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(54) **METHOD FOR MACHINING A GLASS PANE**

VERFAHREN ZUM BEARBEITEN EINER GLASSCHEIBE

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- **HALTER, Alfred**
5103 Möriken (CH)
- **GLOOR, Marcel**
4900 Langenthal (CH)

(30) Priority: **09.11.2017 EP 17200843**

(74) Representative: **Blaser, Stefan**
Ammann Patent Attorneys Ltd.
Schwarztorstrasse 31
P.O. Box 5135
3001 Berne (CH)

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(73) Proprietor: **Glaston Switzerland AG**
4922 Bützberg (CH)

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(72) Inventors:

- **STAPF, Alexander**
4922 Bützberg (CH)

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Description

[0001] The present invention relates to a method for machining a glass pane, wherein the edge of the glass pane is machined using at least one grinding tool, in that the glass pane and the grinding tool are moved relative to one another.

[0002] Such a method is known, for example, from patent application EP 0 255 476 A1 by the present applicant. In the production of glass panes, which are to have a predetermined shape, grinding of the edge is used to obtain the exact desired final dimensions and/or to give the edge the desired profile (angular or rounded, for example). To allow precise grinding so that the edge is machined uniformly all the way around, correspondingly accurate information is required concerning the position of the glass pane or of the edge with respect to the position of the grinding tool. This information may be too imprecise when, for example, the device is to be used for grinding a new pane shape and therefore must be reconfigured. It is also possible that changes in length of the device may occur after the configuration, for example due to temperature fluctuations, so that during the machining a glass pane is no longer exactly in the position assumed by the device.

[0003] The patent application JP 2007 136632 A describes a method, in which the parallel longitudinal sides of a glass sheet are ground by means of two grinding wheels. The currents flowing in the driving motors are shown on a display device in form of two waveforms. There are no measures provided to rectify the problem mentioned above of inaccurate machining due to inaccurate information on the position of the glass pane.

[0004] An object of the present invention is to provide a method that allows precise machining of the edge of a glass pane.

[0005] A method that achieves this object is defined in claim 1. The further claims set forth preferred embodiments of the method, a device with which the method can be carried out, a computer program, and a data carrier.

[0006] The offset of the glass pane with respect to a target position, i.e. desired position, can be determined by detecting and evaluating a variable that is a function of the power consumption of the motor used to drive the grinding tool. This allows correction of a possible offset and precise grinding of the glass panes. For example, the current of the motor may be used as such a variable. In addition, configuring the device for machining a new glass pane shape is simplified, and series production may be monitored to ensure that the ground edges have the desired quality.

[0007] The method according to the invention allows a precise machining of any shape of the glass pane, not only a rectangular shape, but any shape, i.e. a shape having a contour composed of straight and/or curved sections.

[0008] The glass pane to be machined may be e.g. placed on a support to define the actual position. The

latter may deviate from the target position by an offset. The offset may be considered as a displacement in the plane P defined by the backside of the glass pane. The displacement may be a linear and/or rotational one. During machining the glass pane and at least one grinding tool may be moved relative to one another in the plane P.

[0009] The offset of the glass pane is defined by one or more of the following parameters:

- a shift along a first linear axis,
- a shift along a second linear axis,
- a rotation around a rotation axis.

[0010] Preferably, at least one of the following conditions is met:

- the first linear axis extends in the plane P,
- the second linear axis extends in the plane P,
- the first and second linear axes are arranged at angle to each other, preferably they are arranged transversally to each other, most preferably they are perpendicular to each other,
- the rotation axis extends perpendicularly to the plane P.

[0011] At least one of the three parameters mentioned above (shift along first/second linear axis, rotation around a rotation axis) is determined in the method by detecting and evaluating the variable being a function of the power consumption of the motor used to drive the grinding tool. To improve the precision in machining the glass panes, it is not necessary to determine all of said parameters. This may be e.g. the case when one or more parameters is/are less dominant than another one. For instance, the rotation between the actual and target position may be small and therefore negligible and/or the shift between the actual and target position may tend to be greater along a particular axis than along another axis.

[0012] Preferably, the offset is determined in units of length and/or in angular units. This may be achieved e.g. by calibration measurements.

[0013] Preferably, the offset is determined by calculations performed by means of a controller. The latter may be provided with a program configured to calculate the offset. The calculations may include fitting a mathematical model to the detected curves values of the variable, averaging at least some of the detected values of the variable, taking into account values obtained from calibration measurements, etc.

[0014] The determined offset is taken into account in a subsequent cycle of machining. In such a subsequent cycle the same glass pane may be machined at least once more and/or another glass pane may be machined.

[0015] Preferably, based on the determined offset a correction is determined which adjusts the actual position of the glass pane to the target position. The correction may be taken into account in a subsequent cycle of

machining.

[0016] Preferably, the complete circumferential edge of the glass pane is machined using one or more grinding tools.

[0017] The invention is explained below based on exemplary embodiments, with reference to the figures, which show the following:

Fig. 1 schematically shows a device for machining a glass pane,

Fig. 2 shows an exemplary embodiment of a device for machining a glass pane, in a perspective view,

Fig. 3 shows an example of values of the current required by a motor for driving the grinding tool, as a function of the position of the grinding tool along the edge of the glass pane,

Fig. 4 shows the grinding speed corresponding to the curve in Fig. 3, and its derivative,

Fig. 5 shows an example of the weighting function for a rectangular glass pane shape in the x direction (Fig. 5(a)), y direction (Fig. 5(b)), and rotational direction (Fig. 5(c)),

Fig. 6 shows an example of current values in the x direction (Fig. 6(a)), y direction (Fig. 6(b)), and rotational direction (Fig. 6(c)), obtained by applying the weighting function from Fig. 5, and

Fig. 7 schematically shows the method sequence for configuring a device for series production.

[0018] Fig. 1 schematically shows a device that is used for machining a glass pane edge. (The edge is the circumferential outer area between the top side and the bottom side of the pane.) The device includes a support 9 on which a glass pane rests during machining, a grinding tool 10 that may be set in rotation by means of an electric motor, for example a spindle motor, and a controller 15. An asynchronous motor or synchronous motor, for example, is suitable as an electric motor. The grinding tool 10 is designed, for example, as a one- or multi-part grinding disk.

[0019] The support 9 and the grinding tool 10 are movable relative to one another so that an edge of the glass pane may be ground. This is achievable in various ways, for example as follows:

- The support 9 is stationary and the grinding tool 10 is movable around the edge of the glass pane.
- The grinding tool 10 is stationary and the support 9 is movable in such a way that the edge of the glass pane may be moved past the grinding tool.
- The support 9 and the grinding tool 10 are movable, for example in that the support 9 is rotatable about a

center of rotation and the grinding tool 10 is movable back and forth along a linear axis, or in that the support 9 is movable back and forth along a first linear axis and the grinding tool 10 is movable back and forth along a second linear axis, wherein the two axes are situated transversely with respect to one another, for example at right angles.

[0020] In order to move the support 9 and/or the grinding tool 10, a corresponding suitable drive and optionally a guide are provided. The grinding tool 10 is delivered by means of the drive, for example by path control. The grinding tool 10 then follows a fixed, predefined path. It is also conceivable for the grinding tool to be delivered in some other way, for example by force control or by path control and force control.

[0021] Fig. 2 shows by way of example a device having a rotary table 8 that is rotatable about a center of rotation, as indicated by the double arrow 8a, and a grinding tool 10 that is movable back and forth along a linear axis, as indicated by the double arrow 10a. The rotary table 8 includes a support 9 in the form of one or more suction units on which a glass pane rests during the machining, and by means of which the glass pane is securely held. Fig. 2 also shows a controller 15 and an electric motor 11 for driving the grinding tool 10. The grinding tool together with the electric motor 11 is situated on a carriage 12 that is displaceable along a track 13 as a guide.

[0022] Returning to Fig. 1, a glass pane 1' which is in the actual position is also illustrated. During configuration of the device for machining a new glass pane shape, the controller 15 has information concerning the desired shape of the glass pane 1', but does not necessarily know the exact location of the glass pane. The glass pane 1 in Fig. 1 represents the target position thereof, on the basis of which the controller 15 determines the movement of the support 9 and/or of the grinding tool 10 so that the glass pane edge 1a would be ground in the target position. It is apparent in Fig. 1 that the actual position and the target position are offset relative to one another. An offset may result from a displacement in the plane and/or from a rotation in the plane. In Fig. 1, for example the x axis and y axis define the coordinate system in which the glass pane edge 1a is specified in the target position, while the x' axis and y' axis define the coordinate system in which the glass pane edge 1a' is provided in the actual position. The x'-y' coordinate system is displaced relative

to the x-y coordinate system by the vector $\vec{a}$, and is rotated by an angle α .

[0023] In the ideal case, i.e., when the actual position and the target position are the same, the electrical power consumption of the electric motor 11 while driving the grinding tool 10 is a function only of predefined process parameters, for example the pane shape, grinding speed, delivery, etc. During grinding along an essentially straight path, for example, the power consumption is essentially constant. The inventors have now found that

an offset results in a corresponding variation in the power consumption. Conclusions concerning the offset may thus be drawn by detecting and evaluating a variable that corresponds to the power consumption. For example, the current required by the electric motor 11 for driving the grinding tool 10 may be used as a variable that reflects the power consumption. The controller 15 is used to control the movement of the support 9 and/or the grinding tool 10, as well as the electric motor 11. The controller 15 is provided with a suitable program for evaluating the detected variable. During operation, for the particular position of the support 9 and/or of the grinding tool 10, the current value of the electric motor 11 and/or some other variable is detected which is a function of the power consumption. In the variant according to Fig. 2, in addition to the current, for example the rotational position of the rotary table 8 in degrees, the position of the grinding tool 10 on the linear axis, and optionally further parameters, for example for force-controlled delivery, are recorded.

[0024] In the following description, as an example the current is used as the variable to be detected. It is conceivable to use some other electrical variable, for example the voltage or a combination of current and voltage.

[0025] Fig. 3 shows an example of a detected current curve I. The ordinate is the current, for example in units of amperes, and the values on the abscissa correspond to the position at the circumference of the glass pane 1a. During operation, the current value is recurrently detected after a displacement in the position. This results in a number N of measured values. (In the example according to Fig. 3, this corresponds to approximately 450 measured values. Of course, N may also be different.)

[0026] For evaluating the current curve I, the measured values are processed in a first step. Current dips may occur, as is apparent in Fig. 3. In this case, the current dip at the beginning and at the end of the measurement arises from the path plan of the grinding operation. The measurement begins with the recording of the values while the grinding tool 10 is still moving toward or away from the glass pane 1'. The start and end points of the actual grinding operation are determinable, for example, by taking the first N1 and the last N2 measured values (for example, N1 = N2 = 50 or some other value), and, based on the position values of the support 9 and of the grinding tool 10, determining the corresponding x and y coordinates and comparing them to one another. The stated start and end points of the measurement are between the two values having the smallest interval between them. All preceding and subsequent measured values are no longer used in the steps that follow for determining the offset. However, the value of the current required by the grinding tool 10 in idle mode, i.e., without contact with the glass pane 1', may be determined from the omitted measured values.

[0027] The further four current dips, visible in Fig. 3 between the first and the last current dips, arise from the

selected shape of the glass pane 1'. In the present case, the glass pane has a shape according to Fig. 1; i.e., it has four rounded corners that are defined by an external radius. At the corners, the direction in which the edge extends, viewed in the top view of the glass pane 1', changes by more than a predefined angular value, for example by more than 45 degrees. When the grinding tool 10 is grinding in each case during such a change in direction, it has a small support surface, so that almost no glass removal results and the current drops markedly. In contrast, the calculated grinding speed, as the difference between two position values during a defined time period, behaves in a complementary manner during the stated changes in direction; i.e., it increases greatly during the current dips. In Fig. 4, the grinding speed v corresponding to the current curve I according to Fig. 3 is illustrated in units of length per unit time (in the present case, millimeters per 20 milliseconds). The bottom curve in Fig. 4 shows the derivative v' of the grinding speed v.

[0028] The program uses, for example, the ratio of the spindle current I to the grinding speed v for filtering out the mentioned further current dips. As is apparent in Fig. 4, the derivative v' at the locations of the stated changes in direction has positive and negative outliers. Current measured values for which the value of the derivative v' is above or below a predefined limit value (for example, ± 0.25 in the example in Fig. 4) are declared as current dips, and are omitted for the further evaluation or are adjusted, for example by setting them to the average value of the detected current.

[0029] The offset may be determined after the current measured values are processed. As mentioned above with respect to Fig. 1, the offset is definable by three parameters: two parameters for a linear displacement in the plane (for example, the x and y values of the displacement vector $\vec{a}$) and one parameter for the rotation α in the plane. Various methods are conceivable for determining the offset from the plurality of current measured values, for example by fitting a mathematical model to the measuring curves, iteration, etc.

[0030] For the device according to Fig. 2, for example the following procedure is conceivable: As a result of the geometry, the greater the distance of a point from the center of rotation of the rotary table 8, the farther this point is displaced. The course of the glass pane edge 1a in the target position may be defined by values for the x and y coordinates. Based on these values, a weighting function is determined in each case by forming the derivative and normalization to ± 1 . Fig. 5(a) and Fig. 5(b) show an example of this weighting function for the x and y directions in the case of a rectangular glass pane 1. In each case here, one side of the rectangle has no effect, while the other side has a maximum effect.

[0031] Fig. 5(c) shows the weighting function for the angle that is obtained by forming the derivative of the absolute value of the vector based on the stated values for the x and y coordinates of the glass pane edge 1a. In the example according to Fig. 5(c), the effect is greatest in

each case at the corners of the rectangle. In the center of a rectangle side the effect is equal to zero in each case, since the vector is then directed at 90 degrees with respect to the side.

[0032] The current measured values I are reduced by the current value averaged over the entire measurement and multiplied by the weighting function for the x and y directions. For the example from Fig. 5(a) and Fig. 5(b), the curves illustrated in Fig. 6(a) and Fig. 6(b) are obtained. The offset in the x and y directions is obtained, in units of amperes per measured value, by averaging the values. In the example according to Fig. 6(a) and Fig. 6(b), the offset in the x direction is zero, and in the y direction the offset corresponds approximately to 0.13 A per measured value.

[0033] To prevent a skewed calculation of the angular offset, the current measured values, reduced by the average value, are corrected according to the determined x and y offsets, and are then multiplied by the weighting function for the angle. For the example from Fig. 5(c), the curve according to Fig. 6(c) is obtained with this procedure. The angular offset is obtained by averaging the values. In the example according to Fig. 6(c), this angular offset corresponds to approximately 0.025 amperes per measured value.

[0034] Conversion of the values of the offset into units of length or into angular units is possible by calibration measurements, for example, in which the current of the electric motor 11 is detected at predefined glass thicknesses and grinding speeds as well as predefined values for the offset. The calibration measurements may take place by grinding a single glass pane multiple times, or by grinding multiple glass panes. The glass pane is optionally disposed of, and the determined values for the offset are used for the subsequent glass panes to be machined.

[0035] In one embodiment, a glass pane 1' is ground twice: In a first run the pane 1' is ground not to the final dimensions, but, rather, with a residual edge having a predefined width b , for example $b = 0.25$ mm or some other suitable value. The residual edge is removed in the second run. Based on the second run, the current that is consumed in order to remove a width b is thus known. A calibration value (for example, in amperes per mm for the linear offset) is determinable by averaging the current values of the second run, subtracting the current value in idle mode, and dividing the result by two, since according to Fig. 5(a), Fig. 5(b) the normalization here extends from -1 to +1.

[0036] Based on the current curve of the first run, the offset is determinable in units of amperes, and by use of the calibration value may be converted into units of mm or degrees.

[0037] The procedure described here with two grinding operations has the advantage, among others, that the program is able to calibrate itself for any given pane shapes, without the need for information concerning the pane thickness or grinding speed.

[0038] Furthermore, the inventors have found that the

current curve of the second run may be used to decide whether or not the glass pane has been completely ground, i.e., is free of unmachined and/or only partially machined locations. The current value for the offset is relatively large for a pane that is not completely ground. If a predefined threshold value is exceeded, the glass pane is not recognized as completely ground, and is remachined or disposed of.

[0039] Fig. 7 summarizes the various method steps explained above:

Step 100: The grinding is started in order to configure the device in such a way that glass panes may be ground in series without offset.

Step 101: A glass pane is ground up to a residual edge in a first run.

Step 102: The residual edge having a predefined width is removed in a second run.

Step 103: The program determines the offset in the physical units and the corresponding correction values in order to compensate for the displacement and/or rotation between the x' - y' coordinate system and the x - y coordinate system in Fig. 1.

Step 104: The program checks as to whether the glass pane is completely ground. If not, this is followed by:

Step 105, in which the glass pane is disposed of and a new glass pane is ground to the final dimensions according to step 102, using the determined correction values.

Step 106: A user additionally checks as to whether the glass pane is completely ground. This step is optional and may be omitted.

Step 107: The device is now configured and the series production is started, in which a plurality of glass panes is ground.

[0040] The detection and evaluation of the current I may be used not only for configuring the device, but also for monitoring and/or continuously adjusting the series production. In the series production, the offset may be determined, for example, for each glass pane, and for example one-half the offset may be used as a correction value for the next glass pane.

[0041] It is also conceivable to monitor the variation of the current I over time. This should essentially correspond to the variation over time that results after the device is configured, and thus, when an offset is not present. If this is no longer the case during grinding of a glass pane, the facility is no longer correctly calibrated, and may be reconfigured, for example, via the sequence

according to Fig. 7.

[0042] The measures described here are usable in many ways to grind the edge of a glass pane, in particular automotive window glass and glass panes for monitors and/or displays. Any given edge profiles to be ground are conceivable: rectangular, beveled, C-shaped, rounded edge, stepped cut, etc. The detection and evaluation of a variable that is a function of the power consumption of the motor has the advantage, among others, that it is not absolutely necessary to provide additional sensors to determine the offset.

[0043] The device may be configured in such a way that information concerning the detected values of the variable, for example the detected current, the determined offset, the calculated correction, and/or other parameters, is displayed on a monitor.

[0044] It is not necessary to detect and/or evaluate all values of the variable along the edge of the glass pane in order to determine the offset. In addition, values of the variable on only a portion of the grinding path represent sufficient measuring points to determine the offset having a maximum of three parameters.

[0045] The method is also applicable for a device in which more than one grinding tool is used for the grinding, for example two or more grinding tools with motors that are offset relative to one another. Each grinding tool may optionally machine only a section of the edge. By use of the methods described here, for example the correction values for each grinding tool may be determined, and an average correction value may then be set.

Claims

1. A method for machining a glass pane (1'), wherein the edge (1a') of the glass pane is machined using at least one grinding tool (10), in that the glass pane and the grinding tool, which is set in rotation by means of a motor (11), are moved relative to one another, wherein a variable (I) that is a function of the power consumption of the motor (11) used to drive the grinding tool is detected along at least a section of the edge (1a') being machined, **characterized in that** the variable (I) is evaluated to determine an offset of the glass pane (1') with respect to a target position (1), wherein the offset of the glass pane is defined by one or more of the following parameters:

- a shift along a first linear axis (x),
- a shift along a second linear axis (y),
- a rotation around a rotation axis,

and wherein the determined offset is taken into account in a subsequent cycle of machining.

2. The method according to claim 1, wherein the edge (1a') is machined in two runs, wherein the values of the variable detected in the second run are used to

calibrate the offset determined in the first run.

3. The method according to one of the preceding claims, wherein at least one of the following evaluation steps is carried out:

- The value of the variable is determined for the state in which the rotating grinding tool (10) is not in contact with the edge (1a').
- Values of the variable that result on a section on which the direction in which the edge extends, viewed in the top view of the glass pane (1'), changes by more than a predefined angular value are omitted for the evaluation or are adjusted.
- Based on the predefined glass pane shape, at least one weighting function is defined which is applied to the detected values of the variable to obtain the offset in at least one direction.

4. The method according to one of the preceding claims, wherein a correction is determined which adjusts (103) the target position (1) and the actual position of the glass pane (1') to one another and which is taken into account during machining of the next glass pane, wherein this procedure is carried out until the detected values of the variable are within a predefined tolerance range.

5. The method according to one of the preceding claims, wherein a plurality of glass panes is subsequently machined, and in each case a check is made as to whether the detected values of the variable are within a predefined tolerance range.

6. The method according to one of the preceding claims, wherein the relative movement between the glass pane (1') and the grinding tool (10) takes place in that only the glass pane or only the grinding tool is moved, or both are moved, the glass pane preferably being rotated and/or moved along a linear axis while the grinding tool is moved along a linear axis.

7. The method according to one of the preceding claims, wherein a check is made as to whether the glass pane (1') is free of locations that are unmachined and/or only partially machined, by determining whether the detected values of the variable are below a predefined threshold values, and if this is not the case, information that the glass pane is not completely ground is associated with the glass pane.

8. The method according to one of the preceding claims, wherein the detected variable is an electrical variable, preferably corresponding to the current consumed by the motor (11) used for driving the grinding tool.

9. A device for machining a glass pane (1'), with which the method according to one of the preceding claims can be carried out, wherein the device has a support (9) for the glass pane, at least one grinding tool (10) that is used for machining the edge (1a') of the glass pane and is settable in rotation by means of a motor (11), and a controller (15) for detecting and evaluating a variable that is a function of the power consumption of the motor used to drive the grinding tool, wherein the support and the grinding tool are arranged so as to be movable relative to one another in order to machine the edge, and wherein the controller is provided with a program which, when executed, allows the method to be carried out.
10. The device according to claim 9, including a monitor on which information concerning the detected values of the variable, the calculated offset, and/or a calculated correction for adjusting the target position and actual position to one another are/is displayed during operation.
11. A computer program, **characterized in that** the method according to one of claims 1 to 8 is carried out when the computer program is executed on a device according to claim 9 or 10.
12. A data carrier on which the computer program according to claim 11 is stored.

Patentansprüche

1. Ein Verfahren zum Bearbeiten einer Glasscheibe (1'), bei welchem die Kante (1a') der Glasscheibe mit mindestens einem Schleifwerkzeug (10) bearbeitet wird, indem die Glasscheibe und das mittels eines Motors (11) in Rotation versetzte Schleifwerkzeug relativ zueinander bewegt werden, wobei eine Grösse (I), welche von der aufgenommenen Leistung des zum Antreiben des Schleifwerkzeugs verwendeten Motors (11) abhängt, entlang mindestens einer Teilstrecke der bearbeiteten Kante (1a'), erfasst wird, **dadurch gekennzeichnet, dass** die Grösse (I) ausgewertet wird, um einen Versatz der Glasscheibe (1') in Bezug auf eine Soll-Lage (1) zu bestimmen, wobei der Versatz der Glasscheibe (1') durch einen oder mehrere der folgenden Parameter definiert ist:
- eine Verschiebung in einer ersten linearen Achse (x),
 - eine Verschiebung in einer zweiten linearen Achse (y),
 - eine Rotation um eine Rotationsachse,

und wobei der bestimmte Versatz bei einem nachfolgendem Bearbeitungszyklus mitberücksichtigt

wird.

2. Das Verfahren nach Anspruch 1, bei welchem die Kante (1a') in zwei Durchgängen bearbeitet wird, wobei die beim zweiten Durchgang erfassten Grössenwerte zur Eichung des beim ersten Durchgang bestimmten Versatzes verwendet werden.
3. Das Verfahren nach einem der vorangehenden Ansprüche, bei welchem mindestens einer der folgenden Auswertungsschritte durchgeführt wird:
- Der Wert der Grösse wird für den Zustand bestimmt, bei welchem das rotierende Schleifwerkzeug (10) nicht in Kontakt zur Kante (1a') steht.
 - Grössenwerte, die sich auf einer Teilstrecke ergeben, auf welcher die Richtung, in der die Kante in der Draufsicht auf die Glasscheibe (1') gesehen verläuft, um mehr als einen vorgegebenen Winkelwert ändert, werden für die Auswertung weggelassen oder angepasst.
 - Anhand der vorgegebenen Glasscheibenform wird mindestens eine Gewichtsfunktion definiert, welche auf die erfassten Grössenwerte angewendet wird, um den Versatz in mindestens einer Richtung zu erhalten.
4. Das Verfahren nach einem der vorangehenden Ansprüche, bei welchem eine Korrektur bestimmt wird, welche die Soll-Lage (1) und die Ist-Lage der Glasscheibe (1') miteinander angleicht (103) und welche bei der Bearbeitung der nächsten Glasscheibe berücksichtigt wird, wobei dieses Vorgehen sooft durchgeführt wird, bis die erfassten Grössenwerte innerhalb eines vorgegebenen Toleranzbereiches liegen.
5. Das Verfahren nach einem der vorangehenden Ansprüche, bei welchem nachfolgend eine Vielzahl von Glasscheiben bearbeitet wird und jeweils überprüft wird, ob die erfassten Grössenwerte innerhalb eines vorgegebenen Toleranzbereiches liegen.
6. Das Verfahren nach einem der vorangehenden Ansprüche, bei welchem die Relativbewegung zwischen Glasscheibe (1') und Schleifwerkzeug (10) dadurch erfolgt, indem nur die Glasscheibe oder nur das Schleifwerkzeug bewegt wird oder beide bewegt werden, vorzugsweise wird die Glasscheibe rotiert und/oder entlang einer linearen Achse bewegt, während das Schleifwerkzeug entlang einer linearen Achse bewegt wird.
7. Das Verfahren nach einem der vorangehenden Ansprüche, bei welchem geprüft wird, ob die Glasscheibe (1') frei von Stellen ist, die unbearbeitet und/oder nur teilweise bearbeitet sind, indem bestimmt wird,

ob die erfassten Grössenwerte unterhalb eines vorgegebenen Schwellenwerts liegen, und, wenn dies nicht der Fall ist, der Glasscheibe Informationen zugeordnet werden, dass sie nicht ausgeschliffen ist.

8. Das Verfahren nach einem der vorangehenden Ansprüche, bei welchem die erfasste Grösse eine elektrische Grösse ist, vorzugsweise entspricht sie dem Strom, den der zum Antreiben des Schleifwerkzeugs verwendete Motor (11) aufnimmt.
9. Eine Vorrichtung zum Bearbeiten einer Glasscheibe (1'), mit welcher das Verfahren nach einem der vorangehenden Ansprüche durchführbar ist, wobei die Vorrichtung eine Auflage (9) für die Glasscheibe, mindestens ein Schleifwerkzeug (10), welches zum Bearbeiten der Kante (1a') der Glasscheibe verwendet wird und mittels eines Motors (11) in Rotation versetzbar ist, und eine Steuerung (15) zum Erfassen und Auswerten einer Grösse aufweist, die von der aufgenommenen Leistung des Motors, der zum Antreiben des Schleifwerkzeugs benutzt wird, abhängt, wobei die Auflage und das Schleifwerkzeug relativ zueinander bewegbar angeordnet sind, um die Kante zu bearbeiten, und wobei die Steuerung mit einem Programm ausgestattet ist, bei dessen Ausführung das Verfahren durchführbar ist.
10. Die Vorrichtung nach Anspruch 9, mit einem Monitor, auf welchem im Betrieb Informationen über die erfassten Grössenwerte, den berechneten Versatz und/oder eine berechnete Korrektur zum Angleichen von Soll- und Ist-Lage angezeigt werden.
11. Ein Computerprogramm, **dadurch gekennzeichnet, dass** bei dessen Ausführung auf einer Vorrichtung nach Anspruch 9 oder 10 das Verfahren nach einem der Ansprüche 1 bis 8 durchgeführt wird.
12. Ein Datenträger, auf welchem das Computerprogramm nach Anspruch 11 gespeichert ist.

Revendications

1. Un procédé d'usinage d'une vitre (1'), dans lequel le bord (1a') de la vitre est usiné à l'aide d'au moins un outil de meulage (10), en ce que la vitre et l'outil de meulage, qui est mis en rotation au moyen d'un moteur (11), sont déplacés l'un par rapport à l'autre, dans lequel une grandeur (I) qui est fonction de la consommation électrique du moteur (11) utilisé pour entraîner l'outil de meulage est détectée le long d'au moins une section du bord (1a') en cours d'usinage, **caractérisé en ce que** la grandeur (I) est évaluée pour déterminer un décalage de la vitre (1') par

rapport à une position cible (1), dans lequel le décalage de la vitre est défini par un ou plusieurs des paramètres suivants :

- 5 - un déplacement le long d'un premier axe linéaire (x),
- un déplacement le long d'un deuxième axe linéaire (y),
- une rotation autour d'un axe de rotation,

et dans lequel le décalage déterminé est pris en compte dans un cycle d'usinage suivant.

2. Le procédé selon la revendication 1, dans lequel le bord (1a') est usiné en deux passes, dans lequel les valeurs de la grandeur détectées dans la deuxième passe sont utilisées pour étalonner le décalage déterminé dans la première passe.

3. Le procédé selon l'une des revendications précédentes, dans lequel au moins l'une des étapes d'évaluation suivantes est effectuée :

- La valeur de la grandeur est déterminée pour l'état dans lequel l'outil de meulage rotatif (10) n'est pas en contact avec le bord (1a').
- Valeurs de la grandeur qui résultent sur une section sur laquelle la direction dans laquelle le bord s'étend, vue dans la vue de dessus de la vitre (1'), change de plus d'une valeur angulaire prédéfinie sont omises pour l'évaluation ou sont ajustées.
- Sur la base de la forme de vitre prédéfinie, au moins une fonction de pondération est définie, qui est appliquée aux valeurs détectées de la grandeur pour obtenir le décalage dans au moins une direction.

4. Le procédé selon l'une des revendications précédentes, dans lequel une correction est déterminée, qui ajuste (103) la position cible (1) et la position réelle de la vitre (1') l'une par rapport à l'autre et qui est prise en compte lors de l'usinage de la vitre suivante, dans lequel cette procédure est effectuée jusqu'à ce que les valeurs détectées de la grandeur se trouvent à l'intérieur d'une plage de tolérance prédéfinie.

5. Le procédé selon l'une des revendications précédentes, dans lequel une pluralité de vitres est ensuite usinée, et dans chaque cas un contrôle est effectué pour savoir si les valeurs détectées de la grandeur se trouvent à l'intérieur d'une plage de tolérance prédéfinie.

6. Le procédé selon l'une des revendications précédentes, dans lequel le mouvement relatif entre la vitre (1') et l'outil de meulage (10) a lieu en ce que

seule la vitre ou seul l'outil de meulage est déplacé, ou les deux sont déplacés, la vitre étant de préférence tournée et/ou déplacée le long d'un axe linéaire pendant que l'outil de meulage est déplacé le long d'un axe linéaire.

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7. Le procédé selon l'une des revendications précédentes, dans lequel un contrôle est effectué pour savoir si la vitre (1') est exempte d'emplacements qui ne sont pas usinés et/ou seulement partiellement usinés, en déterminant si les valeurs détectées de la grandeur sont en dessous d'une valeur seuil prédéfinie, et si ce n'est pas le cas, une information que la vitre n'est pas complètement meulée est associée à la vitre. 10
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8. Le procédé selon l'une des revendications précédentes, dans lequel la grandeur détectée est une grandeur électrique, correspondant de préférence au courant consommé par le moteur (11) utilisé pour entraîner l'outil de meulage. 20
9. Un dispositif d'usinage d'une vitre (1'), avec lequel le procédé selon l'une des revendications précédentes peut être effectué, dans lequel le dispositif présente un support (9) pour la vitre, au moins un outil de meulage (10) qui est utilisé pour usiner le bord (1a') de la vitre et qui peut être mis en rotation au moyen d'un moteur (11), et une commande (15) pour détecter et évaluer une grandeur qui est fonction de la consommation électrique du moteur utilisé pour entraîner l'outil de meulage, dans lequel le support et l'outil de meulage sont disposés de manière mobile l'un par rapport à l'autre afin d'usiner le bord, et dans lequel la commande est pourvue d'un programme qui, lorsqu'il est exécuté, permet au procédé d'être effectué. 25
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10. Le dispositif selon la revendication 9, comprenant un moniteur sur lequel des informations concernant les valeurs détectées de la grandeur, le décalage calculé et/ou une correction calculée pour ajuster la position cible et la position réelle l'une par rapport à l'autre sont affichés pendant le fonctionnement. 40
45
11. Un programme informatique, **caractérisé en ce que** le procédé selon l'une des revendications 1 à 8 est effectué lorsque le programme informatique est exécuté sur un dispositif selon la revendication 9 ou 10. 50
12. Un support de données sur lequel le programme informatique selon la revendication 11 est stocké. 55

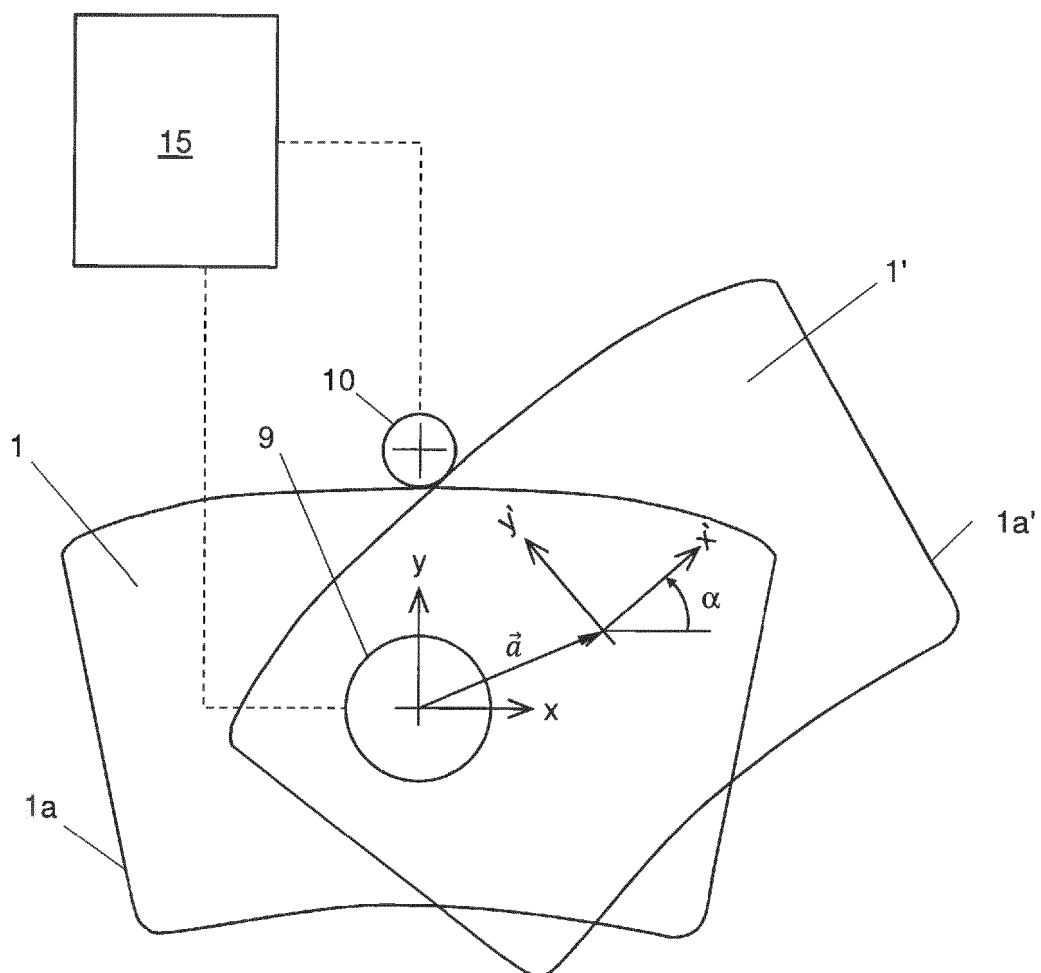


Fig. 1

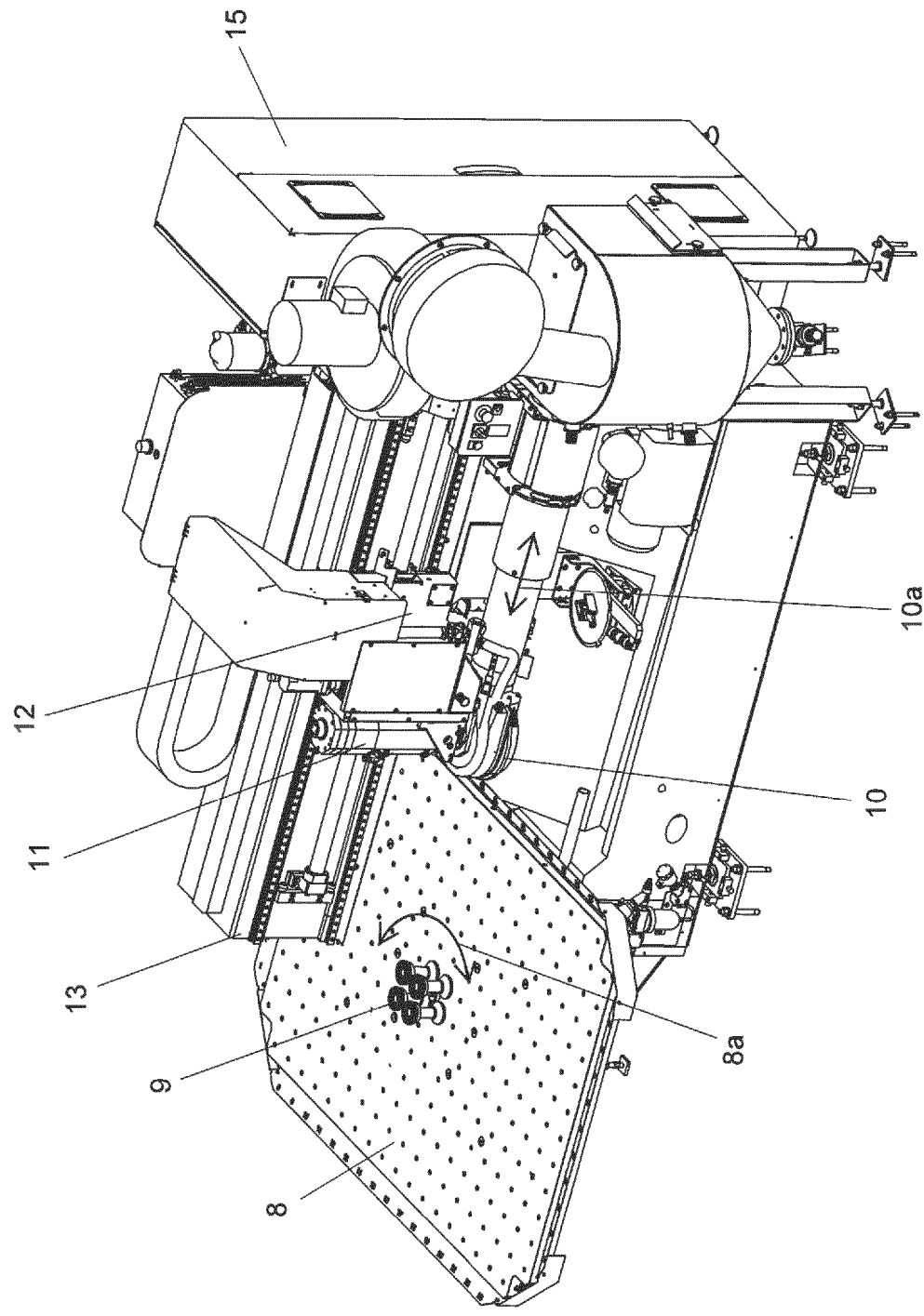


Fig. 2

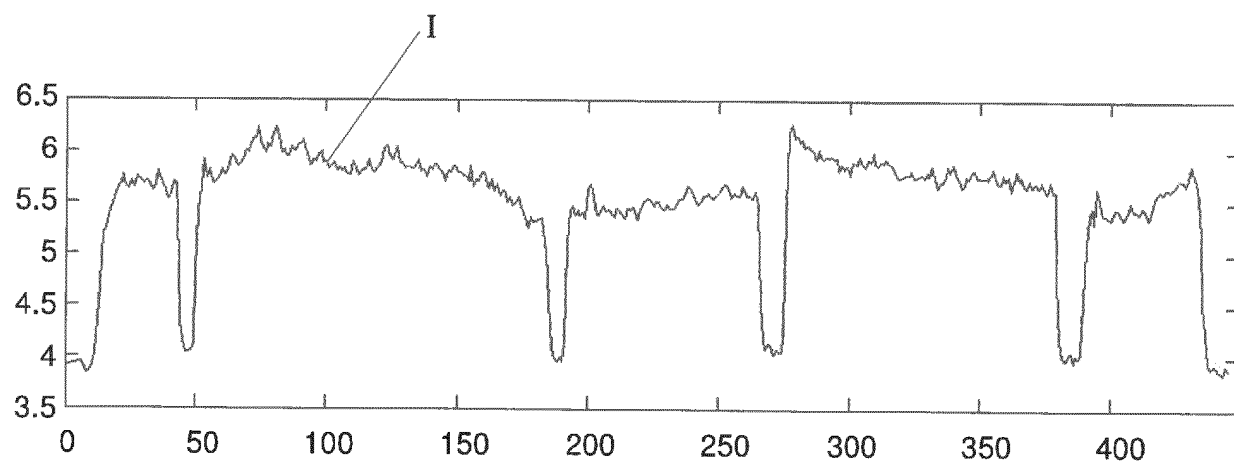


Fig. 3

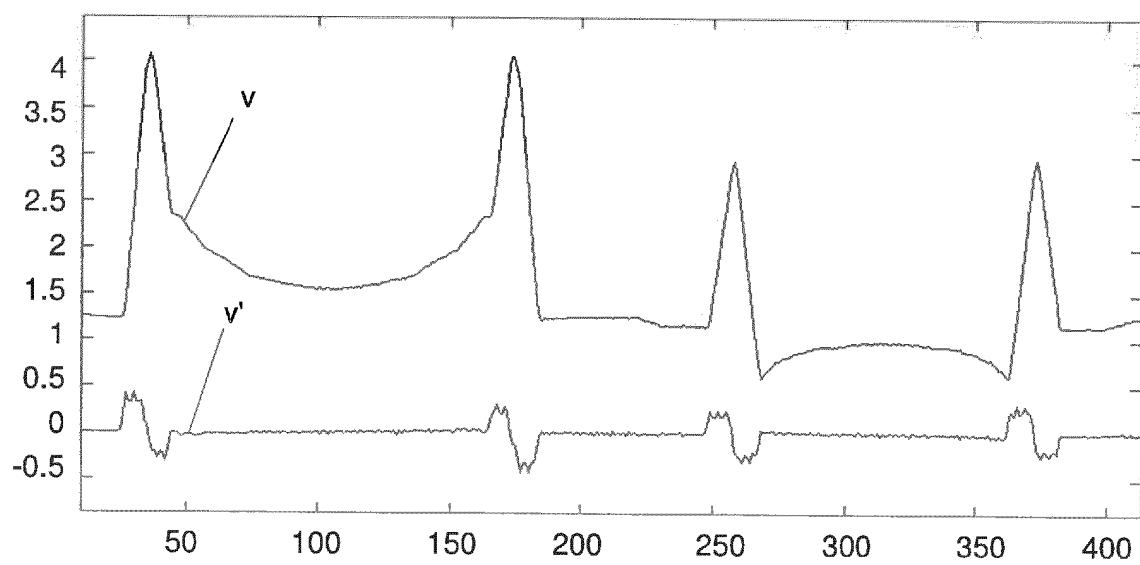


Fig. 4

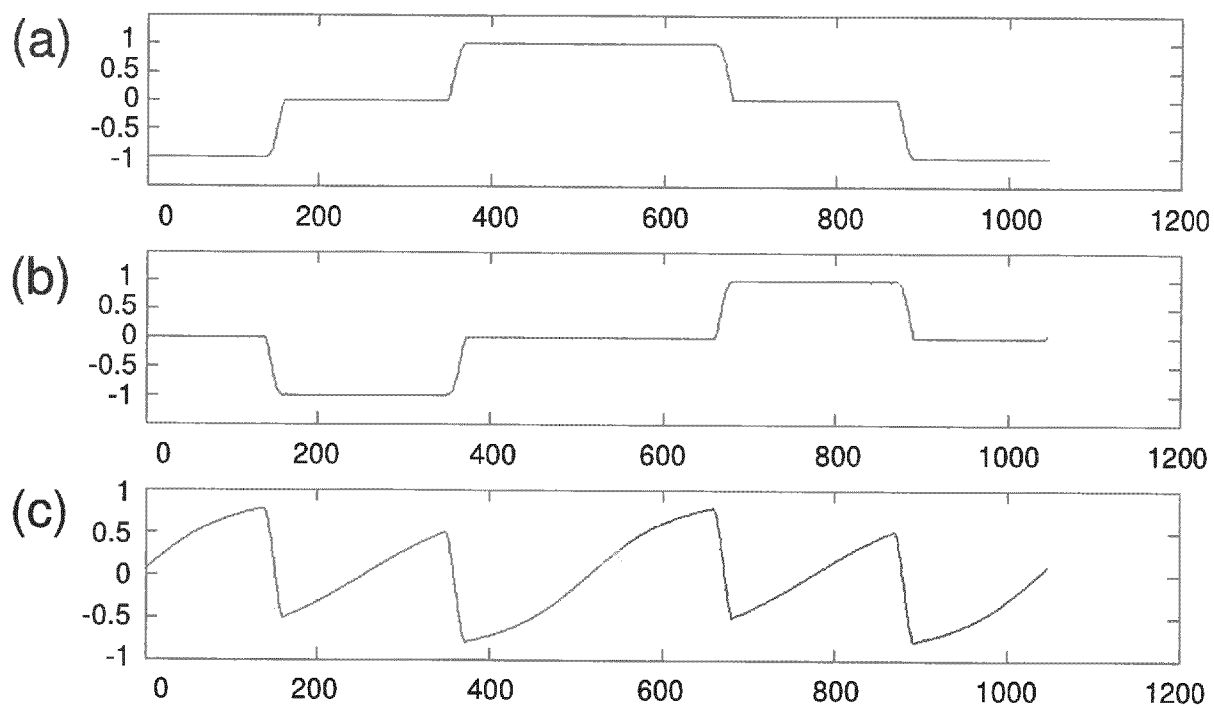


Fig. 5

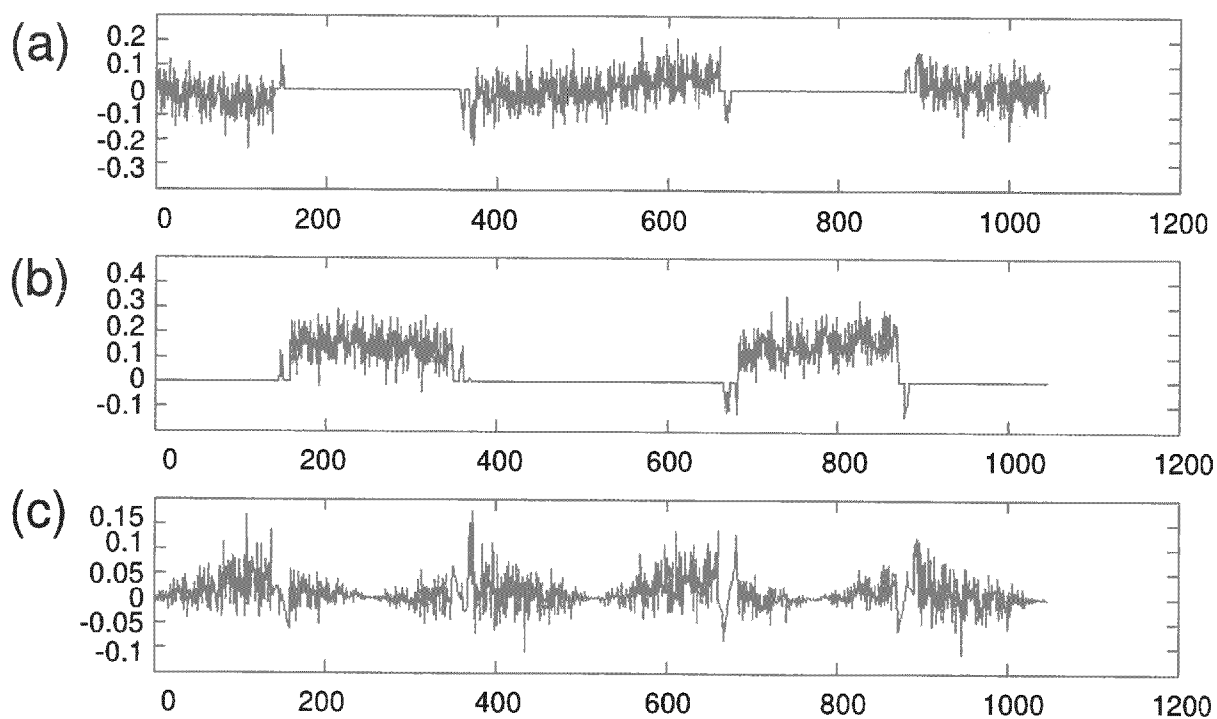


Fig. 6

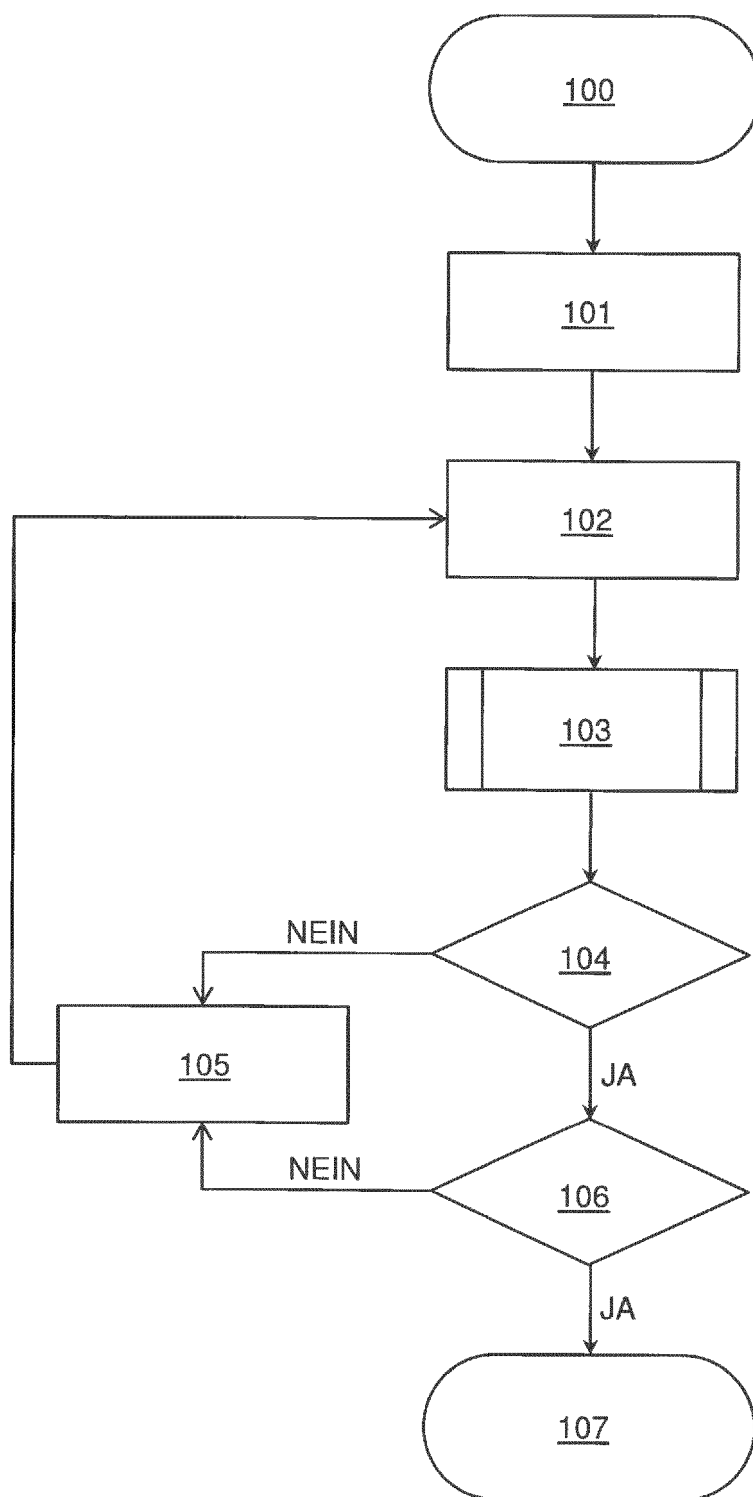


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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