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(54) **A device for adjusting inclination of an excavating head for constructing concrete underground walls**

Vorrichtung zur Neigungsverstellung eines Baggerkopfes zum Herstellen von Schlitzwänden

Dispositif de réglage de l'inclinaison d'une tête d'excavatrice pour le creusement de murs enterrés

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(74) Representative: **Di Francesco, Gianni et al**
Ing. Barzanò & Zanardo Milano S.p.A.
Corso Vittorio Emanuele II, 61
10128 Torino (IT)

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(73) Proprietor: **SOILMEC S.p.A.**
47023 Cesena, Forli (IT)

(72) Inventor: **Galdini Villa, Filippo**
48014 Castel Bolognese RA (IT)

- **PATENT ABSTRACTS OF JAPAN vol. 016, no. 030 (M-1203), 24 January 1992 & JP 03 241118 A (FUJITA CORP), 28 October 1991,**
- **Technical Brochure "Schlitzwandfräse Bauer MBC 30"; 02/1992**

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Description

Field of the invention

[0001] The present invention falls within the field of excavations for constructing concrete underground walls. More particularly, the invention relates to a device for adjusting inclination of an excavating head for said constructions.

Background of the invention

[0002] There are known underground walls composed of a series of adjacent panels. Each panel is constructed in an excavation generally of rectangular cross section elongated in the direction of the curtain. The short sides of the rectangular cross section are located adjacent the short sides of the near panels. Excavation is performed by a grab bucket or a drilling bucket with two, four or more toothed rotary boring tools.

[0003] For the stability and efficiency of the work it is important that the wall of the underground wall has no break in continuity, i.e. all adjacent panels must contact throughout the whole depth. Therefore, the long sides and short sides of each panel must be vertical. Moreover, helical torsion of a single panel has to be avoided. It is actually possible that some panels, although being contiguous at the top and having vertical axes, form gaps therebetween under a certain depth due to torsion about the vertical axis. Verticality of the panel sides during excavation is so of primary importance.

[0004] Verticality errors are caused by irregularities in the soil and rocks lying on the vertical excavation axis, whilst torsion errors are due to the twisting of the rope during rising and falling of the excavating head.

[0005] At present, most buckets or other devices for excavating continuous underground walls are provided with guide elements for limiting deviation from the vertical line. Recent kinds of such elements are capable of accomplishing adjusting movements for correcting the inclination of the excavation and are fitted with sensors for detecting the direction and the extent of a verticality error.

[0006] WO 94/21864 discloses a device for maintaining the vertical excavation direction of a subterranean curtain. The device comprises an outer guiding body suspended to an excavator by a rope. A hydraulic clamshell is mounted to an orientable body linked within the outer guiding body so as to correct the excavation inclination relative to the plane of the curtain. Inclination detectors are mounted to the outer and/or inner orientable body. The signals from the detectors are transmitted to a control device which, in the event of the deviation of the clamshell body from the predetermined vertical direction, compensates therefor by pivoting the inner body in relation to the guide in the opposite direction to that of the deviation.

[0007] JP-A-3-241 118 discloses an excavator of un-

derground continuous walls making use of an automatic system for correction inclination of the excavation. Twelve movable surfaces are mounted to the excavating head, six at a higher level and six at a lower level. Said surfaces can be singularly urged towards or retracted from the excavation walls perpendicularly there-to for engaging said walls in sliding contact so as to correct the position of the excavating head and eliminate play relative to the excavation walls.

[0008] Document EP-A-0.518.298 discloses a device for adjusting the inclination of an excavating head for constructing concrete underground walls; the device comprises a plurality (six) of movable surfaces. To accomplish to all the movements of the six surfaces the device needs twelve actuator means with respective hinges. Such a device, obviously, needs corresponding sensors means associated to the actuator means to accomplish to the various movements of the surfaces, therefore it is a very complicate and expensive device.

Summary of the invention

[0009] It is an object of the present invention to provide a device for correcting the excavation inclination whereby inclination can be adjusted in the plane of the wall as well as in a vertical plane perpendicular to the plane of the wall and also torsion about the vertical line can be corrected.

[0010] It is another object of the present invention to provide a device of simple construction capable of performing all the adjustments required through a reduced number of controls, thereby being easier to direct.

[0011] In accordance with one aspect of the invention as claimed, these objects are accomplished by the provision of a device for adjusting inclination of an excavating head for constructing concrete underground walls, as claimed in claim 1.

Brief description of the drawings

[0012] In order that the present invention may be well understood there will now be described a preferred embodiment thereof, given by way of example, reference being made to the accompanying drawings, in which:

FIG. 1 is an exploded perspective view schematically showing an embodiment of the device of this invention applied to an excavating bucket; and
 FIGS. 2, 3 and 4 schematically depict a number of operations which the device of FIG. 1 is capable of carrying out.

Detailed description of a preferred embodiment

[0013] With reference initially to FIG. 1, numeral 3 designates the body of a conventional excavating buck-

et suspended to a rope 6. The excavating bucket 3 is fitted with lower clamshells 1 and 2, opened and closed via suitable power transmission means schematically designated at 7. These means may indifferently be mechanical (such as rope means), electric (cables) or hydraulic (conduits).

[0014] Although the present example refers to a bucket excavating means, it is understood that the device of this invention is equally applicable to excavating apparatuses of different kind, for example those exploiting drilling means.

[0015] In accordance with the present invention, coupled to the excavating bucket is a pair of movable guides 4 and 5 mounted to the vertical sides of the excavating bucket body 3. Guides 4, 5 are movable in both the vertical, longitudinal excavation plane and the vertical plane perpendicular to said excavation plane.

[0016] In the preferred embodiment shown in the drawings, the guides 4 and 5 have a C-shaped cross section with the open portions of the section facing the excavating bucket body 3. Each guide has three outer walls: a side wall (41 and 51), and two front opposite walls (42, 43 and 52, 53). Preferably, the guides have a C-shaped cross section wide enough not to interfere with the body 3 of the excavating head as they move relative thereto. As an alternative, the guides may be mounted spaced apart from the body 3 in such manner to avoid any contact with it. The example illustrated in the drawings shows that the distance between the opposite front walls of each guide is greater than the thickness of body 3.

[0017] The guides 4 and 5 are secured to the body of the excavating bucket through lower pivotal connections 8 and 9 which allow each respective guide to accomplish rotation (see arrow A, FIG. 1) in either direction of rotation about a horizontal geometrical axis passing through both pivotal connections. Furthermore, each guide is provided with a further lower pivotal connection 15, 16 allowing rotation (arrow B, FIG. 1) about horizontal axes substantially perpendicular to the plane of the continuous underground wall (subterranean curtain) to be constructed. The lower pivotal connections 8, 9 as shown in the drawings may obviously be replaced by equivalent binding means, e.g. ball-and-socket joints (not shown), allowing any combination of the rotations shown by arrows A and B.

[0018] The top portion of each guide is secured to actuators 10, 11, respectively, capable of pushing and pulling the guide horizontally, in the plane of the underground wall (as indicated by arrow C, FIG. 1) as well as perpendicularly to said plane (arrow D, FIG. 1). Preferably, actuators 10 and 11 are independent of each other and should be able to operate simultaneously in the same or opposite way, to the extent required for correcting inclination of the excavating head, as will be more apparent hereinafter. Actuators 10 and 11, which may have a mechanical, electric or hydraulic control, may be either connected to the power transmission means con-

trolling the excavating device or independent power transmission means. These may be of different kind (mechanic, electric or hydraulic) from those provided for operating the excavating instrument (bucket, drill, etc.).

[0019] Owing to the lower linkage which allows the lateral guides to accomplish single (arrows A and B) or combined rotation in vertical planes under the action of respective actuators, the device according to the present invention allows to carry out all the possible corrections of the inclination. As shown in FIG. 2, to divert the excavation sideways (arrow E) in the plane of the underground wall it is sufficient to extend actuator 10 and withdraw actuator 11 in the same horizontal direction (arrows C). Similarly, as shown in FIG. 3, to divert the excavation frontally (arrow F) in a plane perpendicular to that of the underground wall, both actuators 10, 11 are extended parallel in the same direction as indicated by arrow D. To attain a correction of the torsion (FIG. 4, arrow G) the actuators 10 and 11 have to be activated in parallel and opposite horizontal directions (arrows D1 and D2).

[0020] Obviously, the device of this invention provides also for combined corrections of verticality and torsion by suitably controlling rotation of the guides and so attain any possible correction resulting from the combination of two or more of the arrows E, F and G depicted in FIGS. 2 to 4. Advantageously, this is accomplished in accordance with the present invention by the provision of only two side guiding means.

[0021] Still referring to FIG. 1, the upper end portions of guides 4 and 5 may be mutually connected by horizontal rods 12 and 13 secured so as to allow rotation and torsion shown in FIGS. 2 to 4.

[0022] Alternatively, the guides 4 and 5 may have different shapes from the C one described and illustrated, as far as they have walls adapted to engage the walls of the excavation sideways and/or frontally in order to effect the required deviation.

[0023] The excavating bucket (or drill or other excavating means used) is fitted with sensors (not shown for simplicity) for detecting all data concerning position and inclination of the excavation at the point of the excavating head. These sensors are connected to an on-surface electronic processing unit for controlling correction of inclination and/or torsion in response to errors being possibly detected. The correction may be performed automatically or manually by an operator.

[0024] The sensors can be mounted on the body 3 of the excavating head and/or the movable guides. Said sensors comprise: two inclination detectors, one for sensing inclination in the vertical plane of the underground wall and the other for detecting inclination in the vertical plane perpendicular to said plane of the underground wall; a gyroscope for orientation about the excavation axis; and a depth detector for measuring depth. A sum of increments calculation method allows to know the position of the excavating tool at any depth during the falling step, and particularly the final position relative

to the ideal position.

[0025] The extent of the distance between the excavating bucket and the walls of the excavation may be gauged by an ultrasonic system of known kind (not shown). The overall available data (concerning distance from the walls of the excavation, depth, inclination) provide continuous information which enables to know the instantaneous shape of the excavation and modify it if necessary.

[0026] The comparison between the ideal shape of the excavation provides the correction to be made to reduce and nullify any error. Correction can be carried out automatically or by an operator.

Claims

1. A device for adjusting inclination of an excavating head for constructing concrete. underground walls, of the type comprising a plurality of movable surfaces mounted to the excavating head (3) and capable of being selectively urged against the walls of the excavation; **characterised in that** said surfaces are comprised of only a pair of rigid, substantially vertical guide means (4, 5) mounted on two opposite vertical sides of the excavating head and having a C-shaped cross section, with the open portions of the section facing the body (3) of the excavating head; the bottom portions of each guide means (4, 5) being linked to the excavating head by two pivotal connections (8, 15; 9, 16) rotatable about two horizontal axes which are perpendicular to each other so as to accomplish rotation in vertical planes by means of a respective, independent upper actuator means (10, 11).
2. A device according to claim 1 **characterised in that** each of said actuator means (10, 11) is capable of acting along perpendicular directions (C, D) in a substantially horizontal plane.

Patentansprüche

1. Vorrichtung zur Neigungsverstellung eines Baggerkopfes zur Herstellung von Betonschlitzwänden, zu der mehrere bewegliche Flächenelemente gehören, die an dem Baggerkopf (3) angebracht sind und die sich wahlweise gegen die Wände der Ausschachtung drücken lassen, **dadurch gekennzeichnet, dass** die Flächenelemente lediglich ein Paar von starren, im Wesentlichen vertikal ausgerichteten Führungselementen (4, 5) umfassen, die an zwei gegenüberliegenden senkrechten Seiten des Baggerkopfes befestigt sind und einen C-förmigen Querschnitt aufweisen, wobei die offenen Abschnitte des Querschnitts dem Grundkörper (3) des Baggerkopfes zugewandt sind; die unteren Ab-

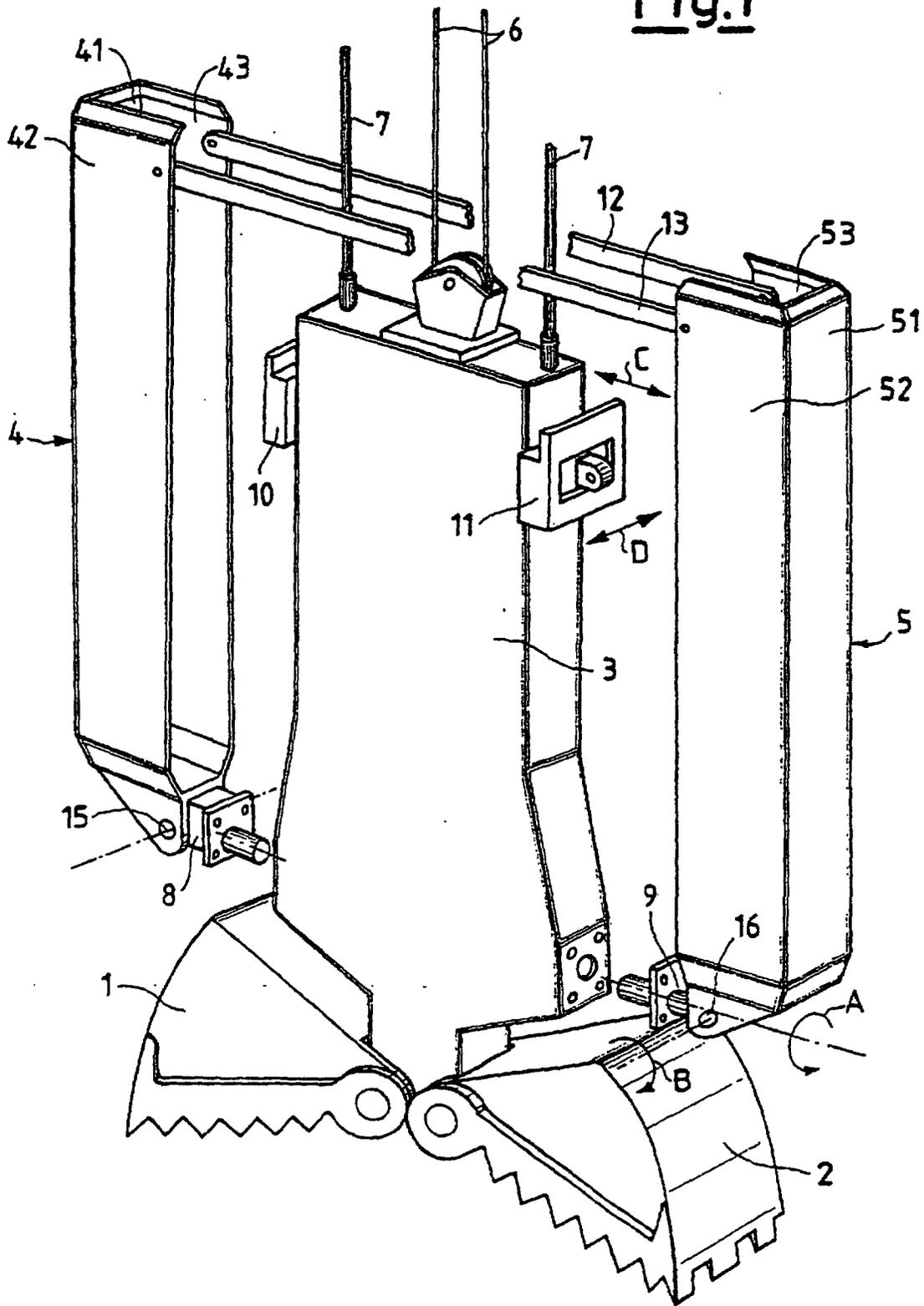
schnitte einer jeden Führungsvorrichtung (4, 5) mit dem Baggerkopf mittels zwei Drehgelenkverbindungen (8, 15; 9, 16) verbunden sind, die Drehungen um zwei horizontale, senkrecht zueinander stehende Achsen zulassen, um mittels entsprechenden, voneinander unabhängigen oberen Aktuatorvorrichtungen (10, 11) in vertikalen Ebenen Drehbewegungen zu erreichen.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** jede der Aktuatorvorrichtungen (10, 11) in der Lage ist, entlang zueinander senkrechten, in einer im Wesentlichen horizontalen Ebene verlaufenden Richtungen (C, D) zu wirken.

Revendications

1. Dispositif permettant d'ajuster l'inclinaison d'une tête d'excavatrice permettant de construire des parois souterraines en béton, du type comprenant une pluralité de surfaces mobiles montées sur la tête d'excavatrice (3) et pouvant être appuyées de façon sélective contre les parois de l'excavation ; **caractérisé en ce que** lesdites surfaces ne sont composées que d'une paire de moyens de guidage rigides et sensiblement verticaux (4, 5), montés sur deux côtés verticaux opposés de la tête d'excavatrice et présentant une section transversale en forme de C, les parties ouvertes de la section faisant face au corps (3) de la tête d'excavatrice ; les parties basses de chaque moyen de guidage (4, 5) étant reliées à la tête d'excavatrice par deux liaisons pivotantes (8, 15 ; 9, 16) pouvant pivoter autour de deux axes horizontaux qui sont perpendiculaires de façon à permettre une rotation dans les plans verticaux par le biais d'un moyen d'actionnement supérieur indépendant respectif (10, 11).
2. Dispositif selon la revendication 1, **caractérisé en ce que** chacun des moyens d'actionnement (10, 11) peut agir le long de directions perpendiculaires (C, D) dans un plan sensiblement horizontal.

Fig.1



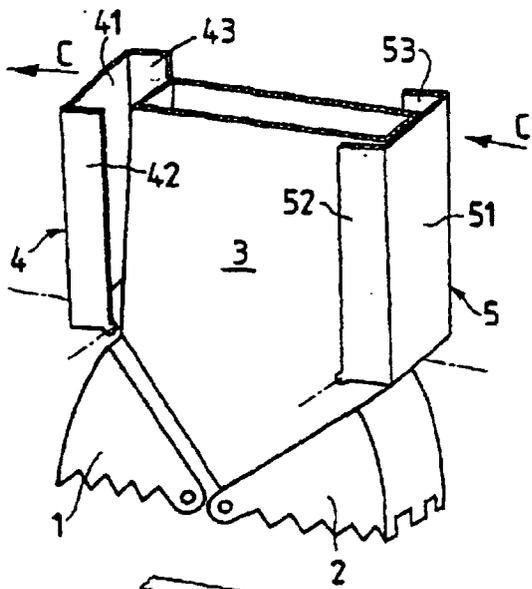


Fig. 2

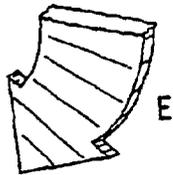


Fig. 3

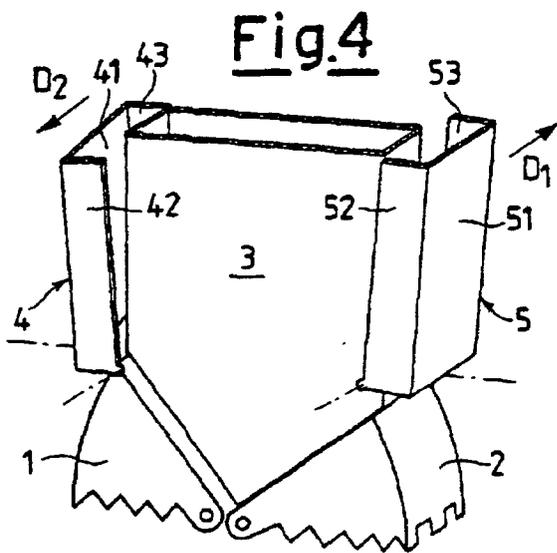
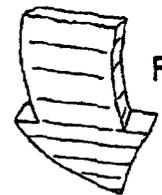
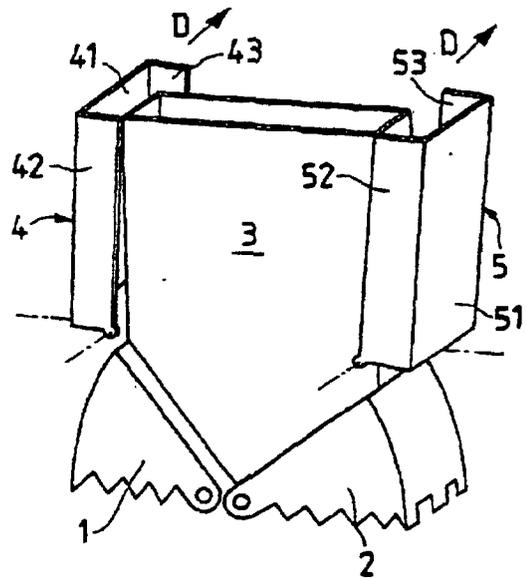


Fig. 4

