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(54) **Electronic musical instrument**

(57) The present invention refers to an electronic musical instrument, broadening the options of production and modulation of sounds currently offered to musicians

by traditional keyboards. By use of strain sensors arranged therein, it remarkably broadens expressive options with respect to a traditional keyboard.

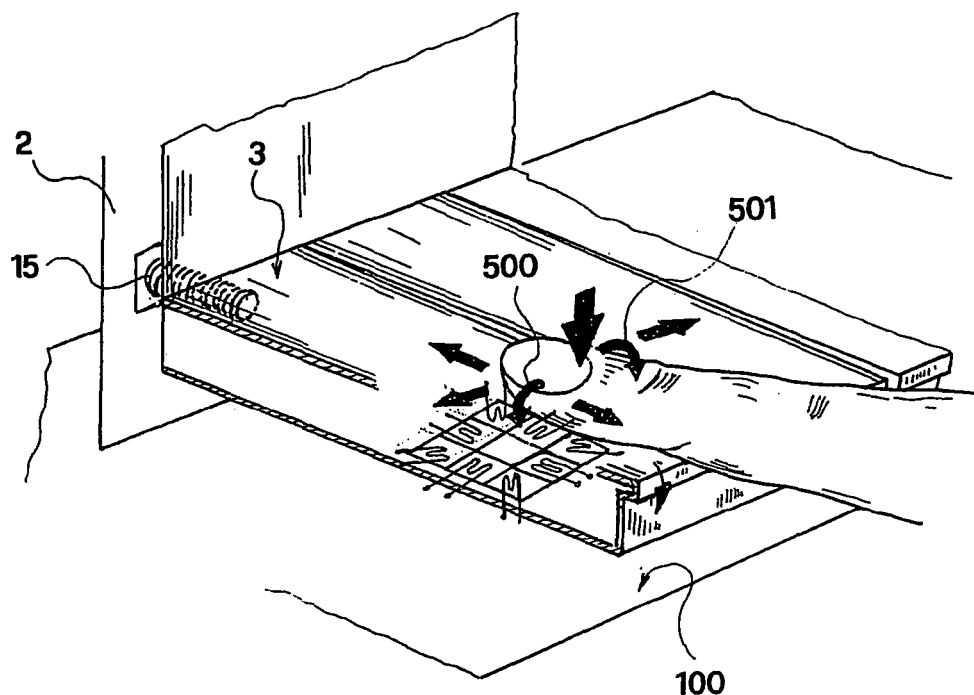


FIG. 5

Description

[0001] The present invention refers to an electronic musical instrument, broadening the options of production and modulation of sounds currently offered to musicians by traditional keyboards.

[0002] Modern electronic keyboards generally comprise therein a vocal synthesizer suitable for the production of sounds.

[0003] Vocal synthesizers, also called expanders, are driven by a MIDI type interface.

[0004] As it is widely known in the current state of the art, MIDI, an acronym for Musical Instrument Digital Interface, is substantially a computer language according to which instructions are transmitted to a synthesizer that, on their basis, produces the desired sound.

[0005] Modern electronic keyboards are widely used for simulating different instruments.

[0006] Generally, on modern electronic keyboards, the pressing of a key causes the production of an electric signal sent to the synthesizer. The signal comprises therein three properties of the sound that has to be produced, i.e. the note (frequency), the dynamics of the simulated instrument and the intensity of the sound to be produced.

[0007] Sound intensity substantially simulates the dynamics, also called "velocity", of the note played. In fact, e.g. a violin-played note having a strong dynamics will be different, volumes being equal, from a note played by the same instrument, yet with a weaker dynamics.

[0008] To date, keyboard keys have a single degree of freedom, along which they are pressed and subsequently released. For each pressuring of a key, a system measures the time the same key spends to reach the lowest position. Obtained data is received by an electronic control unit, which on its basis processes a MIDI control signal to be sent to the synthesizer. Therefore, the faster (and therefore with greater force) the key is pressed, the greater will be the dynamics of the synthesizer-produced note. Instead, for less expensive keyboards, the velocity with which the key is pressed regulates the note volume only.

[0009] Hence, the pressing of a key generates electric signals (type of instrument, note to be played and velocity thereof) that are received by the electronic control unit, which translates them into an instruction packet, according to the MIDI standard, that is subsequently sent to the synthesizer for the production of the required sound.

[0010] Moreover, some traditional electronic keyboards are equipped, on a side, with a small lever, also called bender; its operation allows a user to avail him/herself of some effects that can be associated to the note played.

[0011] Generally, the bender is used, while the key is pressed, to obtain a pitch-shift on the note played, i.e. to cause a frequency variation of the note itself depending on the effect to be obtained. Thus, there can be carried out a vibrato effect, by which the pitch-shift is rapidly per-

formed about an average frequency value, or a glissando (gliding) effect, by which the frequency variation of the note is performed slowly, without returning to the starting value.

[0012] In addition to the above-mentioned levers, some traditional keyboards have the option of adjusting produced sounds by pedals actuated during the same playing. In any case, said pedals adjust at most general features of the sounds produced by the keyboard, and not the features of the sound produced by a specific key.

[0013] Electronic keyboards marketed to date ensure production of sounds of ever-higher quality, and ever more faithful simulation of other instruments; nevertheless, they are affected by several evident drawbacks.

[0014] The main drawback of classical electronic keyboards lies in that they offer scanty options to modulate emitted sounds. In fact, to date a user can modulate sounds during playing solely by adjusting the key-pressing force (i.e., by adjusting the velocity of the notes as described above) and by use of the bender, to perform, e.g., a vibrato or a glissando.

[0015] Clearly, many different effects may be inserted into the keyboard memory, yet they can hardly be managed by the same user during playing; moreover, they can in no way constitute a means for increasing playing expressiveness.

[0016] Moreover, the user, when making use of the lever to modulate sound, has to resort to the use of a hand, which therefore is taken away from the keyboard.

[0017] Analogously, should the user programs the keyboard in order to obtain predefined effects, performing such an operation while playing the piece, he/she will have to make use of one of the two hands in order to access keyboard settings, thereby limiting his/her expressive options in this way as well.

[0018] The above-described drawbacks become prominent in case the electronic keyboard is used to simulate another instrument, like e.g. a violin or a wind instrument.

[0019] In fact, as it could certainly be appreciated by a person skilled in the art, oft-times a violinist has to comply with various modulations and coloraturas. E.g., a violinist typically plays a continuous note doing a crescendo, i.e., gradually increasing its intensity by varying the pressure or the speed of the bow on the strings. Analogously, with a wind instrument a musician will do a crescendo over a note by inletting more or less air therein.

[0020] With classical electronic keyboards, such an effect cannot be easily obtained without compromising musical execution and limiting a performer's expressivity.

[0021] Hence, object of the present invention is to overcome the drawbacks mentioned above with reference to the known art, by providing an instrument substantially as described in claim 1.

[0022] Secondary features of the present invention are instead defined in the respective dependent claims thereof.

[0023] The present invention, by overcoming the men-

tioned problems of the known art, entails several evident advantages.

[0024] The electronic instrument subject-matter of the present invention uses, in the present embodiment described herein by way of example and not for limitative purposes, strain sensors positioned at the bottom of keys. In particular, the keys of the instrument subject-matter of the present invention have more degrees of freedom in their motion with respect to classical keyboard keys (which can only be pressed downward).

[0025] In fact, the key is connected to the keyboard by an elastic joint, which allows the key itself to move along plural degrees of freedom.

[0026] As it will be detailed hereinafter, one or more movements imparted to the keys by the user are sensed by the strain sensors, or strain gauges, positioned at their bottom, subsequently translated into an electric signal and then into a sound.

[0027] In particular, strain gauge deformation is encoded by an electronic control unit connected to a MIDI interface, which sends to the synthesizer one or more control signals corresponding to one or more musical events to be reproduced.

[0028] Thus, it considerably broadens the expressive options of the instrument, furthermore enabling an extremely faithful simulation of other musical instruments, as it will be detailed hereinafter.

[0029] For clarity's sake, hereinafter there is provided technical information on the strain sensors used in the instrument subject-matter of the present invention.

[0030] Pressure sensors, also called strain gauges, consist of a support onto which a grid of very thin wire is bonded.

[0031] The strain gauge is then bonded onto the body of which strains are to be measured.

[0032] The grid of very thin wire follows the strains of the body, by lengthening and shortening, depending on whether the body is subjected to a tensile or compressive stress. According to the known Ohm's law, these dimensional variations of the wire cause a variation of its electric resistance; therefore, by measuring these variations with suitable electric circuitry it is possible to trace the extent of the strain.

[0033] Strain gauges may be disposed in order to measure strains deriving from a tensile state along an axis, by arranging one or more wire grids along said axis, or they may be disposed in order to measure strains caused by a plane tensile state, by arranging pairs of grids perpendicular therebetween along a plane whose strains are to be known.

[0034] In the first case the strain gauges are of uniaxial type, whereas in the second case they are biaxial.

[0035] To measure more complex tensile states, in addition to grids perpendicular therebetween usually other grids are interposed, tilted with respect thereto of an angle of 45°.

[0036] The main advantage lies in that the instrument subject-matter of the present invention remarkably

broadens expressive options with respect to a traditional keyboard.

[0037] By use of a strain sensor it is possible, e.g., to play a note in crescendo (or in diminuendo) simply by pressing the key and gradually increasing (or decreasing) the pressure thereon.

[0038] More generally, once pressed the key, the instrument subject-matter of the present invention allows to continue modulating the sound with the movements imparted by the user to the key, and encoded as mentioned above by the strain sensor lying therebelow.

[0039] Moreover, by the instrument subject-matter of the present invention it is possible to simulate other instruments in an extremely faithful manner.

[0040] Another advantage of the present invention lies in that the keys are equipped with further position sensors, located at their outer surface pressed by the user. Thus, the instrument can modulate the sound produced by the motion of a key also depending on which portion of the key itself has been pressed, thereby obtaining other options of modulation on the sounds produced.

[0041] Lastly, the instrument subject-matter of the present invention is based on the use of components (strain gauges) widely used to date and not particularly expensive, making the manufacturing thereof not particularly onerous in terms of costs, though dramatically broadening the options of a standard keyboard in the production and modulation of sounds.

[0042] Other advantages, features and the operation modes of the present invention will be made evident from the following detailed description of two embodiments thereof, given by way of example and not for limitative purposes. Reference will be made to the figures of the annexed drawings, wherein:

Figure 1 shows, in a top plan view, the instrument subject-matter of the present invention;

Figures 2, 3, 4, 5, 6, 6A show, in a perspective view, a detail of the instrument subject-matter of the present invention;

Figure 2A shows a side view of a detail of the instrument subject-matter of the present invention;

Figures 3A and 4A show a top plan view of a detail of the instrument subject-matter of the present invention;

Figure 5A shows a front view of a detail of the instrument subject-matter of the present invention;

[0043] The present invention will hereinafter be described making reference to the above-indicated figures.

[0044] In particular, referring to Figure 1, the electronic musical instrument 1 subject-matter of the present invention is depicted in a top plan view. It comprises a main body 2 to which there are movably connected a plurality

of keys.

[0045] Purely by way of example, hereinafter there will be detailed the features of the instrument 1 subject-matter of the present invention, related to a key 3; it is understood that said features are the same for all keys of the instrument.

[0046] The key 3 has a bottom surface (not shown in figure), and a top surface 5 on which a user exerts a pressure in at least one preferential direction, for the production/modulation of a sound, as it will be detailed hereinafter.

[0047] The instrument 1 comprises means for the instantaneous measuring of pressure exerted by the user on the top surface 5. Said means is apt to generate an electric signal, corresponding to the measured pressure, and to send it to an electronic control unit 8 through an electric circuit 80. The electronic control unit is apt to continuously receive said electric signal and to process instant-wise one or more corresponding control signals. Said control signals could be processed by the control unit by means of a MIDI interface, according to the standard most used in the production of digital music. Then, the control unit sends said control signals to a synthesizer 9 for the production/modulation of a sound. A control signal comprises all information needed by the synthesizer to operate the desired sound production/modulation.

[0048] It will be appreciated that both the electronic control unit and the synthesizer could be located inside the main body 2, or remotely with respect thereto.

[0049] It will be appreciated that said means for the instantaneous measuring of pressure could be of various types. Hereinafter a preferred embodiment thereof is described, purely by way of example and without limitative purposes.

[0050] Said measuring means comprises a resilient base member (not shown in figure 1) integral to said main body 2 and positioned bottomwise to said key 3, substantially at the bottom surface thereof, in a manner such as to cooperate therewith when the key 3 is subjected to a pressure exerted on the top surface 5 by the user. There could be a respective resilient base member for each key of the instrument, or a resilient base member common for all keys, by which each key will cooperate with a respective portion underlying thereto. Technical solutions for such an embodiment are within the reach of a person skilled in the art and will not be delved into hereinafter.

[0051] Moreover, said instantaneous measuring means comprises for each key a strain sensor, schematically denoted in the figure by the numeral 7, arranged on a respective resilient base member.

[0052] Always referring to figure 1, the sensor 7 is connected by the electric circuit 80 to the electronic control unit 8. As it is evident, a pressure exerted by a user on the key 3 against the resilient base member is detected and measured by the strain sensor 7.

[0053] The strain sensor may be made by one or more strain gauges.

[0054] Strain gauges, as mentioned above, are made

of a grid of very thin wire bonded to a surface of which strains are to be known. In particular, by positioning one or more strain gauges onto the resilient base member it is possible to measure its strain, caused by the pressure of the key 3 against it. By measuring its strains it is possible, knowing the elastic properties of the strained material, to trace the properties of intensity and direction of the pressure exerted.

[0055] Contrivances needed for the technical implementation of strain gauges into the instrument subject-matter of the present invention are deemed to be within the reach of a person skilled in the art, therefore a detailed description thereof will be omitted.

[0056] Therefore, by measuring the deformation (strain) of the resilient base member onto which it is positioned, proportional to the pressure exerted on the key 3, the strain sensor 7 sends an electric signal, corresponding to said measured strain, to the electronic control unit 8 through the electric circuit 80. Then, the electronic control unit receives said signal and processes one or more control signals to be sent to the synthesizer for the production/modulation of a sound.

[0057] The key 3 is connected to the main body by connecting means 15, and is movable between a rest position, in which it does not interact with the respective strain sensor, and an operative position in which it cooperates with the resilient base member, when pressed by the user.

[0058] Referring to next Figures 2 and 2A, the strain sensor 7 is implemented by a strain gauge 71, arranged on the resilient base member, denoted in the figure by numeral 4, at the bottom surface 6 of the key 3.

[0059] The connecting means 15 is such as to allow to the key 3, when pressed, a movement along a direction substantially orthogonal to a plane 100 containing the resilient base member 4, and denoted in figure by arrow 200. Therefore, the key effects a strain of the resilient base member along said orthogonal direction, strain that is measured by the strain gauge 71. Moreover, said means 15 allow said key 3 to return to the rest position as soon as the pressure on the key - exerted just by the user - ceases. Said means 15 is implemented, by way of example and not for limitative purposes, by an elastic joint 15.

[0060] In light of the foregoing, in the exemplary and non-limiting case in which the keyboard simulates a violin, by pressing the key 3 the synthesizer will generally produce a sound that will depend, other than on the specific key, on the pressure with which the key is pressed. By gradually increasing the pressure on the key, the strain gauge 71 will measure a strain increasing over time and will continuously transmit to the electronic control unit a corresponding signal at each pressure value sensed. Therefore, by a suitable adjustment of the MIDI interface of the control unit, it is possible to set it in a manner such as to associate to each pressure value a specific intensity of the note produced by the synthesizer.

[0061] Therefore, by increasing the pressure on the

key, intensity of the played note will increase, thereby faithfully simulating a violin, when a "crescendo" note" is performed, according to what has been described above.

[0062] It will be appreciated that simulation faithfulness will also depend on the specific electronic control unit used, and on the quality and quantity of sampled sounds present inside the synthesizer. Therefore, the greater the technological grade of these components, the better the quality of the obtained simulation.

[0063] It will be appreciated that, according to the specific adjustment operated on the M.I.D.I interface, to the increase (or decrease) of pressure on the key 3 there could be associated other types of modulations or effects, to be associated to the specific note produced, and of which intensity is just a non-limiting example.

[0064] Referring to the next figures 3 and 3A, the elastic joint 15 is such as to allow to the key 3, in addition to its lowering along the orthogonal direction indicated by arrow 200, a sliding onto the resilient base member along a vertical direction lying on the plane 100 and indicated by arrows 300 and 301.

[0065] In other words, following the pressure exerted by the key 3 onto the resilient base member in an orthogonal direction, the user has the option to slide the key forward or backward along the direction indicated by said arrows 300 and 301. Thus, the resilient base member is subjected to a strain along said vertical direction, measured by the strain sensor 7. In this case, the strain sensor may be made by a pair of strain gauges 72, 73 arranged just along the vertical direction onto which the strain takes place.

[0066] It will be appreciated that said pair of strain gauges 72, 73 is such as to measure both the strain along the orthogonal direction, produced by the lowering of the key 3 against the resilient base member, and the strain of the resilient base member along the vertical direction, produced by the sliding of the key thereon in the direction indicated by arrows 300 and 301.

[0067] Therefore, evidently the electric signal produced by the pair of strain gauges 72 and 73 and corresponding to the strain of the resilient base member in the vertical direction is transmitted to the electronic control unit and may be associated thereby to a specific effect/modulation of the sound produced by the synthesizer, according to the modes discussed above.

[0068] Hence, a pressure on the key in the orthogonal direction causes the production of a sound. An increase of the pressure causes, e.g., a dynamic variation of the same sound, whereas a sliding of the key along the vertical direction causes, e.g., an effect/modulation of the sound itself.

[0069] Referring now to Figures 4 and 4A, the elastic joint 15 allows the key 3, in addition to its movement along the orthogonal direction indicated by arrow 200, a further sliding along a longitudinal direction, lying onto the plane 100 indicated by arrows 400 and 401, and orthogonal to the above-discussed vertical direction.

[0070] In other words, following the pressure in the or-

thogonal direction exerted by the key 3, the elastic joint 15 allows the user to slide the key rightwise or leftwise onto the resilient base member along the direction indicated by said arrows 400 and 401. Thus, the resilient base member is subject to a strain, along said longitudinal direction, measured by the strain sensor 7. The strain sensor 7 may be made by a pair of strain gauges 74, 75, now arranged along the longitudinal direction on which the strain occurs.

[0071] The pair of strain gauges 74 and 75, in an entirely analogous manner, will send to the electronic control unit an electric signal corresponding to the strain measured along said longitudinal direction to operate a further modulation/effect of the sound produced by the synthesizer.

[0072] Therefore, the pair of strain gauges 74 and 75 arranged along the longitudinal direction, is orthogonal to the pair of strain gauges 72 and 73 for measuring the strain in the vertical direction. Therefore, the two pairs form a first strain gauge cross.

[0073] Always referring to Figures 4 and 4A, the key 3 is advantageously characterised in that it has a substantially trapezoidal shape, in order to allow said sliding along the longitudinal direction without interfering with keys 3' and 3" adjacent thereto.

[0074] Referring now to Figures 5 and 5A, the elastic joint is such as to allow the key 3 a roll sliding onto the resilient base member about the plane 100, along the arrows 500 and 501. In an entirely analogous manner, the pressure sensor measures the strains of the resilient base member corresponding to said roll sliding of the key and transmits an electric signal, corresponding to said strains, to the electronic control unit for a further effect/modulation of the sound produced.

[0075] In this case, the strain sensor can be made by four strain sensors forming a second strain gauge cross, concentric with respect to the first strain gauge cross and rotated with respect thereto of an angle of about 45°.

[0076] As it is evident from Figure 5, the elastic joint 15 allows the key 3, beside pressure in a direction orthogonal to the plane 100, a sliding obtainable by a combination of said vertical, longitudinal and roll slidings.

[0077] For each position assumed by the key 3 with said combination of sliding, the elastic joint 15 is such as to return the key 3 into the rest position, as soon as the pressure exerted thereon by the user ceases.

[0078] Thus, it will be appreciated that expressive options are remarkably broadened with respect to a traditional keyboard.

[0079] By way of example and not for limitative purposes, the roll sliding might simulate the variation of sound of a note obtained on a violin by varying the position of the bow with respect to the strings. While performing a roll modulation, by increasing pressure in the orthogonal direction there can be obtained a timbre variation of the note (simulating an increase or decrease in the intensity of the bow on the string), beside obtaining other desired effects by a combination of sliding of the

key along the vertical and longitudinal directions.

[0080] Referring to Figure 6, the key 3 of the instrument 1, movable in the above-described manner, additionally has a plurality of position sensors 20, 20', 20'', each placed substantially at the top surface 5 and apt to detect a respective zone of the top surface 5 at which the user exerts pressure. In an entirely analogous manner, the position sensors transmit to the electronic control unit a second electric signal corresponding to the detected pressure zone, to operate a further modulation of the sound produced by the audio synthesizer.

[0081] Referring to the last Figure 6A, the musical instrument subject-matter of the present invention comprises a single key 3, movable with respect to the main body 2 according to what has been described in the foregoing, and having on its surface a plurality of pressure sensors, arranged grid-like thereon. By way of example, the key 3 might associate a specific note to each zone in which pressure is detected by the respective position sensor, and operate various modulations/effects on the note produced by the above-discussed modes.

[0082] The present invention has hereto been described with reference to a preferred embodiment thereof. It is understood that there might be other embodiments afferent to the same inventive kernel, all falling within the protective scope of the claims hereinafter.

Claims

1. An electronic musical instrument (1), comprising a main body (2) to which it is connected, by connecting means (15), at least one movable key (3) having a bottom surface (6), and a top surface (5) on which a user exerts a pressure in at least one preferential direction in order to produce a sound, said musical instrument (1) being **characterised in that** it comprises:
 - means (7) for the instantaneous measuring of said pressure, apt to generate an electric signal corresponding to the measured pressure;
 - an electronic control unit (8) apt to continuously receive said electric signal and to process one or more control signals depending on said electric signal, to be sent to an audio synthesizer (9) for the production/modulation of one or more sounds corresponding to said one or more control signals.
2. The electronic musical instrument (1), wherein said means (4, 7) for the instantaneous measuring of pressure comprises a resilient base member (4) integral to said main body (2) and positioned bottomwise to said at least one key (3) substantially at said bottom surface (6), in a manner such as to cooperate therewith when said at least one key (3) is subjected to said pressure; a strain sensor (7), arranged on said resilient base member (4), apt to measure a strain thereof in said at least one preferential direction, said strain being proportional to the pressure exerted by the user on said at least one key (3).
3. The electronic musical instrument (1) according to claim 2, wherein said connecting means (15) is apt to allow to said at least one key (3), when pressed, a lowering along a direction substantially orthogonal to a plane (100) containing said resilient base member (4), said strain sensor (7) being apt to measure a strain in said orthogonal direction of said resilient base member (4).
4. The electronic musical instrument (1) according to claim 3, wherein said connecting means (15) is such as to further allow to said at least one key (3), when pressed, a sliding onto said resilient base member (4) along a vertical direction lying on said plane (100), said strain sensor (7) being apt to measure a strain in said vertical direction of said resilient base member (4).
5. The electronic musical instrument (1) according to claims 3 or 4, wherein said connecting means (15) is such as to further allow to said at least one key (3), when pressed, a sliding onto said resilient base member (4) along a longitudinal direction lying on said plane (100), said strain sensor (7) being apt to measure a strain in said longitudinal direction of said resilient base member (4).
6. The electronic musical instrument (1) according to one of the claims 3 a 5, wherein said connecting means (15) is such as to further allow to said at least one key (3), when pressed, a roll sliding onto said resilient base member (4) about said plane (100), said strain sensor (7) being apt to measure a corresponding strain of said resilient base member (4).
7. The electronic musical instrument (1) according to claims 4 to 6, wherein said connecting means (15) is such as to allow to said at least one key (3), when pressed, a movement by a combination of said longitudinal, vertical and roll movements.
8. The electronic musical instrument (1) according to claims 4 and 5, wherein said longitudinal and vertical directions are substantially orthogonal therebetween.
9. The electronic musical instrument (1) according to any one of the preceding claims, wherein said strain sensor (7) comprises at least one strain gauge (71).
10. The electronic musical instrument (1) according to any one of the preceding claims, wherein said at least one key (3) has a substantially trapezoidal shape.

11. The electronic musical instrument (1) according to any one of the preceding claims, wherein said at least one key (3) has at least two position sensors (20, 20'), each placed substantially at said top surface (5) and apt to detect a respective zone of the top surface (5) at which the user exerts pressure, said at least two position sensors (20, 20') being apt to transmit to said electronic control unit (8) a second electric signal corresponding to said detected pressure zone, to operate a further modulation of the sound produced by said audio synthesizer (9). 5 10
12. The electronic musical instrument (1) according to any one of the preceding claims, wherein said electronic control unit (8) comprises a MIDI type interface. 15
13. The electronic musical instrument (1) according to any one of the preceding claims, wherein said connecting means (15) comprises an elastic joint (15). 20

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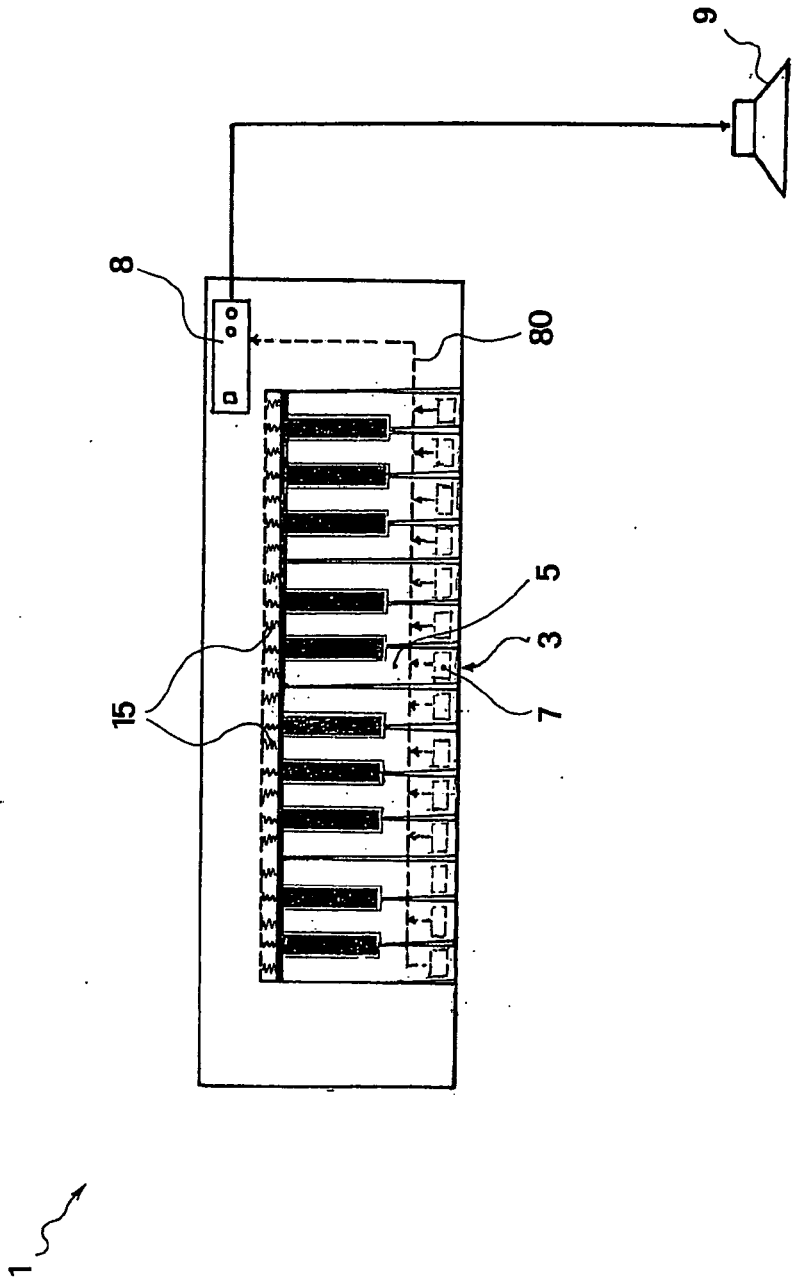


FIG.1

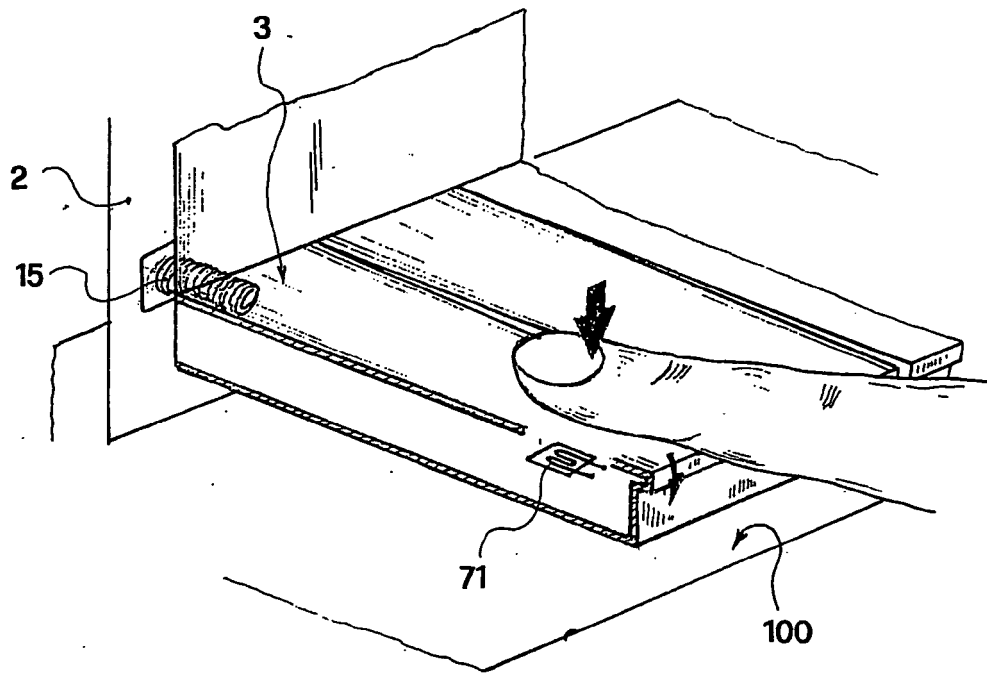


FIG. 2

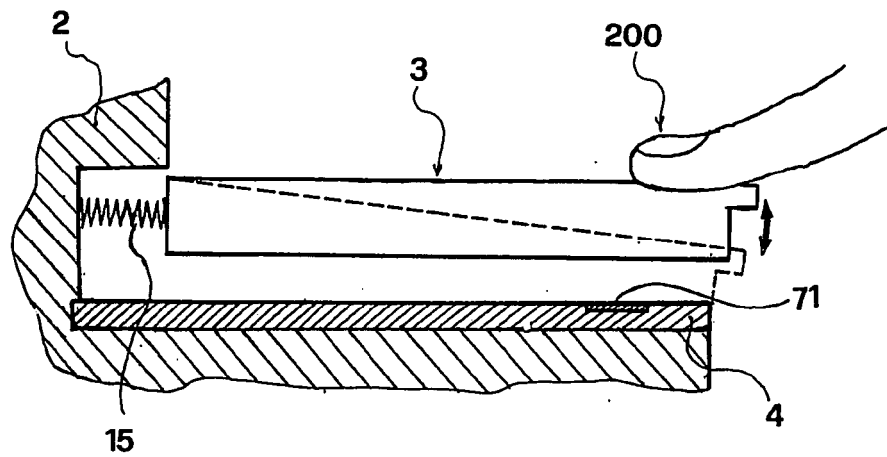


FIG. 2A

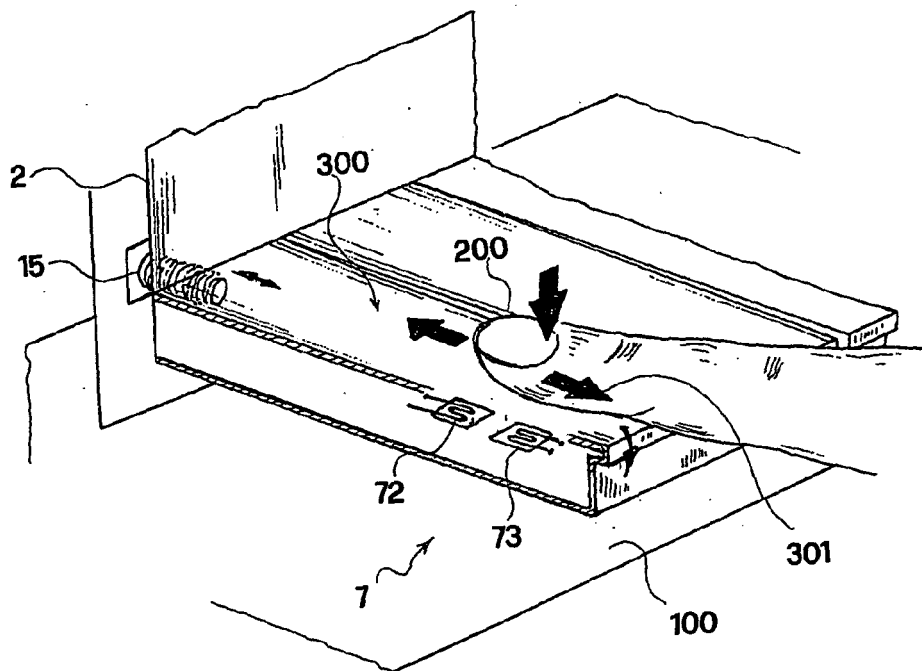


FIG. 3

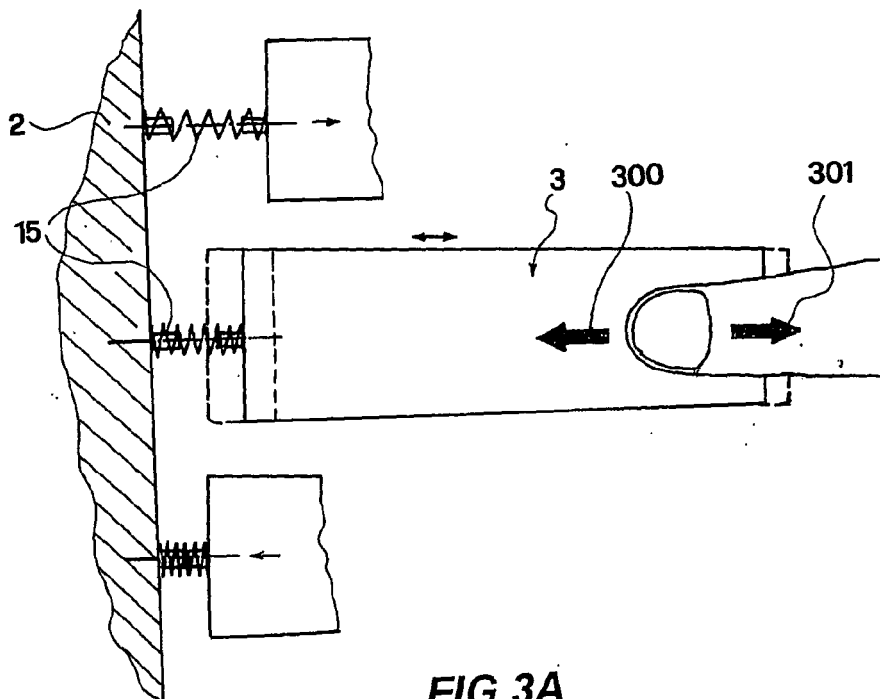


FIG. 3A

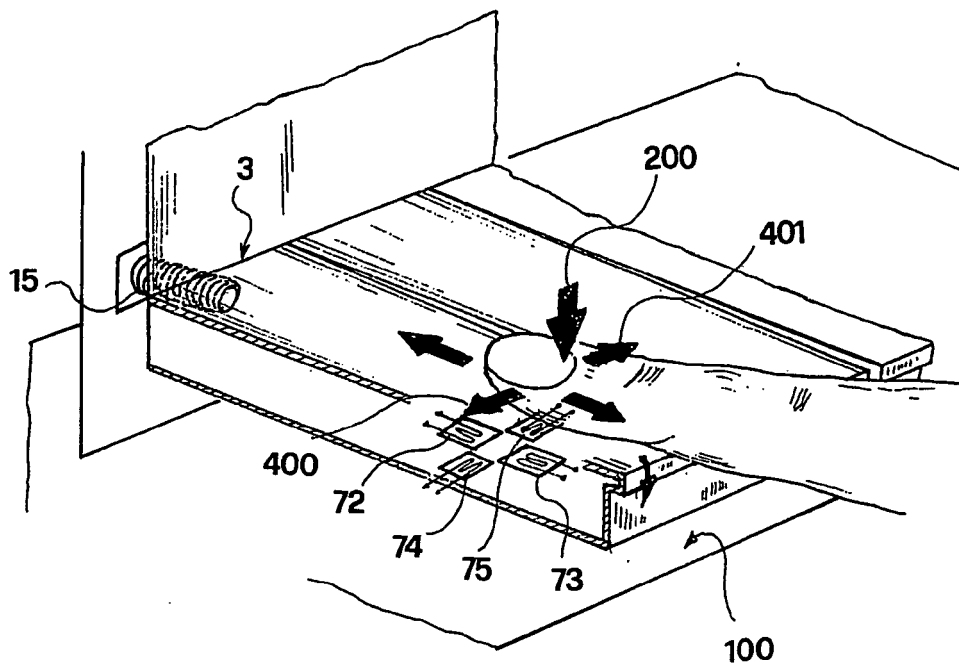


FIG.4

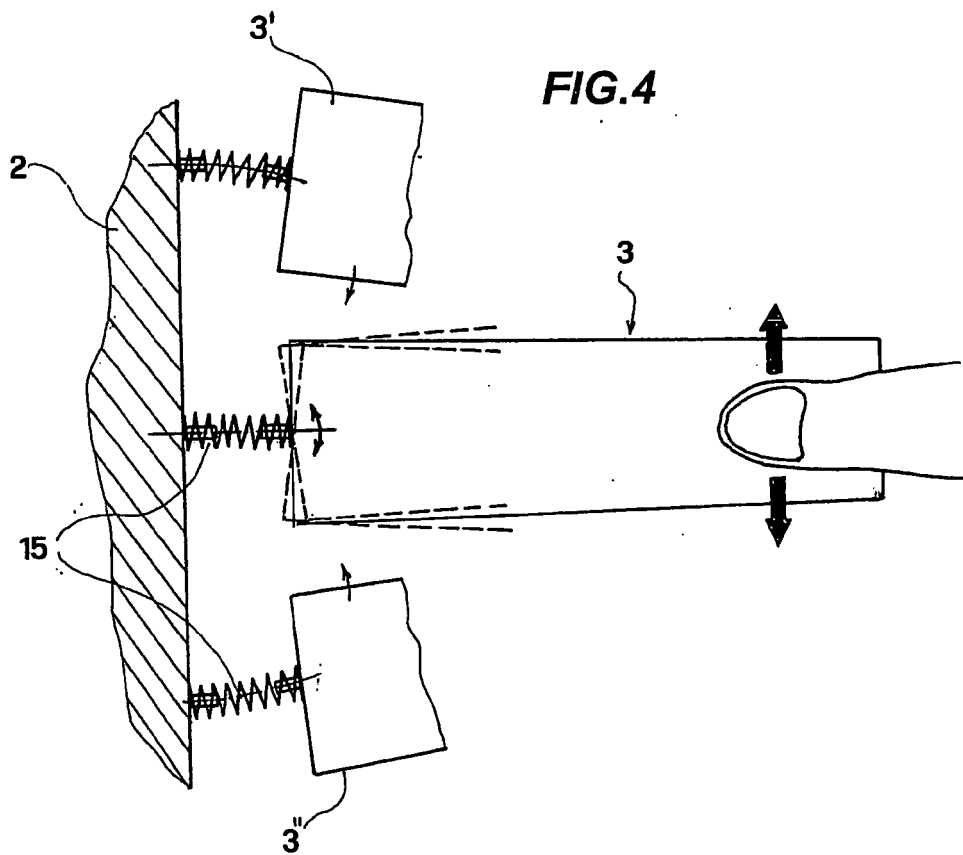


FIG.4A

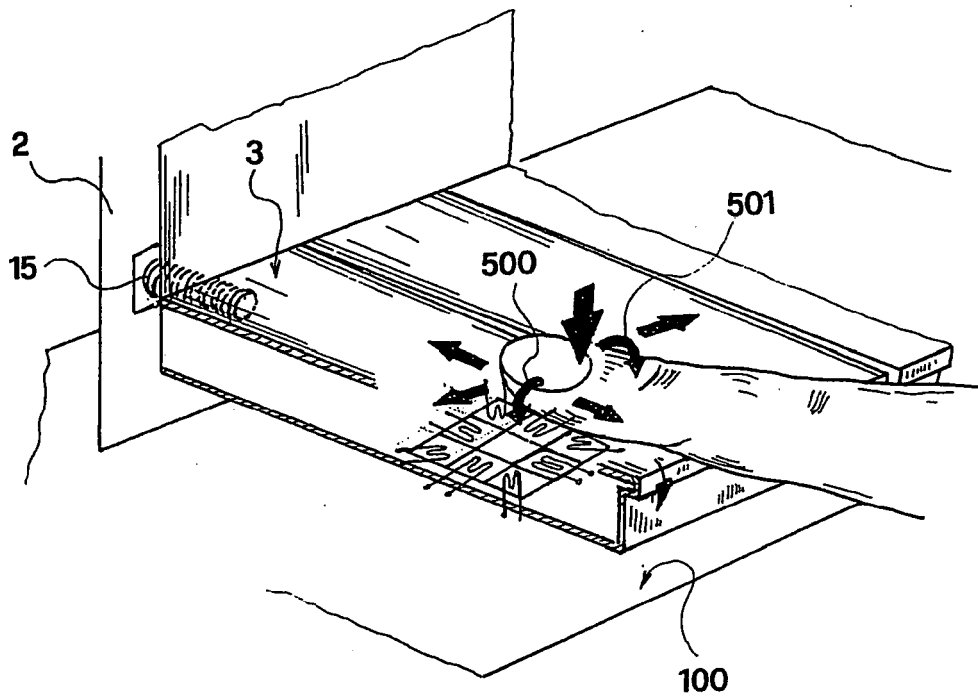


FIG.5

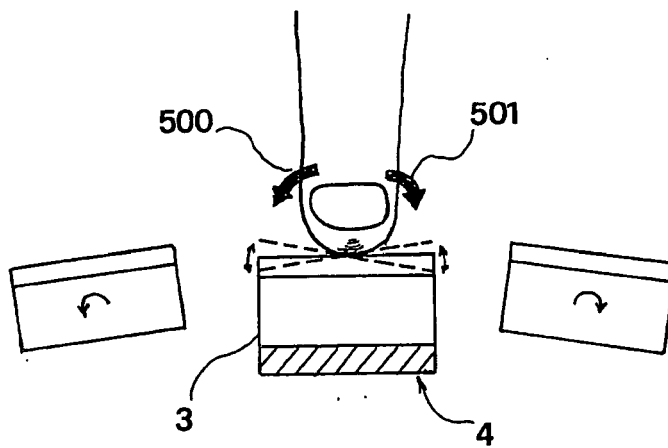


FIG.5A

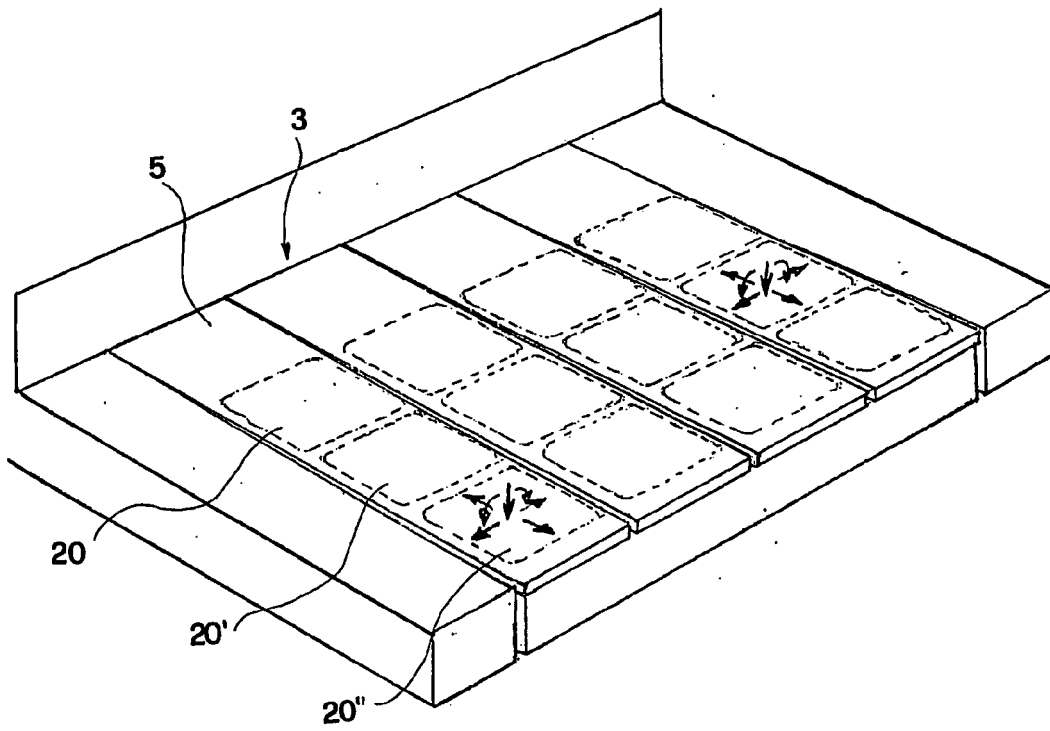


FIG. 6

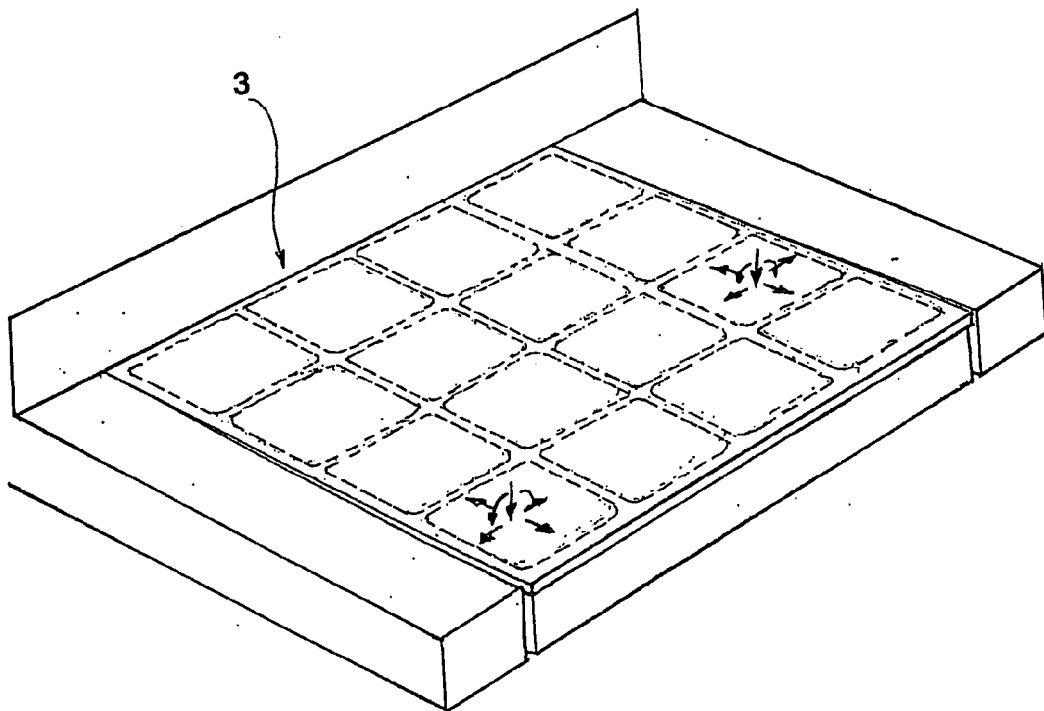


FIG. 6A



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 42 5788

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 495 074 A (KONDO MASAO [JP] ET AL) 27 February 1996 (1996-02-27) * column 3, line 55 - column 12, line 43; figures 10,11,13,16 *	1-5,8	INV. G10H1/34 G10H1/055
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3 The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 May 2008	Examiner Feron, Marc
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)



European Patent
Office

Application Number

EP 07 42 5788

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-5, 8

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-5,8

musical instrument sensing key pressure in two orthogonal directions using strain sensors

2. claims: 6,7

musical instrument sensing "roll sliding" key movement different from above said key pressure detection in two orthogonal directions.

3. claim: 9

musical instrument using strain gauges in key pressure sensors

4. claim: 10

musical instrument with a trapezoidal shaped key

5. claim: 11

musical instrument having at least two position sensors on the top of a key

6. claim: 12

musical instrument having pressure sensing keys and a MIDI type interface

7. claim: 13

musical instrument having pressure sensing keys including an elastic joint

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 42 5788

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-05-2008

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