoted on a pivot 34 associated with the frame 16.

In this example the rotary joint 31 includes three eyelets 35, with which there cooperates momentarily the terminal portion of the jack means 33 with the assistance of a pin 36.

To be more exact, in this case the rotation of the rotary joint 31 by 180° is carried out in three successive steps, in which the jack means 33 cooperate with the first eyelet 35a to perform a rotation of 60°, and then with the second eyelet 35b and lastly with the third eyelet 35c.

Fig.5a shows the starting position, with the jack means 33 cooperating with the first eyelet 35a, whereas Fig.5b shows the position of the cutter 10 after a partial rotation of 60°.

If this operation is repeated twice with the jack means 33 associated with the second eyelet 35b and the third eyelet 35c respectively, the rotation of the cutter 10 according to the invention is carried out by 180°.

According to a variant which is not shown here, the actuation assembly 32 consists of transmission-gear means or other known means to transmit rotary motion.

The cutter 10 of a rotary type advantageously includes attachments 32 for the hoses conveying the drive fluid, these attachments 37 being associated respectively with the cutting assembly 17 and with the thrust and guide assembly 18 and being positioned on the two opposite sides of the cutter 10 so that they can be connected to the means which feed the drive fluid under pressure when the cutter 10 is located in either of the two extreme rotary positions.

We shall describe below the steps in a possible production of a diaphragm 15 (see Figs. 3):

- excavation of a trench 11a in the earth 30 with the normal equipment such as a bucket conveyor or cutters (Fig.3a);
- casting a panel 14a in the trench 11a (Fig.3b);
- excavation of an adjacent trench 11b next to the terminal transverse face 13 of the panel 14a with a resulting baring of the terminal

transverse wall 13 (Fig.3c);
- introduction and descent of the cutter 10 according to the invention in the trench 11b, with the cutting assembly 17 in contact with the terminal transverse wall 13 and with the shield 24 of the thrust and guide assembly 18 cooperating with the bare transverse earth wall 25 in the production of a joint profile 12a in the terminal transverse wall 13 (Fig.3d);
- casting of a panel 14b in the trench 11b (Fig.3e);
- repetition of the operations shown in Figs.3c to 3e until the diaphragm 15 has been completed.

The description of the above operations shows clearly the reduction of the time and cost involved in the production of the diaphragm 15, this reduction being made possible by the cutter 10 according to the invention.

Claims

1. Cutter to form diaphragm joints in the production of concrete panels (14) cast in position in trenches (11) excavated in the ground (30), the cutter (10) cooperating with the trench (11b) adjacent to the last panel (14a) cast so as to form in the transverse wall (13) of that panel (14a) a vertical joint profile (12a), the cutter (10) being characterised in that it comprises a cutting assembly (17) associated with a thrust and guide assembly (18), the cutting assembly (17) and the thrust and guide assembly (18) being positioned longitudinally opposite to each other on a supporting frame.

2. Cutter (10) as in Claim 1, in which the cutting assembly (17) comprises at least one cutting sprocket (20) which is caused to cooperate with the terminal transverse wall (13) of the panel (14).

3. Cutter (10) as in Claim 1 or 2, in which the thrust and guide assembly (18) comprises a shield (24), which can be positioned longitudinally in a direction perpendicular to the direction of feed of the cutter (10) within the trench (11) and is caused to cooperate with the opposite bare terminal transverse earth (30) wall (25) of the trench (11).

4. Cutter (10) as in any claim hereinbefore, in which the shield (24) is actuated by actuators (27) governed by an inclinometer (29) associated with the cutter (10).

5. Cutter (10) as in any claim hereinbefore, in which the adjustment of the actuators (27) is carried out continuously.

6. Cutter (10) as in any of Claims 1 to 4 inclusive, in which the adjustment of the actuators (27) is carried out discontinuously.

7. Cutter (10) as in any claim hereinbefore, which includes debris removal means associated with the cutting assembly (17).

8. Cutter (10) as in any claim hereinbefore, in which the sprockets (20) and toothed chains (21) include replaceable teeth.

9. Cutter (10) as in any claim hereinbefore, in which the sprockets (20) are capable of two opposed directions of rotation, of which one is the working direction while the other is the disengagement direction.

10. Cutter (10) as in any claim hereinbefore, which is connected to the frame (16) by a rotary joint (31), which enables the cutter (10) to be rotated by at least 180° about its longitudinal axis.

11. Cutter (10) as in Claim 10, in which the rotary joint (31) is operated by hand.

12. Cutter (10) as in Claim 10, in which the rotary joint (31) is operated by an actuation assembly (32) associated with the frame (16).

13. Cutter (10) as in Claim 12, in which the actuation assembly (32) comprises jack means (33).

14. Cutter (10) as in Claim 12, in which the actuation assembly (32) comprises gear means.

15. Cutter (10) as in any of Claims 10 to 14 inclusive, which comprises attachments (37) for hoses delivering drive fluid, the attachments (37) being associated with the cutting assembly (17) and the thrust and guide assembly (18) respectively and being positioned thereabove on the two opposite sides of the cutter (10).

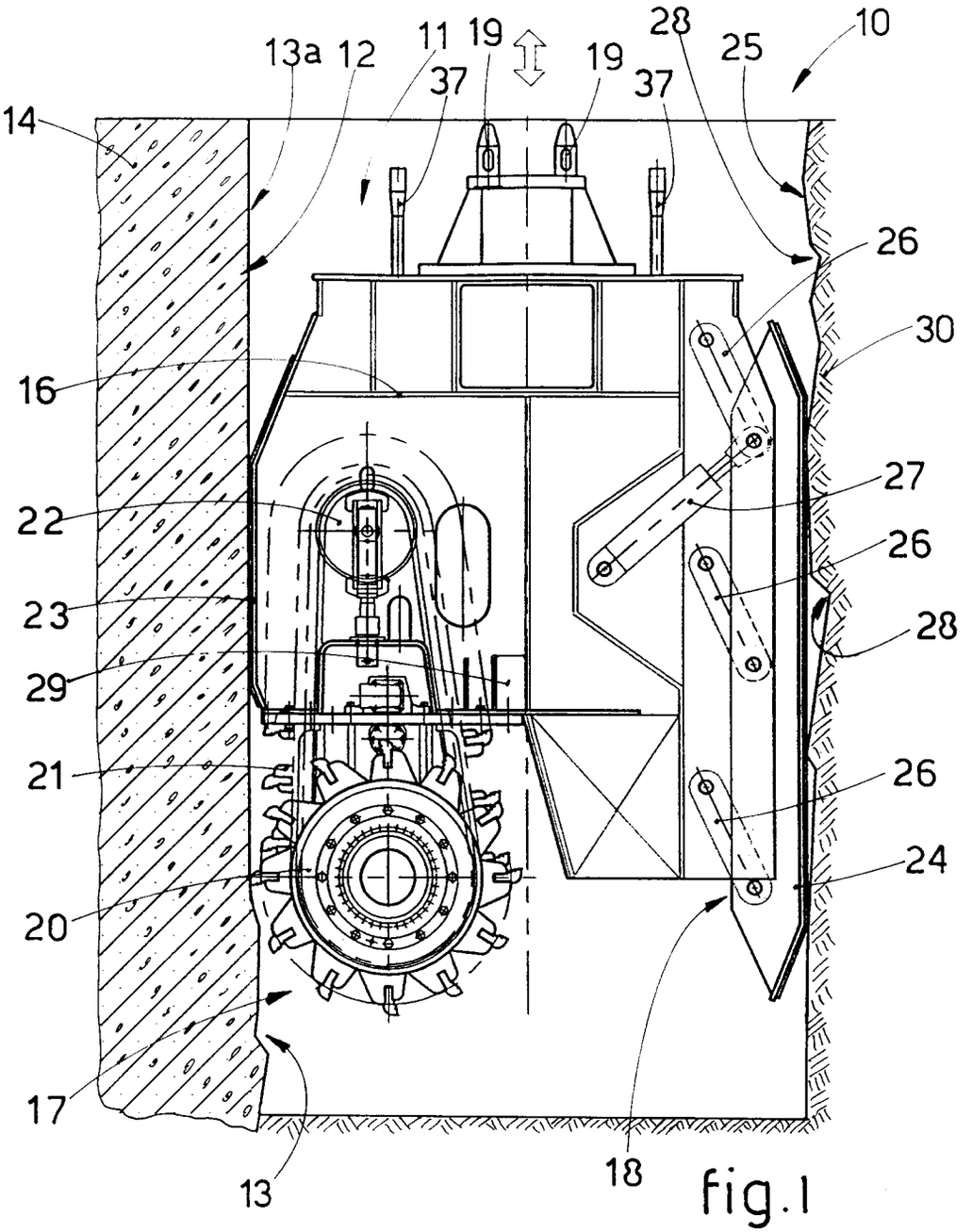
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fig.1

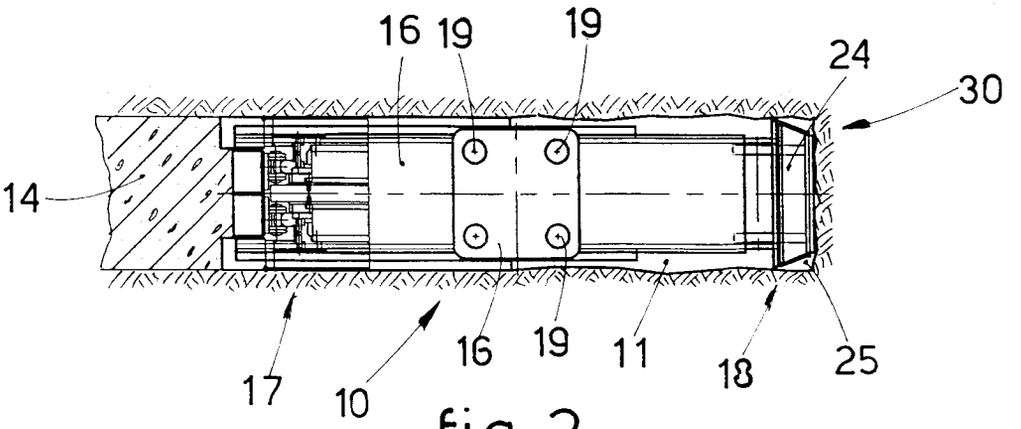
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fig.2

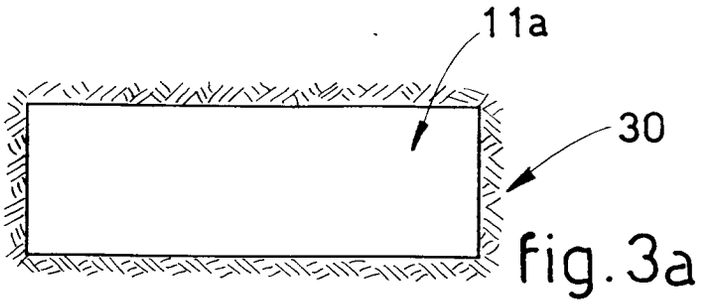

fig.3a

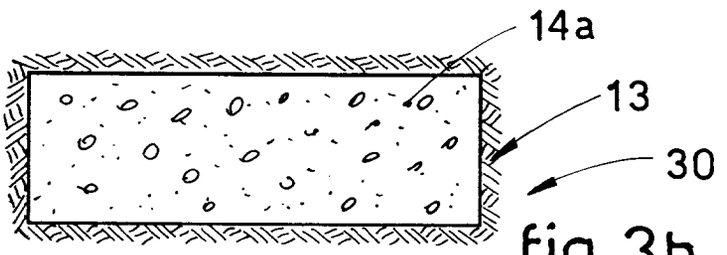

fig.3b

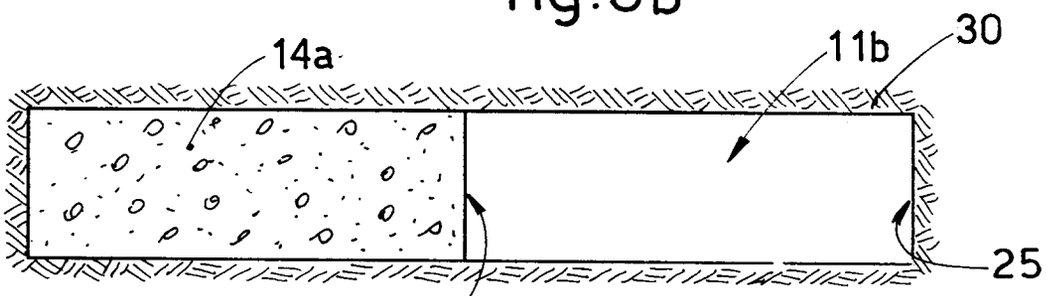

fig.3c

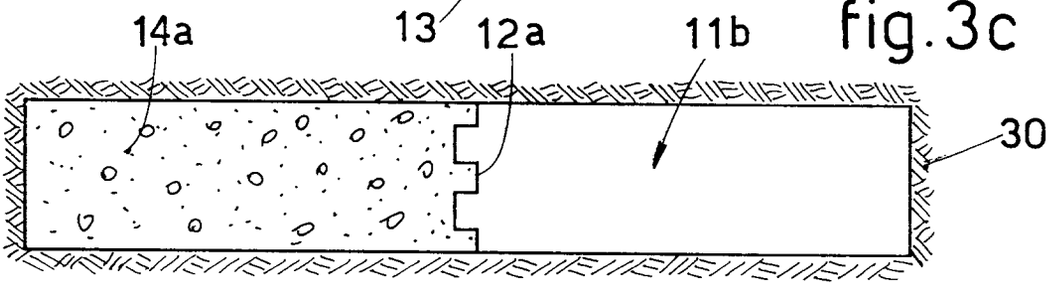

fig.3d

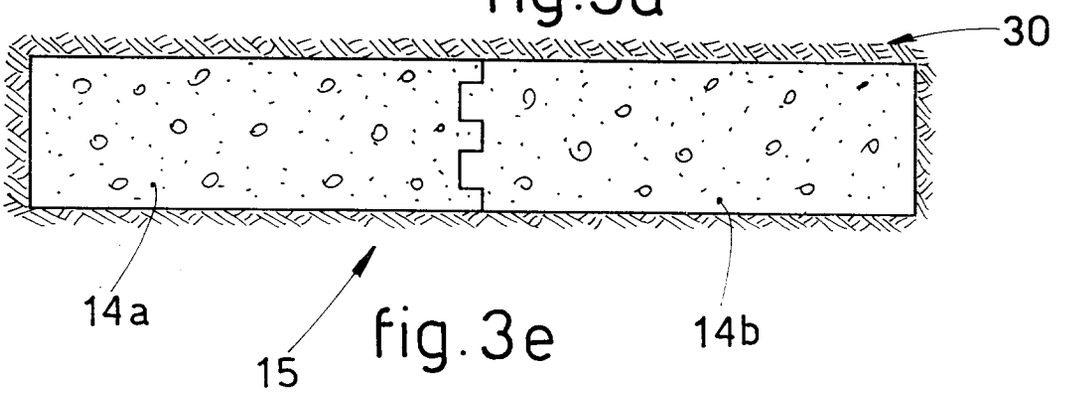

fig.3e

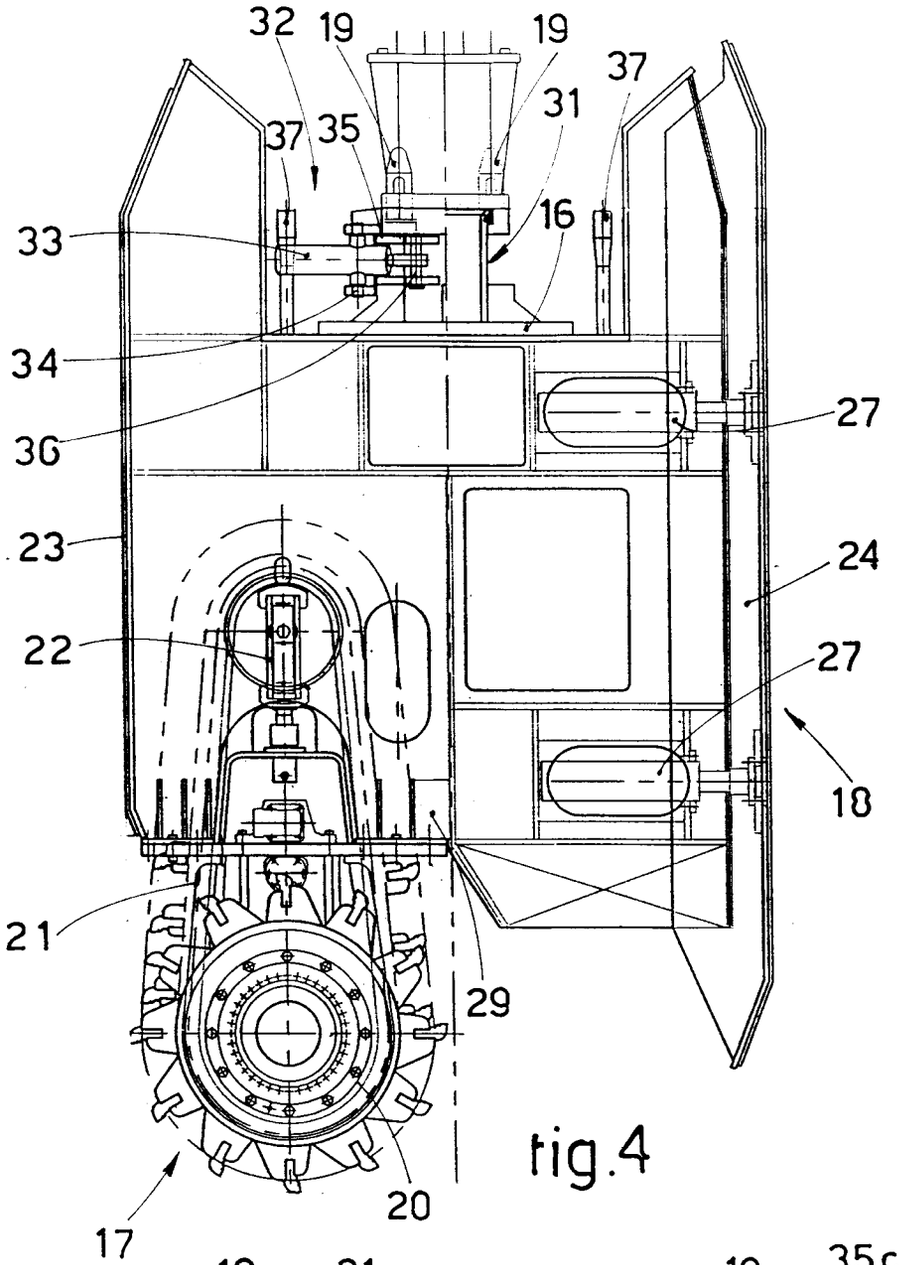

fig.4

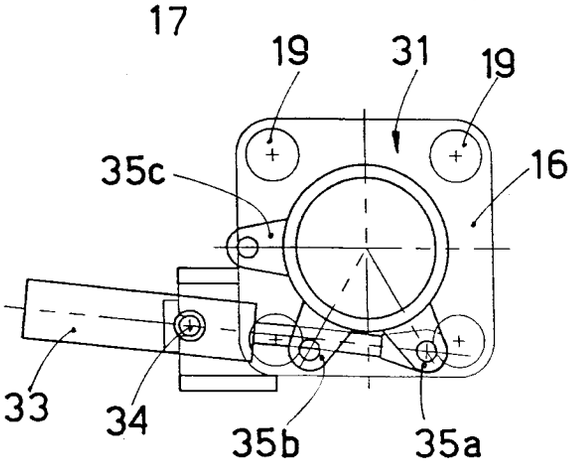

fig.5b

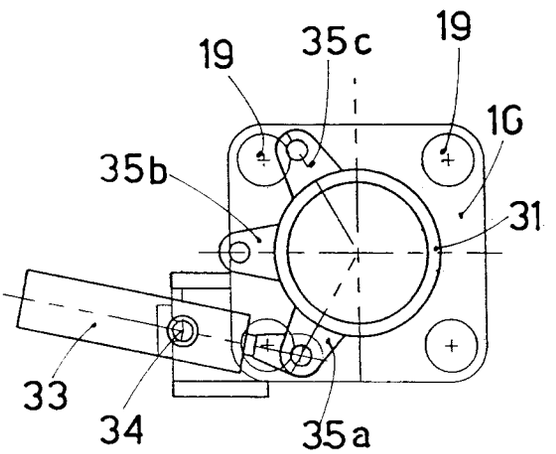

fig.5a

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 4293

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 12, no. 374 (M-749) 6 October 1988 & JP-A-63 125 727 (SHIMIZU CONSTRUCTION CO. LTD.) * abstract * ---	1-8	B28D1/04 E02D17/13 E02F3/18
A	GB-A-2 128 233 (SHIMIZU CONSTRUCTION CO. LTD.) * page 3, line 8 - line 71; figures 7,10 * -----	1,2	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B28D E02D E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 February 1995	Ljungberg, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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P : intermediate document

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EPO FORM 1503 03.82 (P04C01)