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(54) **Dishwasher**

Geschirrspüler

Lave-vaisselle

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## Description

**[0001]** The present invention relates to a method for controlling a dishwasher. Dishwashers comprising a contact sensor which signals opening of the dishes introduction/extraction door are well known.

**[0002]** Said sensor comprises two conductor elements positioned on the door. The dishwasher comprises a striking portion which in the closed position encounters the door. This striking portion comprises a lance which when the door is closed places the two conductor elements in contact with each other. When the door is open the two conductor elements are distant from each other and this determines interruption of the passage of electrical current between them.

**[0003]** DE102010015849 discloses a dishwasher provided with a tilt sensor which detects the position of the dishwasher door; the tilt sensor is used to turn on a illumination device when door has been opened to an angle of at least 45°.

**[0004]** In this context, the technical task at the basis of the present invention is to propose a dishwasher enabling the components of it to be optimised, reducing its costs and overall dimensions.

**[0005]** The defined technical task and the specified objects hereof are substantially achieved by a dishwasher comprising the technical aspects described in one or more of the appended claims.

**[0006]** Further characteristics and advantages of the present invention will become more apparent from the following approximate, and therefore non-limiting, description of a preferred, but not exclusive, embodiment of a dishwasher, as illustrated in the appended drawings, in which:

- figure 1 shows a schematic view of a dishwasher according to the present invention;
- figure 2 shows a component of a dishwasher according to the present invention;
- figures 3, 4, 5 show graphs relating to functioning of the dishwasher in a first operating condition;
- figures 6, 7, 8 show graphs relating to functioning of the dishwasher in a second operating condition;
- figure 9 shows an enlargement of figure 8.

**[0007]** In the appended figures of the drawings, reference number 1 denotes a dishwasher comprising:

- a washing compartment 2;
- a door 3 giving access to the washing compartment 2.

**[0008]** The door 3 giving access to the washing compartment 2 enables introduction and extraction of the dishes from the washing compartment 2. The door 3 comprises a sensor 4 which takes a measurement representing the gravity acceleration component at least along a first axis 40 which is integral with the door 3. For example, the sensor 4 measures the gravity acceleration component at least along a first axis 40 which is integral with the door 3 or a value proportionate to it. This enables detection of the inclination of the door 3 and/or abnormal internal vibrations and/or shocks from the outside and associated with predetermined user commands. Said sensor 4 is normally indicated in the technical sector as an accelerometer (for example, said accelerometer is the MEMS type). By way of example, but non-limiting, the sensor 4 is identified by the acronym LSM303DLHC and is supplied by ST Microelectronics. Usually the door 3 is substantially parallel to a placement plane 31, said placement plane 31 being integral to the door 3. Advantageously, the first axis 40 is at a right angle to the placement plane 31. In this case, the gravity acceleration component along the first axis 40 is minimum in absolute value (even being zero) when the door is closed in a substantially vertical position, whilst it is maximum in absolute value when the door 3 is open in a horizontal position. Advancement as a function of time of the gravity acceleration component along the first axis 40 is illustrated in figure 5 in the case of a cycle with full load without detergent and in figure 8 in the case of a cycle without load with detergent. In the cycle with full load, the machine is more silent and presents lower vibrations compared with the cycle with no load. The peaks indicated in figures 5 and 8 with references 100, 200, 300 refer to opening of the door. The peaks indicated in figure 5 with references 101, 201, 301, 401 refer each to the shock which accompanies closing of the door. In correspondence with the peaks, there is a transient in which the signal usually does not provide a measurement representing the gravity acceleration component (to obtain this measurement it is necessary to wait for the signal to stabilise). Figure 9 shows an enlarged view of figure 8 and shows the transient which accompanies opening of the door 3. The duration of the transient depends on the speed of opening of the door 3 (for example, said transient having a duration of 1.5 seconds). The difference in the signal detected in normal operation before and after the transient depends on the degree of opening of the door 3. Advantageously, the sensor 4 may also detect the gravity acceleration component along a second axis 41 which is integral with the door 3. Typically, such second axis 41 is at a right angle to the first axis 40 (advancement as a function of time of the gravity acceleration component along the second axis 41 is illustrated in figure 3 in the case of a cycle with full load without detergent and in figure 6 in the case of a cycle without load with detergent). For example, the second axis 41 is vertical when the door 3 is closed. In the exemplary solution illustrated in the figures, the sensor 4 is capable of detecting the gravity acceleration component along a third axis 42 which is integral with the door 3. The third axis 42 is at a right angle to the first and to the second axis 40, 41 (advancement as a function of time of the gravity acceleration component along the third axis 42 is illustrated in figure 4 in the case of a cycle with full load without

detergent and in figure 7 in the case of a cycle without load with detergent). The first and the second and the third axes 40, 41, 42 are at right angles two by two. They define a Cartesian triad. In the exemplary solution illustrated, the third axis 42 is parallel to the axis of rotation 30. Figures 3,4,5, therefore illustrate the signal detected by the sensor 4 in the same time interval along the three right-angled axes indicated above. It is evidenced that the signal of figure 5 is the one best usable to control opening of the door 3 and/or the degree of opening of the door 3 and/or closure of the door 3. The signals of figures 4 and 7 being detected along a parallel axis to the axis of rotation 30 do not, on the other hand, provide indications on the degree of opening of the door 3. What is indicated with reference to figures 3,4,5 may be repeated for figures 6,7,8, taking into account the different type of cycle.

**[0009]** The door 3, in order to pass from an open to a closed position, may rotate around its own axis of rotation 30. The first axis 40 is not parallel to said axis of rotation 30. In fact, should the first axis 40 be parallel to the axis of rotation 30 and the door 3 be hinged around the axis 30, the gravity component along said axis 30 would be virtually constant (except for perhaps detecting vibrations at the moment when the door 3 comes into contact with or is disconnected from a first part of the dishwasher, said first part surrounding an opening of the washing compartment 2 and encountering the door 3 in a closed position).

**[0010]** In light of what is indicated above, the sensor 4 is integrated in door 3 position detection means. Every inclination of the door 3 relative to the horizontal position is therefore associated with a corresponding value of the gravity acceleration component along the first axis 40 and the sensor 6 enables determination of a parameter, typically an electrical parameter, associated with said value.

**[0011]** Furthermore, the sensor 4 is integrated in a user interface which detects one or more shocks from the outside and associated with predetermined user commands. This function therefore enables a user to dialogue with the dishwasher in an extremely simplified and rapid manner, using a pre-coded code.

**[0012]** Furthermore, this function is particularly useful in the case of a fully integrated dishwasher. In this case, in fact, when the door 3 is closed, a display visible from the outside is not present. This causes difficulties in dialoguing with the dishwasher 1, for example there are difficulties for the user in understanding when the washing cycle is complete. Using the present invention, on the other hand, it is possible to communicate with the dishwasher 1, even in the absence of visible buttons or switches and without the need to open the door 3.

**[0013]** Conveniently, the dishwasher 1 may also comprise acoustic means or lights (typically of modest dimensions) capable of responding to prompts of the user. In the case of the previous example, the user, by hitting the door 3 and causing the sensor 4 to vibrate with a predetermined prompt (for example, two consecutive taps) may send a request for information to the dishwasher 1 (for example: is the washing cycle finished?). The dishwasher 1 may respond with a prerecorded voice message or a predetermined acoustic signal.

**[0014]** Conveniently, the sensor 4 is integrated in abnormal vibration detection means. In fact, the vibrations are in any case picked up by the sensor 4. The sensor 4 could therefore pick up abnormal vibrations which could signify a malfunction or warn of an imminent breakage. In this regard, in fact, the frequency of moving elements forming part of the dishwasher 1 is well known (for example, should the rotating spray arms positioned in the washing compartment come into contact with the dishes, vibrations would be produced which could be transmitted through structures of the dishwasher 1 and therefore detected by the sensor 4). In this regard, the abnormal vibration detection means comprise signalling devices capable of communicating the anomaly to a user and, in the most serious cases, could even stop functioning of the dishwasher 1.

**[0015]** Conveniently, the dishwasher 1 comprises means of release/retention of the door 3 to remaining parts of the dishwasher (for example a hook). These means of release/retention of the door 3 compress a seal when the door 3 is closed; when the door 3 is closed, said seal remains positioned between the door 3 and the remaining parts of the dishwasher 1, guaranteeing the hydraulic seal. In general, the dishwasher 1 comprises means which compress the seal when the door 3 is closed. Further examples of means which compress the seal are elastic means integrated into a hinge which enables rotation around an axis of rotation 30. Alternatively, said means which compress the seal are magnetic means which hold the door 3 in a closed position. Moving away from the axis of rotation 30 opportunely, the door 3 comprises/is formed of a first and a second portion 32, 33 positioned in succession. Extension of the first portion 32 being higher or equal to extension of the second portion 33. The first portion 32 integrates the axis of rotation 30 (or at least is positioned at the axis of rotation 30). When the door 3 is open, the second portion 33 projects cantilevered from the first portion 32. Conveniently, the sensor 4 is integrated in the second portion 33 of the door 3. This zone of the door 3 is, in fact, powered electrically, since it generally houses command buttons or displays and is easily accessible even for inspection and maintenance operations. Conveniently, the sensor 4 comprises/is operatively connected to a local processor. In this way, there is no overloading of the main card of the dishwasher 1 with processing of the signal detected by the sensor 4. An already coded signal therefore leaves the local processor and is usable by other components of the dishwasher. The object of the present invention is a method of control of the position of the door 3 of a dishwasher 1 presenting one or more of the characteristics indicated above.

**[0016]** The method of control of the position of the door

3 comprises the step of measuring through the agency of the sensor 4 of the dishwasher 1 a first quantity connected with the gravity acceleration component along the first axis which is integrated with the door 3 (see, for example, figures 5 or 8). Conveniently, said method also comprises the step of comparing the values taken on by the first quantity with a predetermined threshold value. If the values taken on over time by the first quantity cross the predetermined threshold value to define a peak, the method comprises directly or indirectly comparing the values taken on by the first quantity in a first predetermined time interval upstream of said peak and in a second predetermined time interval downstream of said peak. For example, with reference to figure 9, a peak is indicated by reference 501, the first predetermined interval is indicated by reference 502 and the second predetermined interval is indicated by reference 503. This example is immediately transferable to the graphs of figures 3-8. Conveniently, the first predetermined time interval 502 immediately precedes the peak 501. Conveniently, the second predetermined time interval 503 immediately follows the peak 501. In the first and in the second predetermined time interval 502, 503, the transient connected with said peak 501 has substantially stabilised (excluding background noise). If the dishwasher 1 detects a condition representing the fact that the average value of the first quantity in said first interval 502 differs from the average value of the first quantity in said second interval 503 by a quantity higher than a predetermined quantity, the dishwasher 1 associates said peak with the movement of the door 3. On the basis of the average value of the first quantity in the interval 503, the dishwasher 1 may further quantify the angle of opening of the door 3.

**[0017]** The scope of the present invention is also a method for controlling a dishwasher 1.

**[0018]** The method of controlling the dishwasher also comprises the step of detecting through the agency of said sensor 4 at least one shock applied by a user on the door 3. The method of control also comprises performing a command associated with the detection of at least one shock physically applied by a user on the door. With said at least one shock meaning a single shock or a specific sequence of shocks.

**[0019]** Advantageously, the dishwasher 1 recognises a number of specific sequences of prememorized shocks, with each of which is associated a different command.

**[0020]** The step of detecting through the agency of said sensor 4 the application of said at least one shock comprises the steps of measuring through the sensor 4 of the dishwasher 1 a first quantity connected with the gravity acceleration component along the first axis 40 which is integrated with the door 3.

**[0021]** The step of detecting said at least one shock also comprises the step of comparing the values taken on by the first quantity with a predetermined threshold value.

**[0022]** If the values taken on over time by the first quantity cross the predetermined threshold value to define a peak 501, the method comprises directly or indirectly comparing the values taken on by the first quantity in a first predetermined time interval 502 immediately upstream of said peak 501 and in a second predetermined time interval 503 immediately downstream of said peak 501. In the first and in the second predetermined time interval 502, 503, the transient connected with said peak 501 has substantially stabilised; if the dishwasher 1 detects a condition representing the fact that the average value of the first quantity in said first interval 502 is substantially equal to the average value of the first quantity in said second interval 503, the dishwasher 1 associates said peak 501 with an instruction or with a part of an instruction given by the user. Comparing the average value of the first quantity in the first and in the second predetermined time interval 502, 503, the dishwasher 1 is able to distinguish whether the peak 501 is connected with a command of the user or with an angular variation of the door 3.

**[0023]** The scope of the present invention is also a method of detecting a possible malfunction of a dishwasher presenting one or more of the characteristics indicated above. This method of detecting a malfunction comprises a sub-step of comparison between functioning spectrums prestored in the dishwasher 1 (and advantageously obtained following experimental tests) and at least part of a spectrum (given by the progress over time of the first quantity) detected by the sensor 4.

**[0024]** The invention as conceived enables many advantages to be obtained.

**[0025]** In the first place, it enables simple and intuitive checking of the position of the door 3. In particular, it enables checking whether the door 3 is open or closed. Furthermore, the present invention enables extremely simply controlling/querying of the dishwasher 1.

**[0026]** A further advantage of the present invention is providing a dishwasher 1 which may detect possible malfunctions of the dishwasher 1. In particular, the aforementioned advantages are obtained through use of a single sensor.

## Claims

1. A method for controlling a dishwasher (1) comprising:

   - a washing compartment (2);
   - a door (3) giving access to the washing compartment (2);

   wherein the door (3) comprises a sensor (4) which takes a measurement representing the gravity acceleration component at least along a first axis (40), which is integral with the door (3), in order to detect shocks from the outside and associated with predetermined user com-

mands,
wherein the method comprises the following steps, implemented by the dishwasher:

- detecting, through the agency of the sensor (4), a shock or a sequence of shocks applied by a user on the door (3);
- performing a command associated with the detection of the shock or sequence of shocks applied physically by a user on the door (3); **characterized in that** the step of detecting a shock or a sequence of shocks through the agency of the sensor (4) comprises the steps of:

  - measuring, through the agency of the sensor (4) of the dishwasher (1), a first quantity connected with the gravity acceleration component along the first axis (40);
  - comparing the values of the first quantity with a predetermined threshold value;
  if the values taken on by the first quantity over time exceed the predetermined threshold to define a peak (501), the method comprising directly or indirectly comparing the values taken on by the first quantity in a first predetermined time interval (502) immediately upstream of the peak (501) and in a second predetermined time interval (503) immediately downstream of the peak (501), the transient connected with the peak (501) being substantially stabilized in the first and second time intervals; if the dishwasher detects a condition representing the fact that the mean value of the first quantity in the first time interval (502) is substantially equal to the mean value of the first quantity in the second time interval (503), the dishwasher (1) identifying the peak (501) as part of an instruction comprising that shock or sequence of shocks.

**Patentansprüche**

**1.** Verfahren, einen Geschirrspüler (1) zu steuern/regeln, umfassend:

- eine Wasch-Kammer (2);
- eine Tür (3), die Zugriff zu der Wasch-Kammer (2) bietet;
wobei die Tür (3) einen Sensor (4) umfasst, der eine Messung, welche die Gravitationsbeschleunigungs-Komponente repräsentiert, wenigstens entlang einer ersten Achse (40), welche integral mit der Tür (3) verläuft, nimmt, um Stöße, die von außerhalb kommen und mit vorbestimmten Benutzerbefehlen assoziiert sind, zu ermitteln,
wobei das Verfahren folgende Schritte, die von dem Geschirrspüler ausgeführt werden, umfasst:

  - Ermitteln eines Stoßes oder einer Abfolge von Stößen, die von einem Benutzer an der Tür vorgenommen werden, durch die Vermittlung des Sensors (4);
  - Ausführen eines Befehls, der mit der Ermittlung des Stoßes oder der Abfolge von Stößen, die physisch von einem Benutzer an der Tür (3) vorgenommen werden, assoziiert ist, **dadurch gekennzeichnet, dass** der Schritt der Ermittlung eines Stoßes oder einer Abfolge von Stößen durch die Vermittlung des Sensors (4) folgende Schritte umfasst:
  - Messen einer ersten Größe, die mit der Gravitationsbeschleunigungs-Komponente entlang der ersten Achse (40) verbunden ist, durch die Vermittlung des Sensors (4) des Geschirrspülers (1);
  - Vergleichen der Werte der ersten Größe mit einem vorbestimmten Grenzwert;

  wobei, wenn die durch die erste Größe über der Zeit aufgenommenen Werte die vorbestimmte Grenze überschreiten, um einen Spitzenwert (501) festzulegen, das Verfahren das direkte oder indirekte Vergleichen der, durch die erste Größe in einem ersten vorbestimmten Zeitintervall (502) dem Spitzenwert (501) unmittelbar vorgelagerten und in einem zweiten vorbestimmten Zeitintervall (503) dem Spitzenwert (501) unmittelbar nachgelagerten, aufgenommenen Werte umfasst, wobei die mit dem Spitzenwert (501) verbundene Transiente im wesentlichen in den ersten und zweiten Zeitintervallen stabilisiert wird; wobei, wenn der Geschirrspüler einen Zustand ermittelt, der den Sachverhalt widergibt, dass der Mittelwert der ersten Größe im ersten Zeitintervall (502) dem Mittelwert der ersten Größe im zweiten Zeitintervall (503) im wesentlichen gleich ist, der Geschirrspüler (1) den Spitzenwert (501) als Teil eines diesen Stoß oder diese Abfolge von Stößen umfassenden Befehls identifiziert.

**Revendications**

**1.** Procédé de commande d'un lave-vaisselle (1) comprenant :

- un compartiment de lavage (2) ;

- une porte (3) donnant accès au compartiment de lavage (2) ;
dans lequel la porte (3) comporte un capteur (4) qui prend une mesure représentant la composante d'accélération de la pesanteur au moins le long d'un premier axe (40), lequel est solidaire de la porte (3), en vue de détecter des impacts provenant de l'extérieur et associés à des commandes d'utilisateur prédéterminées, dans lequel le procédé comprend les étapes suivantes, mises en oeuvre par le lave-vaisselle :

- détecter, par l'intermédiaire de l'action du capteur (4), un impact ou une séquence d'impacts appliqué(s) par un utilisateur sur la porte (3) ;
- exécuter une commande associée à la détection de l'impact ou de la séquence d'impacts appliqué(s) physiquement par un utilisateur sur la porte (3) ; **caractérisé en ce que** l'étape de détection d'un impact ou d'une séquence d'impacts par l'intermédiaire de l'action du capteur (4) comporte les étapes suivantes :
- mesure, par l'intermédiaire de l'action du capteur (4) du lave-vaisselle (1), d'une première quantité en rapport avec la composante d'accélération de la pesanteur le long du premier axe (40) ;
- comparaison des valeurs de la première quantité avec une valeur de seuil prédéterminée ;

si les valeurs prises par la première quantité dépasse dans la durée la valeur de seuil prédéterminée afin de définir un pic (501), le procédé comprend une étape de comparaison, directe ou indirecte, des valeurs prises par la première quantité dans un premier intervalle de temps prédéterminé (502) immédiatement sur le front montant du pic (501) et dans un second intervalle de temps prédéterminé (503) immédiatement sur le front descendant du pic (501), la valeur transitoire raccordée au pic (501) étant essentiellement stabilisée dans les premier et second intervalle de temps ; si le lave-vaisselle détecte une situation représentant le fait que la valeur moyenne de la première quantité dans le premier intervalle de temps (502) est essentiellement égale à la valeur moyenne de la première quantité dans le second intervalle de temps (503), le lave-vaisselle (1) identifie le pic (501) comme faisant partie d'une instruction comportant cet impact ou cette séquence d'impacts.

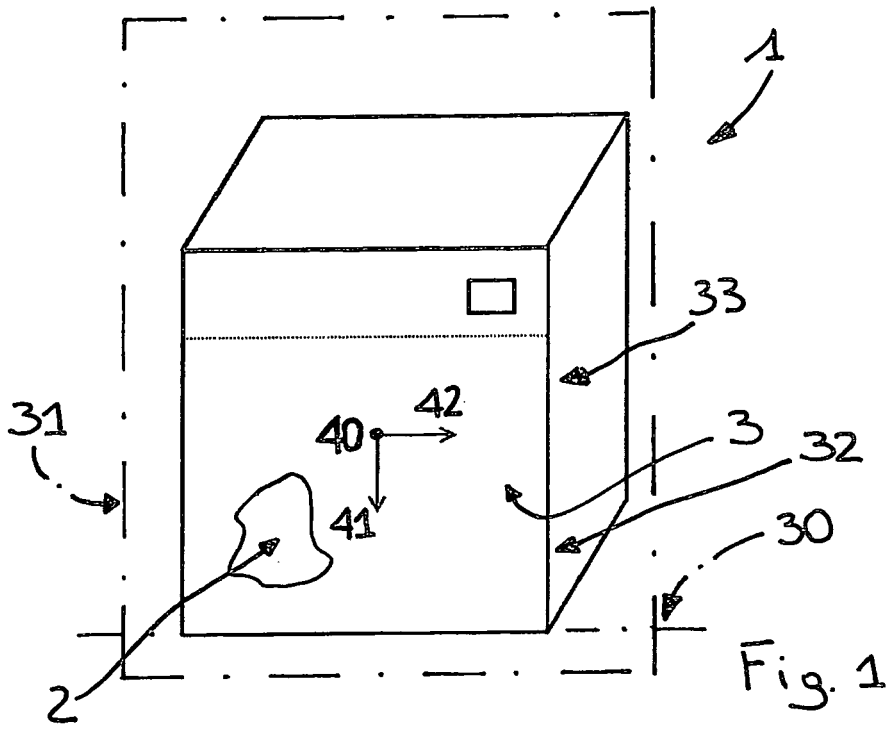



Fig. 1

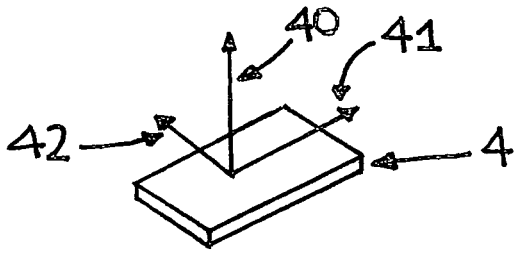



Fig. 2




Fig.3

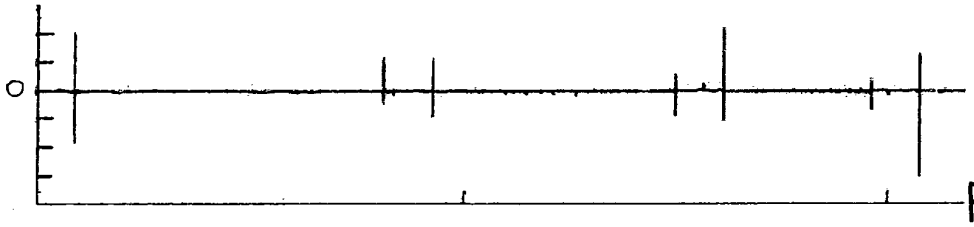



Fig.4

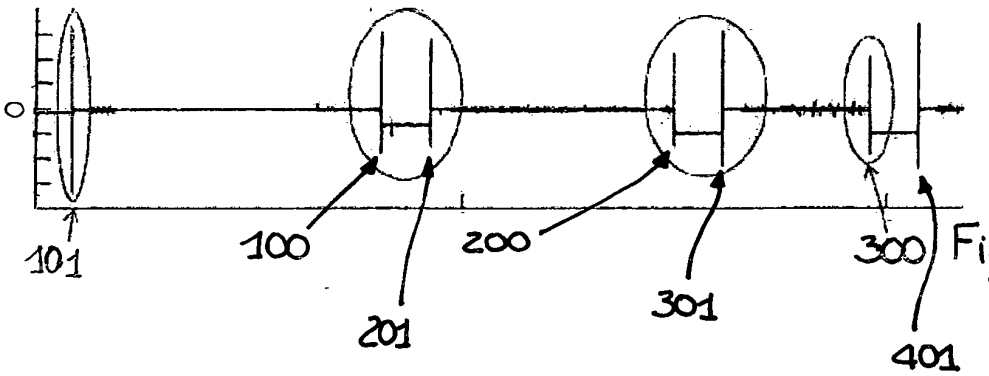



Fig.5

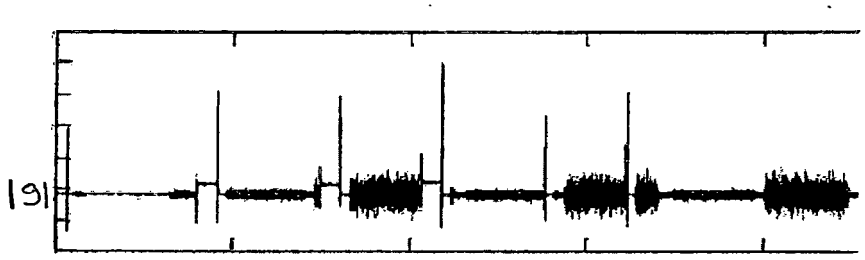



Fig.6

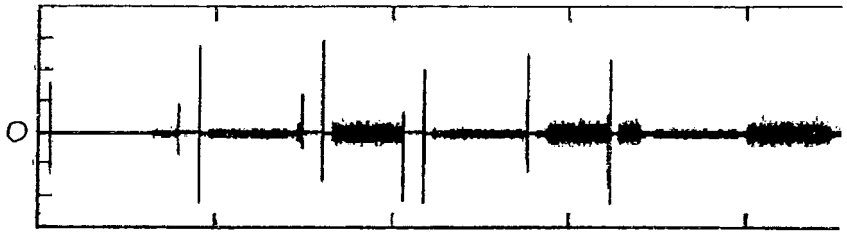



Fig.7

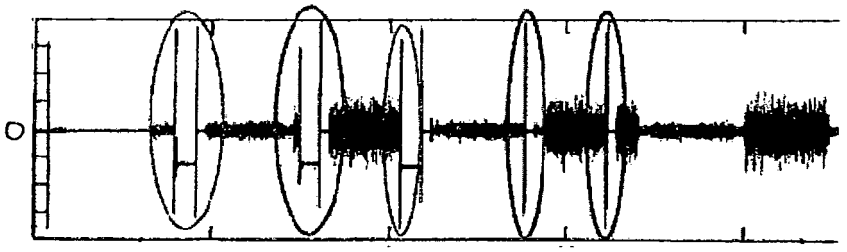



Fig.8

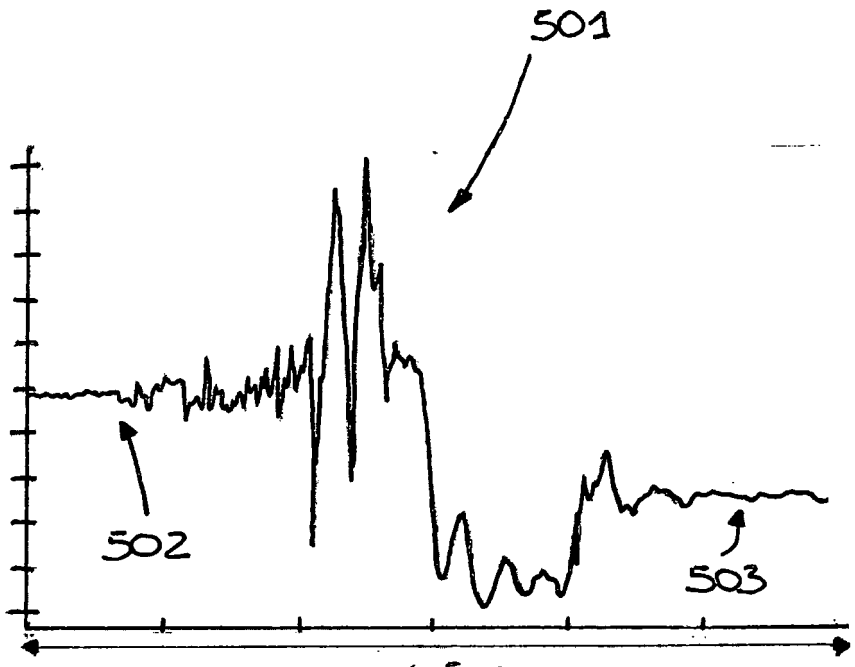



Fig. 9

## REFERENCES CITED IN THE DESCRIPTION

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