(12) STANDARD PATENT (11) Application No. **AU 2007245786 B2**
(19) AUSTRALIAN PATENT OFFICE

(54) Title
Road-making machine, levelling device and method of controlling the cutting depth or cutting inclination in a road-making machine

(51) International Patent Classification(s)
E01C 23/088 (2006.01)

(21) Application No: **2007245786** (22) Date of Filing: **2007.04.12**

(87) WIPO No: **WO07/125017**

(30) Priority Data

(31) Number	(32) Date	(33) Country
102006020293.7	**2006.04.27**	**DE**

(43) Publication Date: **2007.11.08**
(44) Accepted Journal Date: **2011.03.10**

(71) Applicant(s)
Wirtgen GmbH

(72) Inventor(s)
Tewes, Gunter;Hahn, Gunter;Jurasz, Jaroslaw

(74) Agent / Attorney
FB Rice & Co, Level 23 44 Market Street, Sydney, NSW, 2000

(56) Related Art
EP 1154075 A

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

PCT

(43) Internationales Veröffentlichungsdatum
8. November 2007 (08.11.2007)

(10) Internationale Veröffentlichungsnummer
WO 2007/125017 A1

(51) Internationale Patentklassifikation:
E01C 23/088 (2006.01)

(21) Internationales Aktenzeichen: PCT/EP2007/053590

(22) Internationales Anmeldedatum:
12. April 2007 (12.04.2007)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
102006020293.7 27. April 2006 (27.04.2006) DE

(71) Anmelder *(für alle Bestimmungsstaaten mit Ausnahme von US)*: **WIRTGEN GMBH** [DE/DE]; Hohner Strasse 2, 53578 Windhagen (DE).

(72) Erfinder; und

(75) Erfinder/Anmelder *(nur für US)*: **JURASZ, Juroslaw** [DE/DE]; Weidenweg 8, 53578 Windhagen (DE). **HÄHN, Günter** [DE/DE]; Kiefernweg 21, 53639 Königswinter (DE). **TEWES, Günter** [DE/DE]; Erlenweg 14, 53572 Unkel (DE).

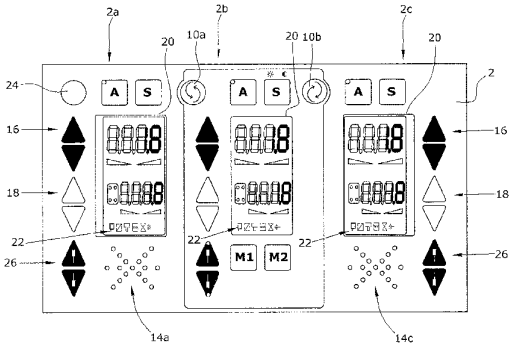
(74) Anwalt: **DALLMEYER, Georg**; Bahnhofsvorplatz 1, Deichmannhaus am Dom, 50667 Köln (DE).

(81) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO,

[Fortsetzung auf der nächsten Seite]

(54) **Title:** ROAD-MAKING MACHINE, LEVELLING DEVICE AND METHOD OF CONTROLLING THE CUTTING DEPTH OR CUTTING INCLINATION IN A ROAD-MAKING MACHINE

(54) **Bezeichnung:** STRAßENBAUMASCHINE, NIVELLIEREINRICHTUNG SOWIE VERFAHREN ZUM REGELN DER FRÄSTIEFE ODER FRÄSNEIGUNG BEI EINER STRAßENBAUMASCHINE



(57) **Abstract:** In a road-making machine (1) for working road surfaces, having a cutting drum (3) vertically adjustable with respect to the cutting depth, having a levelling device (4) with at least one controller (6a, 6c) which receives setpoints for the milling depth and/or the inclination of the cutting drum (3), and having at least one interchangeable sensor (A, B, C) or having a plurality of switchable sensors for detecting the current actual value of the cutting depth and/or of the inclination of the cutting drum (3) in relation to a reference surface, wherein the controller (5a, 6c) performs a milling-depth closed-loop control and/or an inclination closed-loop control for the cutting drum (3) as a function of predetermined setpoints and the currently measured actual values of the at least one sensor (A, B, C) by output of a manipulated variable for achieving or maintaining the setpoint during cutting operation, wherein the levelling device (4) has an indicating and setting device (2) for indicating and setting operating parameters for the at least one sensor (A, B, C), provision is made for the indicating and setting device (2) of the levelling device (4) to have, apart from an indicating and setting unit (2a, 2c) provided for the at least one currently used sensor (A, B), an additional indicating and setting unit (2b) for a selectable sensor (B) to be exchanged for the currently used sensor (A, C).

(57) **Zusammenfassung:** Bei einer Straßenbaumaschine (1) zum Bearbeiten von Straßenoberfiächen mit einer hinsichtlich der Frästiefe höhenverstellbaren Fräswalze (3), mit einer Nivelliereinrichtung (4) mit mindestens einem Regler (6a, 6c), der Sollwerte für die Frästiefe und/oder die Neigung der Fräswalze (3) erhält, und mit mindestens einem auswechselbaren Sensor (A, B, C) oder mit mehreren umschaltbaren

[Fortsetzung auf der nächsten Seite]

WO 2007/125017 A1

RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:
— *mit internationalem Recherchenbericht*

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

Sensoren zum Erfassen des aktuellen Istwertes der Frästiefe und/oder der Neigung der Fräswalze (3) in Relation zu einer Referenzfläche, wobei der Regler (5a, 6c) eine Frästiefenregelung und/oder eine Neigungsregelung für die Fräswalze (3) in Abhängigkeit von vorgegebenen Sollwerten und den aktuell gemessenen Istwerten des mindestens einen Sensors (A, B, C) durch Ausgabe eines Stellwertes zum Erreichen oder Einhalten des Sollwertes im Fräsbetrieb ausführt, wobei die Nivelliereinrichtung (4) eine Anzeige- und Einstelleinrichtung (2) zum Anzeigen und Einstellen von Betriebsparametern für den mindestens einen Sensor (A, B, C) aufweist, ist vorgesehen, die Anzeige- und Einstelleinrichtung (2) der Nivelliereinrichtung (4) außer einer für den mindestens einen aktuell eingesetzten Sensor (A, B) vorgesehenen Anzeige- und Einstelieinheit (2a, 2c) eine zusätzliche Anzeige- und Einstelleinheit (2b) für einen gegen den aktuell eingesetzten Sensor (A, C) auszuwechselnden und auswählbaren Sensor (B) aufweist.

Road construction machine, levelling device, as well as method for controlling the milling depth or milling slope in a road construction machine

The invention relates to a road construction machine a levelling device and a method for controlling milling depth or slope.

It is already known for road milling machines to integrate a levelling device by means of which it is to be ensured that an even milled surface can be produced.

The milling depth control system is designed in such a fashion that different sensors can be connected. Among others, the sensors used include, for example, wire-rope sensors, ultrasonic sensors and slope sensors.

A wire-rope sensor is mounted at the side plates (edge protection) next to the milling drum and thus scans the reference surface, in this case the road surface, very precisely. The ultrasonic sensor operates in a non-contact fashion and is therefore not subject to any mechanical wear and tear. It can be used in a variety of ways as it can be attached in different positions on the machine.

If a defined cross slope is to be produced, a slope sensor can also be used which is integrated into the road milling machine.

The known milling depth control system can be provided with two independent control loops. A controller is provided in each control loop to which the sensors can be connected via plug-in connectors. For example, either two height sensors are provided, or one height sensor in combination with one slope sensor.

It is unfavourable in the state of the art that the frequent change between the many different sensors, which is necessary for application-related reasons, is not possible without an interruption of the milling operation and without negative influences on the work result. To change the current sensor, the automatic mode of the control system needs to be left first as there is merely one controller, or merely one indication and setting device for set values and actual values per controller respectively. The new sensor can then be selected, and the desired set value can be set before it is

possible to change back into the automatic mode of the control system. If the road milling machine continued milling during changing of the sensor, faults in the work result could occur because no control is effected during that time. The machine therefore needs to be stopped for a change of the sensor, which leads to a significant time loss. An adverse effect on the work result ensues even if the road milling machine is stopped during change of the sensor because the milling drum cuts clear when standing. This is an unwelcome effect, in particular during fine milling.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

It is an aim of the invention to specify a road construction machine, as well as a levelling device and a method for controlling the milling depth and/or the milling slope, in which it is possible to change the sensors without any interruption of the milling operation.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

According to a first aspect of the present invention there is provided a road construction machine for the treatment of road surfaces with a milling drum height-adjustable with regard to the milling depth, with a levelling device with at least one controller which receives set values for the milling depth and/or the slope of the milling drum, and with at least one exchangeable sensor (A, B, C) or with several switchable sensors for registering the current actual value of the milling depth and/or the slope of the milling drum relative to a reference surface, where the controller effects a milling depth control and/or a slope control for the milling drum conditional on pre-determined set values and the currently measured actual values of the at least one sensor (A, B, C) by returning an adjustment value for achieving or maintaining the set value during the milling operation, and where the levelling device is provided with an indication and setting device for indicating and setting operating parameters for the at least one sensor (A, B, C),

w h e r e i n

the indication and setting device of the levelling device, in addition to an indication and setting unit provided for the at least one sensor (A, C) currently in use, is provided with an additional indication and setting unit for a selectable sensor (B) which is to be exchanged for the sensor (A, C) currently in use, and

wherein.

the levelling device is provided with a device for the switchover of sensors (A, B, C) which, upon activation of a switchover command, effects switchover of the levelling device from the at least one current sensor (A; C) to at least one pre-selected other sensor (B) without interruption of the milling operation and without any erratic alteration of the current adjustment value for the setting of the milling depth and/or for the setting of the slope of the milling drum.

Providing a further indication and setting unit offers the advantage that the new sensor, which is to be exchanged for a sensor currently in use, can be prepared for the time of switchover in terms of its actual and set values while the operation continues. At the time of switchover, the sensor can therefore be changed without any alteration of the currently applicable adjustment value. The levelling device is provided with a device for the switchover of sensors which, upon activation of a switchover command, effects switchover of the levelling device from the at least one current sensor to at least one pre-selected other sensor without interruption of the milling operation and without any erratic alteration of the current adjustment value for the setting of the milling depth and/or for the setting of the slope of the milling drum.

The switchover device, with the indication and setting device, enables a pre-selection of the other sensor and the pre-setting of operating parameters (set values and actual values) of the other pre-selected sensor.

In this way, a machine operator can already prepare the switchover of the sensors during the milling operation so that switchover of the sensors is possible at the push of a button without any time loss and without an interruption of the milling operation.

For this purpose, the levelling device is provided with an indication and setting device which is capable of indicating and altering the data of the current sensor and the data of the pre-selected sensor. By means of the switchover device, switching over from

the current sensor to the pre-selected sensor can be effected during the milling operation without any repercussion on the work result.

One embodiment of the invention provides that the currently measured actual value for the milling depth and/or for the slope of the milling drum of the at least one pre-selected other sensor can be set, latest at the time of switchover, to the same, last measured actual value for the milling depth and/or for the slope of the previously used sensor.

It is therefore possible, when changing the sensor, to apply the actual value of the sensor last used, so that the adjustment value for the setting of the milling depth and/or for the setting of the slope of the milling drum is not altered on account of the change, and that the evenness of the milled road surface is not adversely affected by the change of the sensor.

An alternative embodiment provides that the set value for the milling depth and/or for the slope of the milling drum can be set, latest at the time of switchover, to the currently measured actual value for the milling depth of the at least one pre-selected sensor.

Equating the set value to the currently measured actual value of the pre-selected sensor which will replace the previous sensor ensures that no alteration of the adjustment value for the setting of the milling depth and/or the slope will be made at the time of switchover.

A third embodiment provides that, in case of a deviation of the measured actual values of the selected other sensor from the previously used sensor, the adjustment value for the setting of the milling depth and/or the setting of the slope can be altered by means of a pre-settable transition function.

According to a further alternative, it is therefore provided that, in case that an alteration of the current adjustment value results on account of the switchover of the sensors, said alteration follows a pre-settable transition function starting from an adjustment value of 0. It is thereby achieved that the alteration of the adjustment value is not effected in an erratic fashion, so that the evenness of the milled road surface is not adversely affected and adaptation to the adjustment value resulting on account of the switchover is effected over a longer distance, for example, over 10 m or more.

It is preferably provided that the levelling device is provided with two controllers, the sensors of which are arranged parallel to the rotating axis of the milling drum at a lateral distance to one another, and which preferably control the milling depth independently of one another on the left and right side of the machine.

In a second aspect, the invention also relates to a levelling device a levelling device for a height-adjustable milling drum of a road construction machine in accordance with the first aspect of the invention, with at least one controller which receives memorizable set values for the milling depth and/or the slope of the milling drum, and with at least one exchangeable sensor (A, B, C) or with several switchable sensors (A, B, C) for registering the current actual value of the milling depth and/or the slope of the milling drum relative to a chosen reference surface, where the controller effects a milling depth control and/or a slope control for the milling drum conditional on pre-determined set values and the currently measured actual values by returning an adjustment value for achieving or maintaining the set value for the milling depth and/or milling slope during the milling operation, where the levelling device is provided with an indication and setting device for setting operating parameters for the at least one sensor (A, B, C),

w h e r e i n

the indication device of the levelling device, in addition to an indication and setting unit provided for the at least one sensor (A, C) currently in use, is provided with an additional indication and setting unit for a selectable sensor (B) which is to be exchanged for the sensor (A, C) currently in use, and wherein

a device is provided for the switchover of sensors (A, B, C) which, upon activation of a switchover command, effects switchover of the sensors (A, B, C) from the at least one current sensor (A; C) to at least one pre-selected other sensor (B) without interruption of the milling operation and without any erratic alteration of the current adjustment value for the setting of the milling depth and/or for the setting of the slope.

According to a third aspect of the invention there is provided a method for controlling the milling depth or milling slope of the milling drum of a road construction machine by registering the current actual value of the milling depth and/or the slope of the milling drum relative to a reference surface using at least one exchangeable or switchable sensor (A, B, C), where a milling depth control and/or a slope control for the milling drum is effected conditional on pre-determined set values and currently measured actual values during the milling operation by returning an adjustment value for achieving or maintaining the set value,

w h e r e i n

when exchanging a currently used sensor (A, C) for a pre-selected other sensor (B), the control of the milling depth and/or the slope is effected, without interruption of the milling operation, by setting the set values and actual values of the sensor (B) by means of an additional indication and setting unit, prior to switchover, in such a fashion that the current adjustment value for the setting of the milling depth and/or for the setting of the slope of the milling drum is not altered in an erratic fashion.

Upon activation of a switchover command for the switchover of sensors, the control is effected without an interruption of the milling operation and without an erratic alteration of the current adjustment value for the setting of the milling depth and/or for the setting of the slope of the milling drum.

The road surface or a defined horizontal plane pre-determined, for instance, by a laser, or any other freely definable pre-selected surface can be used as reference surface, which may show a different slope or gradient (positive or negative) in the course of the road surface.

In the following, embodiments of the invention are explained in more detail with reference to the drawings:

The following is shown:

Fig. 1 a road construction machine,

Fig. 2 a levelling device,

Fig. 3 an indication and setting device,

Fig. 4 matching of the actual values of different sensors at switchover,

Fig. 5 matching of the set value to the actual value of a new sensor at switchover,

Fig. 6a to Fig. 6b the change from a milling depth control to a milling slope control,

Fig. 7a to 7c the switchover procedure with matching of the set values, and

Fig. 8a to 8d a switchover with matching of the actual and set values.

Fig. 1 shows a road machine 1 for the treatment of road surfaces with a milling drum 3 height-adjustable with regard to the milling depth. The front travel drive unit supports itself on, for instance, the road surface 12, which can serve as reference surface for a milling depth control or slope control. For this purpose, the road machine 1 is provided with a levelling device 4 with at least one controller 6a, 6c which receives set values for the milling depth and/or the slope of the milling drum 3. Exchangeable sensors A, B, C can be connected to the controllers 6a, 6c of the levelling device 4. The sensors A, B, C serve the purpose of registering the current actual value of the milling depth and/or the slope of the milling drum 3 relative to a reference surface, which may consist in the road surface 12, a pre-determined horizontal plane or a freely definable, for instance, mathematically pre-determined plane or surface.

The at least one controller 6a, 6c effects a milling depth control and/or a slope control for the milling drum 3 conditional on pre-determined set values and the currently measured actual values of the at least one sensor A, B, C, with an adjustment value being returned for achieving or maintaining the set value in the milling operation. As follows from Fig. 2, the levelling device 4 is provided with an indication and setting device which is divided into three nearly identical indication and setting units 2a, 2b, 2c. The indication and setting device 2 serves the purpose of setting operating parameters for the sensors A, B, C. Set values and actual values of the sensors A, B, C can be set in each indication and setting unit 2a, 2b, 2c. The indication and setting units 2a and 2c right and left are each connected to a controller 6a, 6c which can be activated by means of an automatic button to effect the corresponding control automatically. The controllers remain in automatic mode during switchover. The adjustment value of the controllers 6a, 6c resulting from the difference of the set value and actual value is

indicated qualitatively by arrows 14, with the indication unit being capable of indicating the vertical traverse speed of the machine proportionally, meaning quantitatively, as well. The pre-determined set values and actual values of the central indication and setting unit 2b, which is coupled to a selectable sensor B that is to be exchanged for the currently used sensor A or C, can be interchanged, by means of a switchover device 10a or 10b, with the set values and actual values of the sensor A or C that is to be exchanged for a selectable other sensor B.

The embodiment shows a version in which one controller each 6a, 6c is provided for one side of the road construction machine 1. It is understood that the indication and setting device 2 may also be provided with merely two indication and setting units if merely one controller is present, where one sensor is exchanged for another selectable sensor.

The number of indication and setting units provided is therefore always larger by one than the number of the sensors in use.

Fig. 2 shows the connection of sensors A, B, C to the levelling device 4 with two controllers 6a, 6c, where the levelling device is provided with an indication and setting device 2 with three indication and setting units 2a, 2b, 2c.

Fig. 3 shows an embodiment of the indication and setting device 2, wherein setting buttons 16 (up and down) for the setting of set values, as well as setting buttons 18 (up and down) for the adjustment of measured actual values are present for each indication and setting unit 2a, 2b, 2c.

The currently adjusted set values and the currently measured actual values of the sensors A, B, C are indicated on the displays 20 of the indication and setting units 2a, 2b, 2c. The direction of a possibly set slope of the milling drum can also be indicated on the displays 20. Furthermore, units are indicated, for example, in inch or cm, or percentages in % relating to the value indicated.

A choice of sensors is indicated at the lower end 22 of the display 20, enabling a machine operator to determine by means of the current indication as to which type of sensor is currently indicated on the indication and setting unit 2a, 2b, 2c.

The symbols represent, from left to right, a wire-rope sensor, a slope sensor, an ultrasonic sensor, a multiplex sensor, a total station, as well as a laser for pre-determining the reference surface.

Above the displays 20, one button each is provided for the automatic mode and for the setting mode to set the controller parameters. A horn 24, as well as buttons 26 for adjusting the height of the travel drive unit may also be provided on the indication and setting device 2. Two memory buttons M1, M2 for memorizing set values are additionally provided below the display 20 on the central indication and setting unit 2b.

Various possibilities of how to avoid an erratic alteration of the current adjustment value are explained in Figs. 4 to 6.

In the embodiment of Fig. 4, the measured actual value of the pre-selected sensor B is equated to the last measured current actual value of the previously used sensor A at the time of switchover.

In Fig. 5, the pre-determined set value is adapted to the currently measured actual value of the pre-selected sensor B so that, also in this case, there is no alteration of the adjustment value.

In case of a deviation of the measured actual values of the previously used sensor A from the pre-selected new sensor B, the adjustment value can, as an alternative to the embodiments of Figs. 4 and 5, also change into the adjustment value that results on account of the differences in the actual values by means of a transition function. A temporal transition therefore takes place by means of which no erratic alteration of the adjustment value can occur.

Figs. 6a and 6b show a switchover procedure in compensated condition. Fig. 6a shows the initial situation in which the indication and setting unit 2c, which is linked to the controller 6c, is to be switched over from the operating mode milling depth (set value 10,0 cm) to the operating mode milling slope (set value 2%). Switchover takes place in compensated condition. This means that the respective actual value on both sides of the machine corresponds to the set value, and that the adjustment value is therefore 0 on both sides. The compensated

condition is indicated by the indication and setting device 14a, 14c through a horizontal bar. It is evident from Fig. 6b that, when actuating the switchover button 10b of the switchover device 10, the pre-selected set values and actual values are interchanged from the indication and setting unit 2b to the indication unit 2c, and are taken as the basis in continued automatic mode for a mixed milling depth and milling slope control.

Figs. 7a to 7c show the switchover procedure with matching of the set values.

In this example, the adjustment values on both sides of the machine are unequal 0. The indication and setting unit 2c of the controller 6c is switched over from milling depth control to milling slope control. The set value of the slope is adapted manually in Fig. 7b by actuating the buttons 16, so that no erratic alteration of the adjustment value will occur. It is assumed in this example that the adjustment value is proportional to the control deviation (P controller), and that the proportionality factor for the milling depth and milling slopes is equal numerically. The control deviation is 0.3 cm for the milling depth (indication and setting unit 2c in Fig. 7a), and 0.6% for the milling slope (indication and setting unit 2b in Fig. 7a) so that the adjustment value would therefore double in terms of value after switchover. In order to match the control deviation, the set value of the slope is reduced to 2.0, which results in an equal control deviation numerically. This can be effected manually via the button 16 "reduce set value", or automatically, for example, via the button combination 16, 18 "increase actual value and reduce set value" (Fig. 7b).

By actuating the switchover button 10b in the illustration according to Fig. 7c, the set value and actual value of the milling slope is applied, as indicated by arrows in Fig. 7c. In this process, the adjustment value remains unchanged.

An additional embodiment not shown may provide automatic matching of the set values. In such an embodiment, the alteration of the set values in the embodiment of Figs. 7a to 7c mentioned before is effected automatically when the switchover button 10b (or 10a) is actuated in automatic mode. The first step of the manual alteration of the values in the central indication and setting unit 2b (Fig. 7) can then be dispensed with as it is effected automatically.

A further variant not shown consists in altering, in case of a deviation of the actual values, the adjustment value by means of a pre-set transition function, starting from the current adjustment value.

Figs. 8a and 8d show an embodiment with matching of the actual values and set values.

The initial situation shown in Fig. 8a indicates, with regard to the controller 6c on the right side, the values of a milling depth sensor C, for example, a wire-rope sensor mounted at the edge protection, while the central indication and setting unit 2b indicates the values of a milling depth sensor B, for example, an ultrasonic sensor with scanning point in front of the milling drum.

The milling depth sensor C is to be replaced by the milling depth sensor B, where the set values and actual values of the two sensors B, C do not match. However, the current adjustment value equals 0, as is evident from the indication device 14a, 14c.

As sensor B is adjusted differently, its actual value does not match the actual value of sensor C. It can be equated to the actual value of sensor A by means of the actual value setting buttons 18 either manually or automatically, for example, by keeping the two actual value setting buttons 18 pressed for an extended period of time.

Figs. 8c and 8d show the matching procedure of the set values. As the set value of the two sensors B, C relates to the milling depth on the right, the set value of sensor B is to be adapted to the set value of sensor C. This can be effected via set value setting buttons or automatically, for example, by keeping the two set value setting buttons pressed for an extended period of time.

Following actuation of the right switchover button 10b, the set value and actual value of sensor B are applied. The adjustment value remains 0 and is thus unchanged.

All embodiments indicate the set values and actual values of the pre-selected sensor B, which is to be exchanged for a previously used sensor C, in the indication

and setting unit 2b. It is possible in this way to pre-set all setting values (set values and actual values) of the pre-selected sensor B, and to adapt them to the previously used sensors A, C or their set values or actual values respectively even prior to entering a switchover command via the switchover buttons 10a or 10b. Upon actuation of the switchover button 10a of the switchover device 10, the pre-selected sensor is exchanged with the sensor A that is currently used on the left side of the road construction machine 1.

As already explained before in connection with the embodiment of Fig. 7, instead of effecting equalization of the set values manually, equalization of the set values can also be effected automatically when actuating the switchover button 10b (or 10a) in automatic mode.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. Road construction machine for the treatment of road surfaces with a milling drum height-adjustable with regard to the milling depth, with a levelling device with at least one controller which receives set values for the milling depth and/or the slope of the milling drum, and with at least one exchangeable sensor (A, B, C) or with several switchable sensors for registering the current actual value of the milling depth and/or the slope of the milling drum relative to a reference surface, where the controller effects a milling depth control and/or a slope control for the milling drum conditional on pre-determined set values and the currently measured actual values of the at least one sensor (A, B, C) by returning an adjustment value for achieving or maintaining the set value during the milling operation, and where the levelling device is provided with an indication and setting device for indicating and setting operating parameters for the at least one sensor (A, B, C),

w h e r e i n

the indication and setting device of the levelling device, in addition to an indication and setting unit provided for the at least one sensor (A, C) currently in use, is provided with an additional indication and setting unit for a selectable sensor (B) which is to be exchanged for the sensor (A, C) currently in use, and wherein.

the levelling device is provided with a device for the switchover of sensors (A, B, C) which, upon activation of a switchover command, effects switchover of the levelling device from the at least one current sensor (A; C) to at least one pre-selected other sensor (B) without interruption of the milling operation and without any erratic alteration of the current adjustment value for the setting of the milling depth and/or for the setting of the slope of the milling drum.

2. Road construction machine in accordance with claim 1, wherein the currently measured actual value for the milling depth and/or for the slope of the milling drum of the at least one selected other sensor (B) can be set, latest at the time of switchover, to the same, last measured actual value for the milling depth and/or for the slope of the previously used sensor (A; C).

3. Road construction machine in accordance with claim 1, wherein the set value for the milling depth and/or for the slope of the milling drum can be set, latest at the time of switchover, to the currently measured actual value for the milling depth of the at least one selected sensor (B).

4. Road construction machine in accordance with claim 1, wherein in case of a deviation of the measured actual values of the selected other sensor (B) from the previously used sensor (A; C), the adjustment value for the setting of the milling depth and/or the setting of the slope can be altered by means of a pre-settable transition function.

5. Road construction machine in accordance with any one of the claims 1 to 4, wherein the switchover device is provided with an indication and setting device which enables a pre-selection of the other sensor (B) and the pre-setting of operating parameters of the other sensor (B).

6. Road construction machine in accordance with anyone of the claims 1 to 5, wherein the levelling device is provided with two controllers, the sensors (A, C) of which are arranged parallel to the rotating axis of the milling drum at a lateral distance to one another, and which control the milling depth independently of one another on the left and right side of the machine.

7. Levelling device for a height-adjustable milling drum of a road construction machine in accordance with the first aspect of the invention, with at least one controller which receives memorizable set values for the milling depth and/or the slope of the milling drum, and with at least one exchangeable sensor (A, B, C) or with several switchable sensors (A, B, C) for registering the current actual value of the milling depth and/or the slope of the milling drum relative to a chosen reference surface, where the controller effects a milling depth control and/or a slope control for the milling drum conditional on pre-determined set values and the currently measured actual values by returning an adjustment value for achieving or maintaining the set value for the milling depth and/or milling slope during the milling operation, where the levelling device is provided with an indication and setting device for setting operating parameters for the at least one sensor (A, B, C),

w h e r e i n

the indication device of the levelling device, in addition to an indication and setting unit provided for the at least one sensor (A, C) currently in use, is provided with an additional indication and setting unit for a selectable sensor (B) which is to be exchanged for the sensor (A, C) currently in use, and wherein

a device is provided for the switchover of sensors (A, B, C) which, upon activation of a switchover command, effects switchover of the sensors (A, B, C) from the at least one current sensor (A; C) to at least one pre-selected other sensor (B) without interruption of the milling operation and without any erratic alteration of the current adjustment value for the setting of the milling depth and/or for the setting of the slope.

8. Device in accordance with one of the claims 1 to 7, characterized in that the reference surface is a road surface.

9. Device in accordance with one of the claims 1 to 7, characterized in that the reference surface is a horizontal plane.

10. Device in accordance with one of the claims 1 to 7, characterized in that the reference surface is a freely definable pre-selected plane.

11. Method for controlling the milling depth or milling slope of the milling drum of a road construction machine by registering the current actual value of the milling depth and/or the slope of the milling drum relative to a reference surface using at least one exchangeable or switchable sensor (A, B, C), where a milling depth control and/or a slope control for the milling drum is effected conditional on pre-determined set values and currently measured actual values during the milling operation by returning an adjustment value for achieving or maintaining the set value,

w h e r e i n

when exchanging a currently used sensor (A, C) for a pre-selected other sensor (B), the control of the milling depth and/or the slope is effected, without interruption of the milling operation, by setting the set values and actual values of the sensor (B) by means of an additional indication and setting unit, prior to switchover, in such a fashion that the current adjustment value for the setting of the milling depth and/or for the setting of the slope of the milling drum is not altered in an erratic fashion.

12. Method in accordance with claim 11, wherein, when switching over from the last used sensor (A; C) to the pre-selected other sensor (B), the current actual value of the other sensor (B) is set to the same, last measured actual value of the last used sensor (A; C).

13. Method in accordance with claim 12, wherein, when switching over from the last used sensor (A; C) to the pre-selected sensor (B), the currently pre-determined set value is set to the actual value of the other sensor (B).

14. Method in accordance with claim 11, wherein, when switching over from the last used sensor (A; C) to the pre-selected sensor (B), in case of a deviation of the actual values of the selected other sensor (B) from the previously used sensor (A; C), the currently measured set value is altered by means of a pre-settable transition function starting from the current adjustment value at the time of switchover to the adjustment value resulting on account of the difference in the actual values.

15. A road construction machine substantially as hereinbefore described with reference to the accompanying drawings

16. A method for controlling the milling depth or milling slope of the milling drum of a road construction machine substantially as hereinbefore described with reference to the accompanying drawings

17. A levelling device for a height-adjustable milling drum of a road construction machine substantially as hereinbefore described with reference to the accompanying drawings

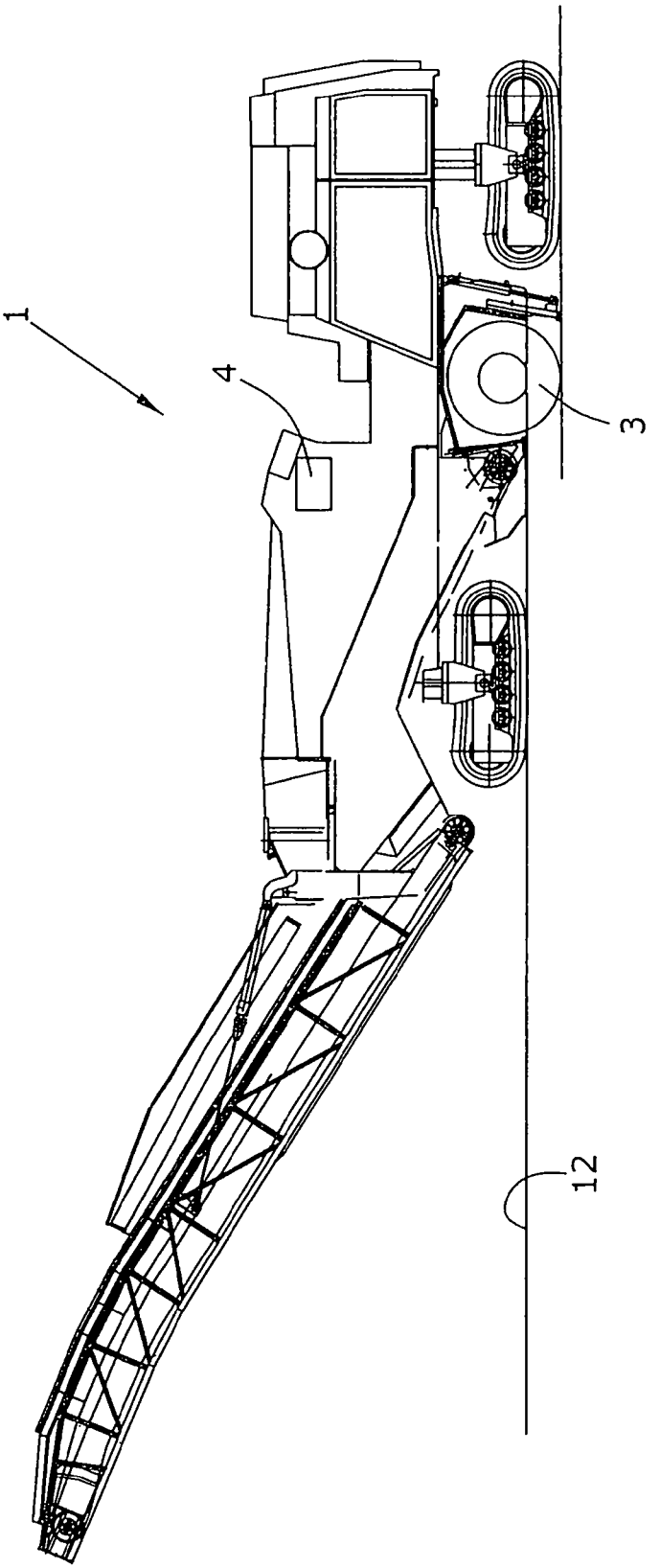


Fig.1

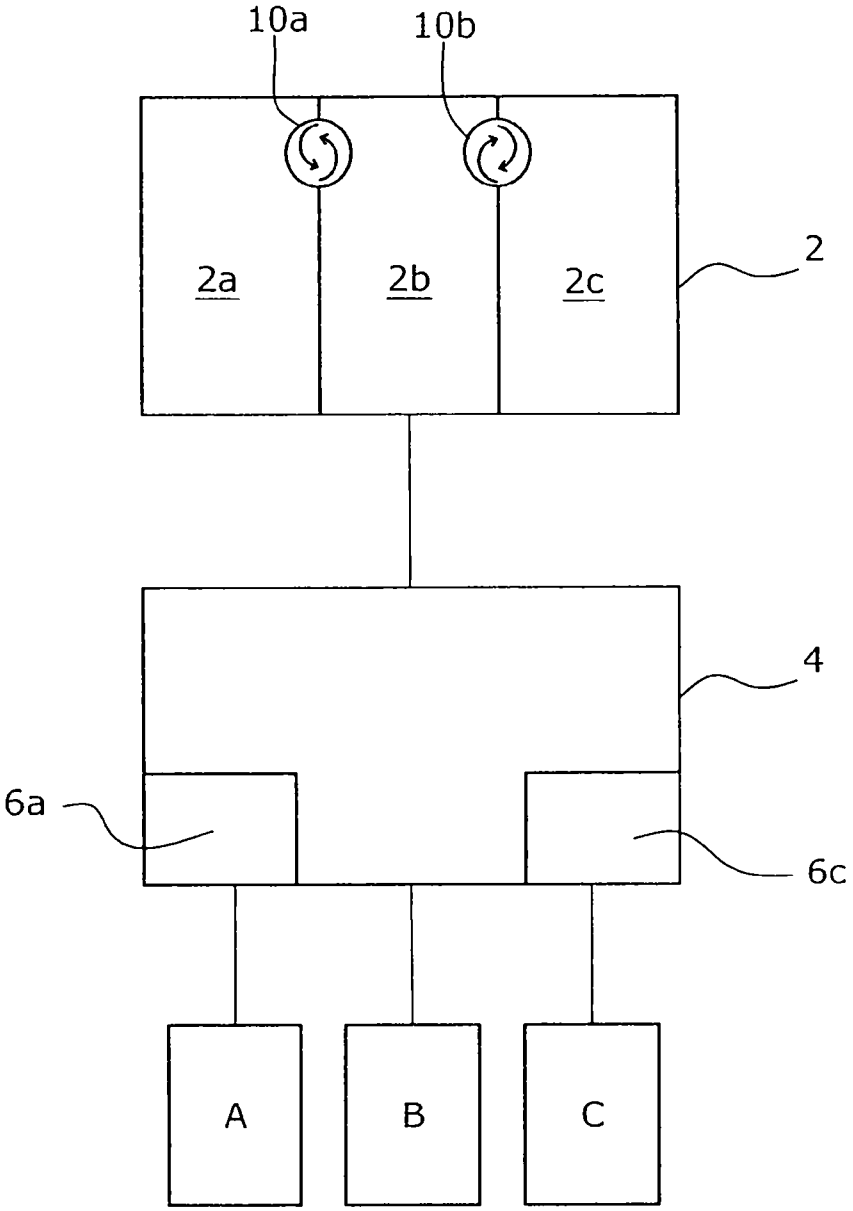


Fig.2

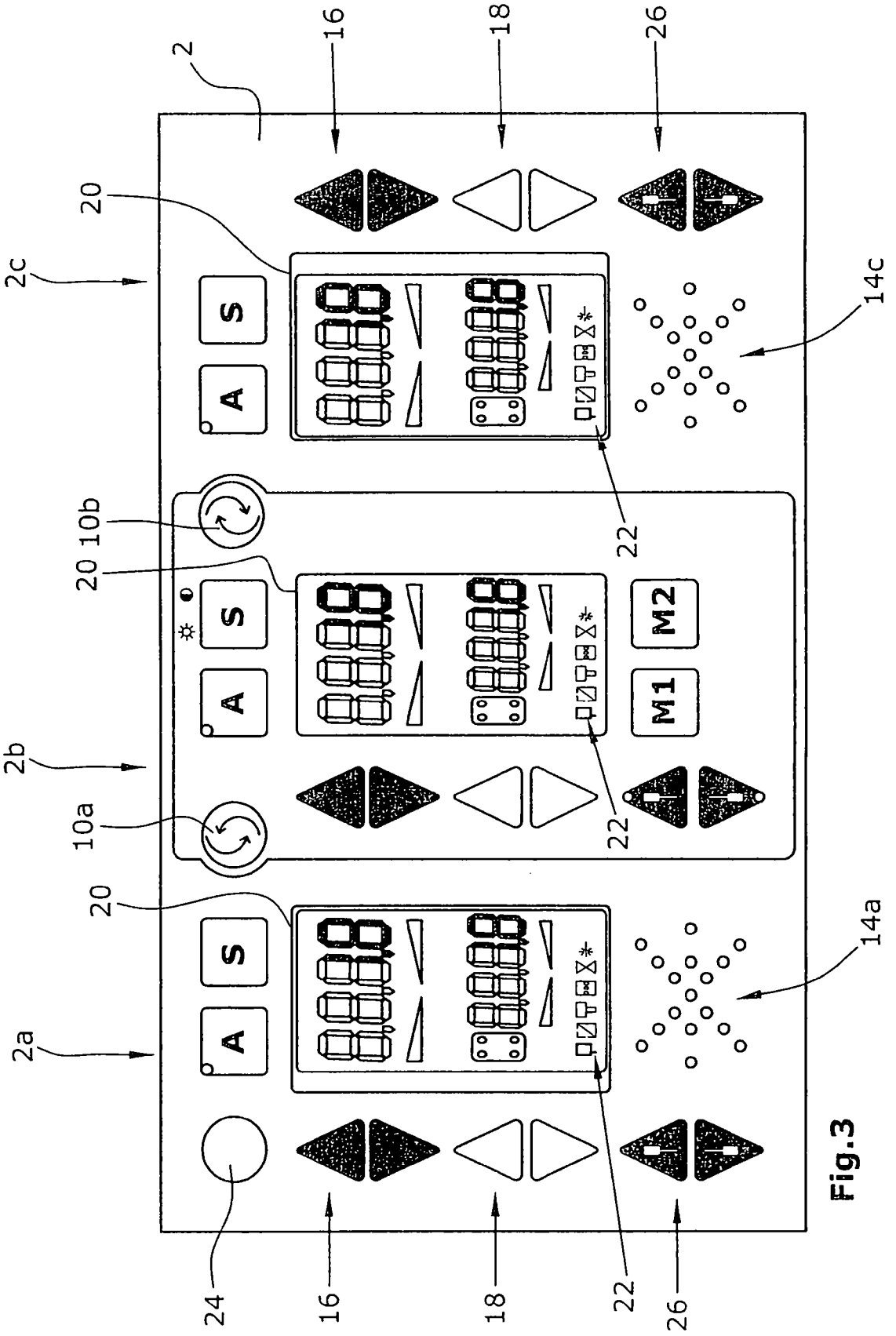


Fig.3

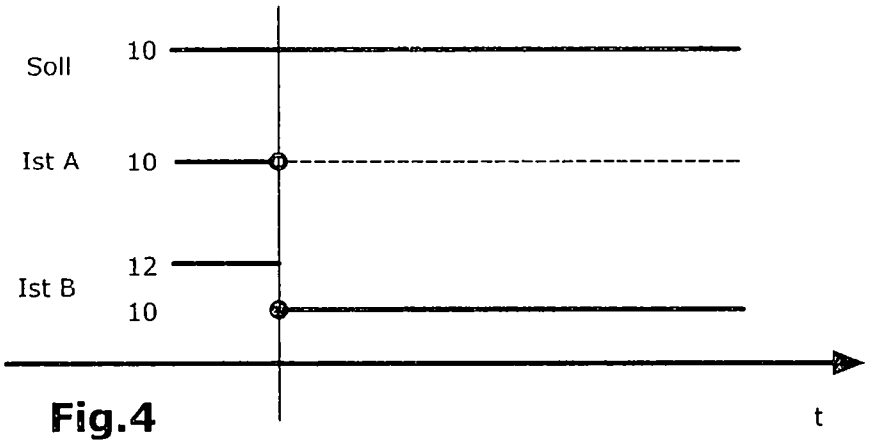


Fig.4

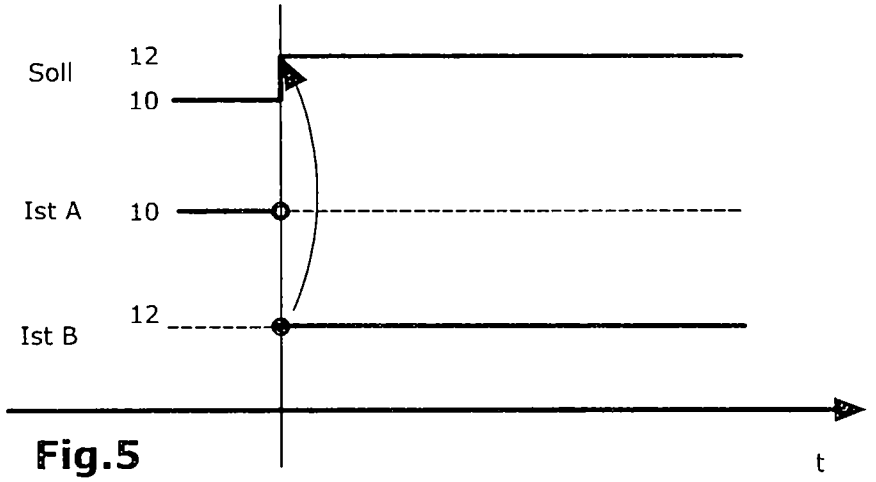


Fig.5

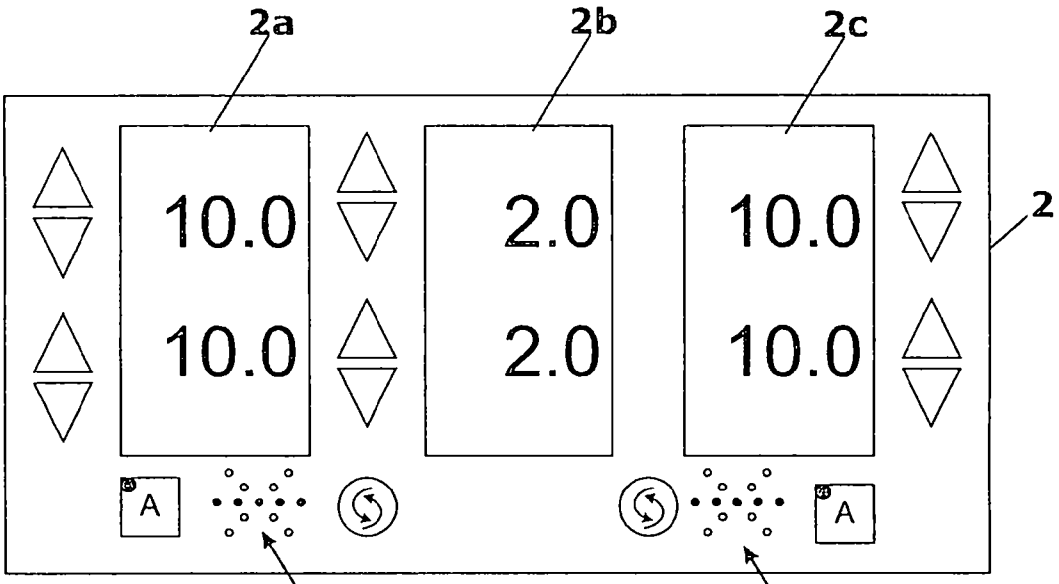

2a
2b
2c
10.0
10.0
2.0
2.0
10.0
10.0
2
A
A
14a
14c

Fig.6a

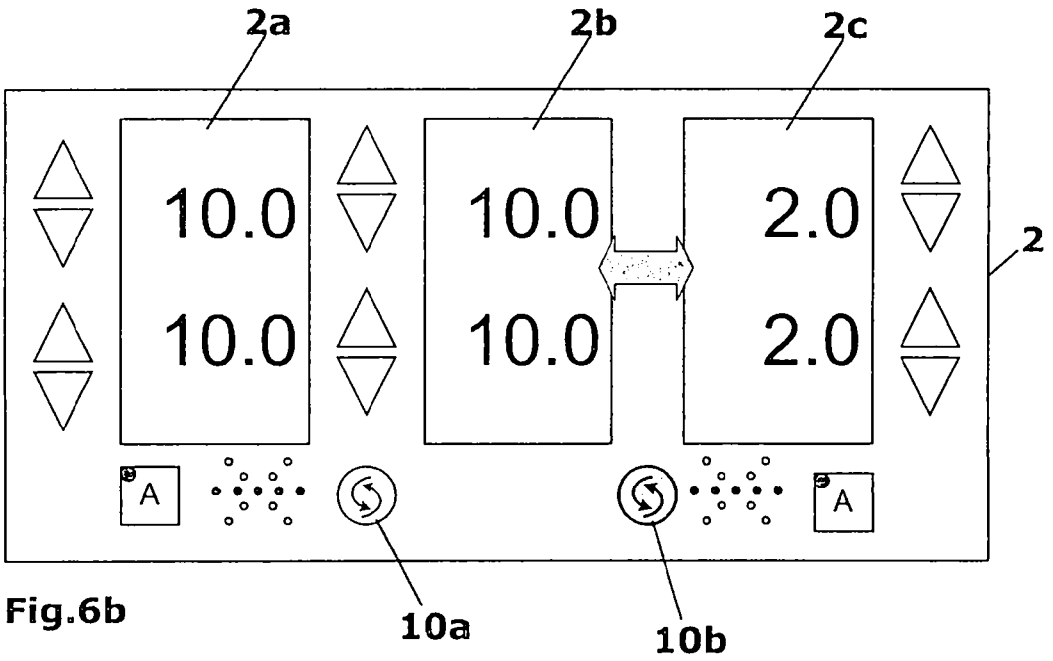

2a
2b
2c
10.0
10.0
10.0
10.0
2.0
2.0
2
A
A
10a
10b

Fig.6b

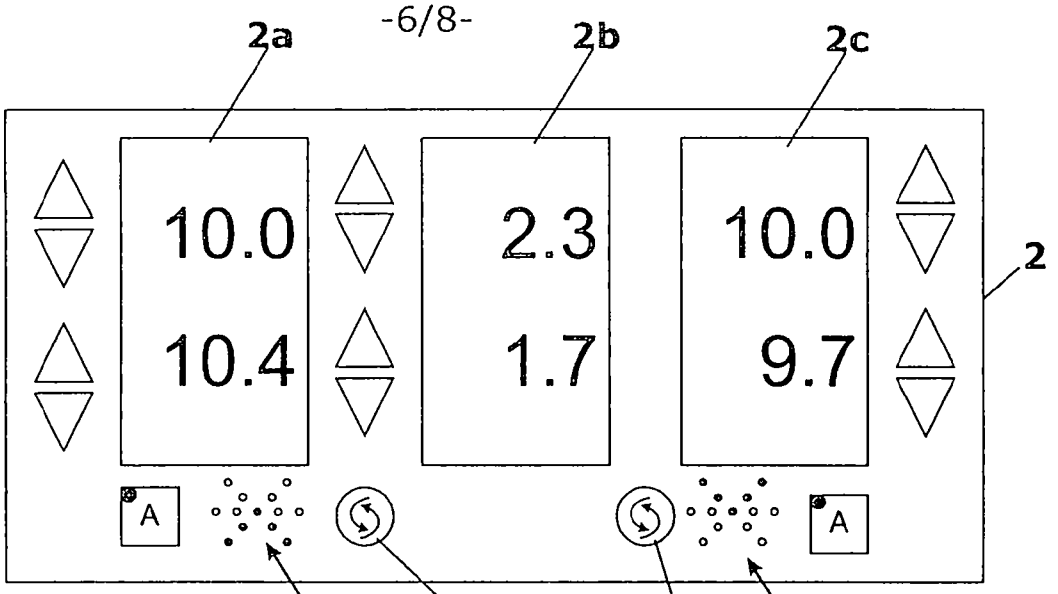


Fig.7a

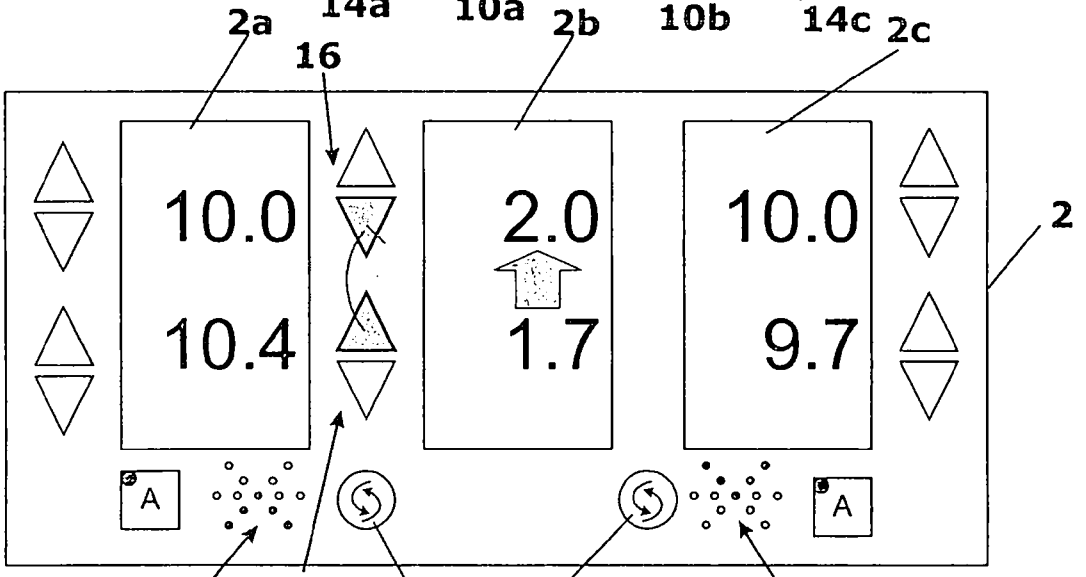


Fig.7b

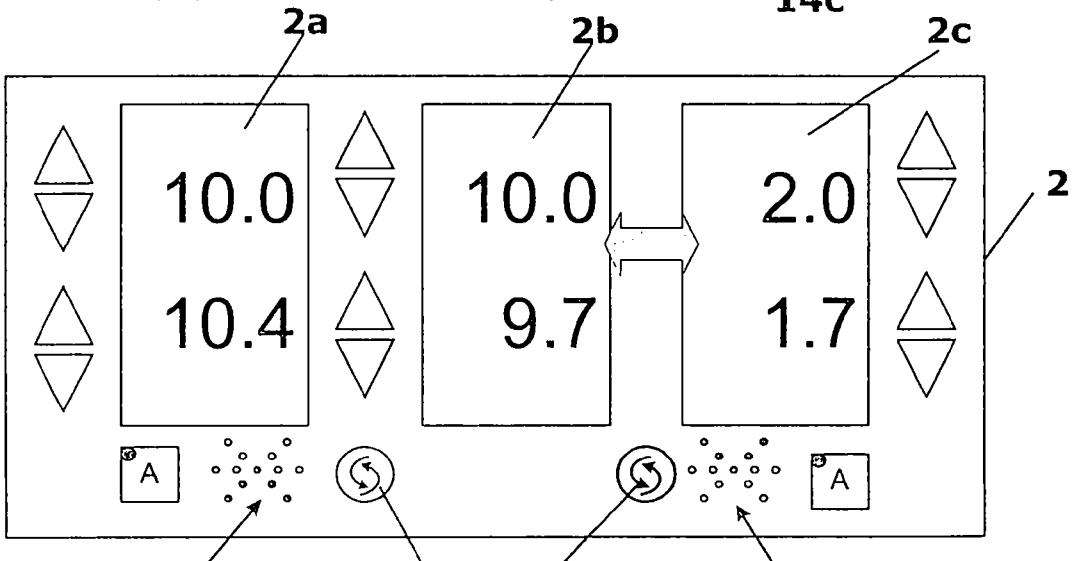


Fig.7c

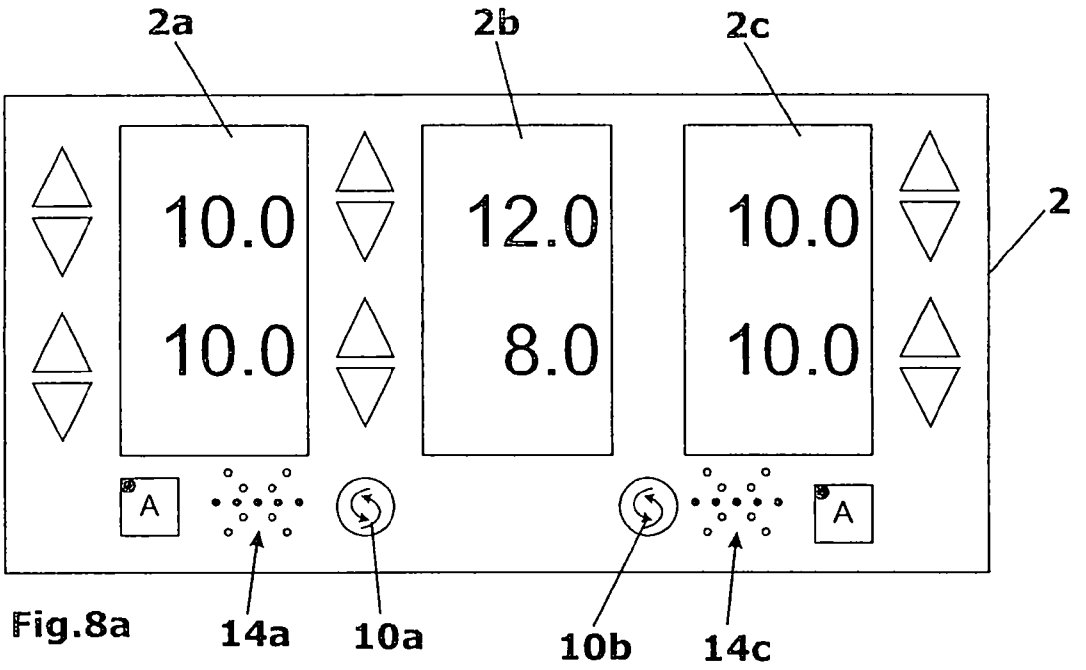

2a
2b
2c
10.0
10.0
12.0
8.0
10.0
10.0
2
A
A
14a
10a
10b
14c

Fig.8a

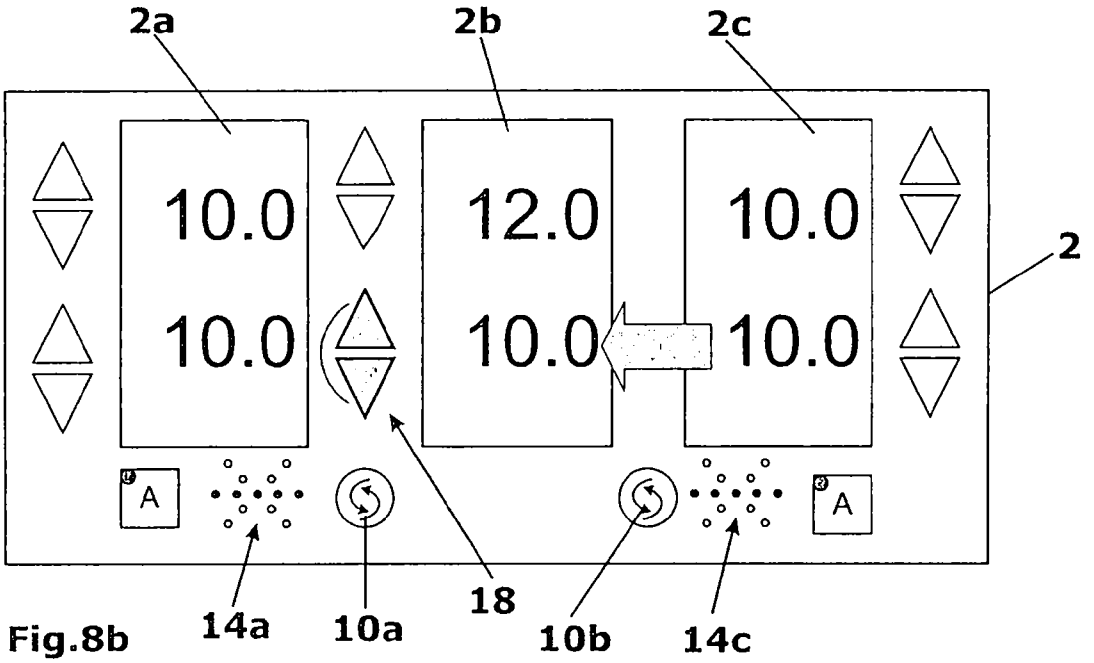

2a
2b
2c
10.0
10.0
12.0
10.0
10.0
10.0
2
A
A
14a
10a
18
10b
14c

Fig.8b

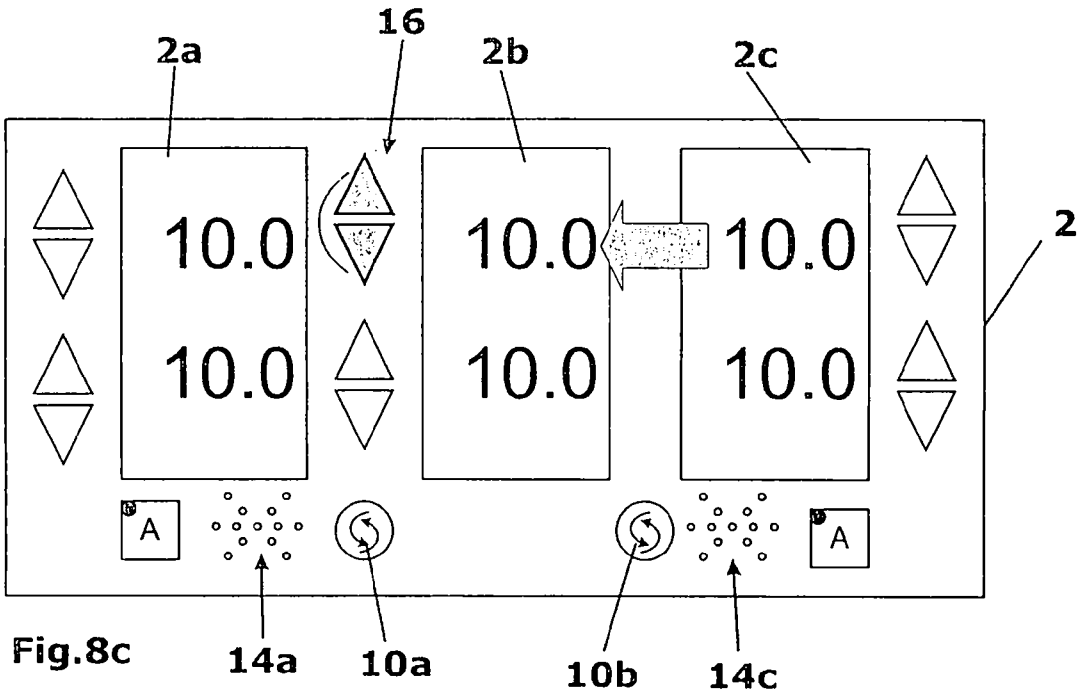

16
2a
2b
2c
10.0
10.0
10.0
10.0
10.0
10.0
2
A
A
14a
10a
10b
14c

Fig.8c

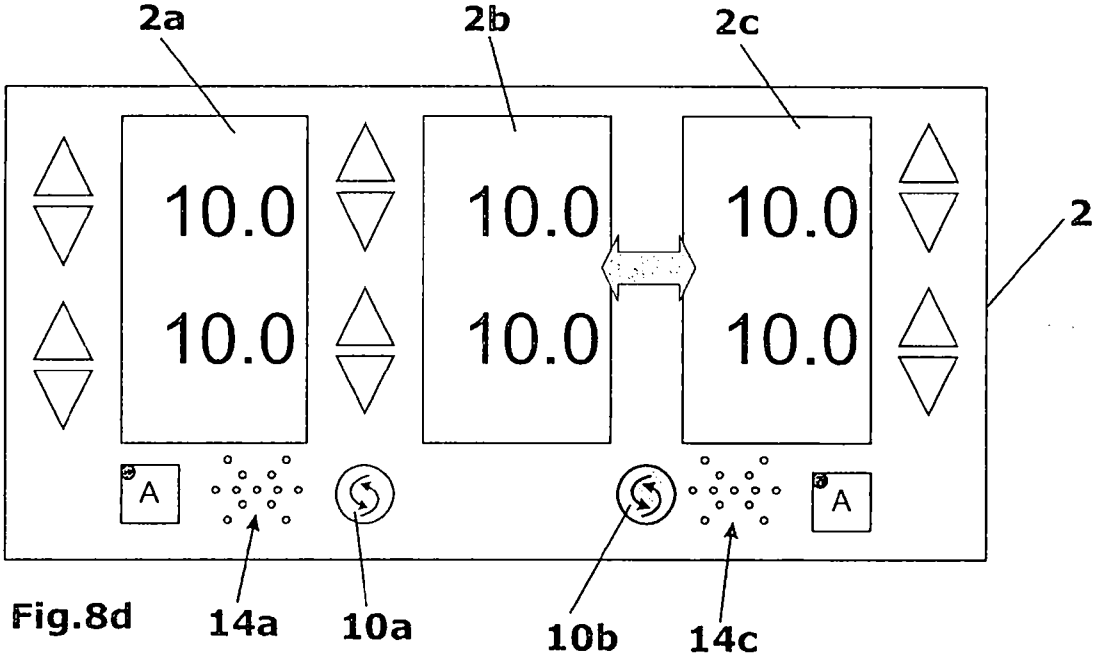

2a
2b
2c
10.0
10.0
10.0
10.0
10.0
10.0
2
A
A
14a
10a
10b
14c

Fig.8d