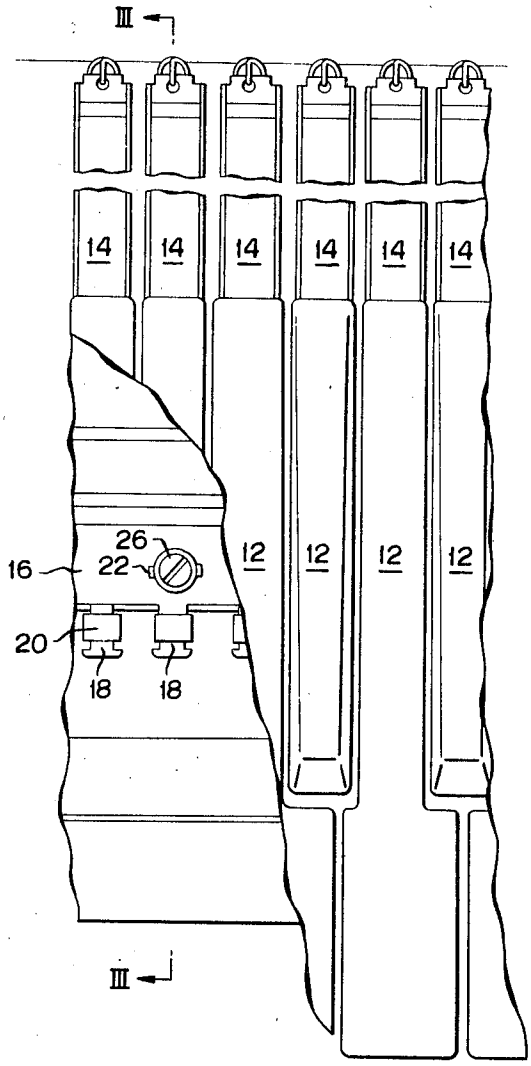
March 10, 1970 JUNJI OHNO 3,499,971

ELECTRICAL MUSICAL INSTRUMENT WITH KEY GUIDE PLATE ELASTICALLY CONNECTED TO KEYBOARD FRAME PERMITTING TRANSVERSE VIBRATORY MOTION OF PLATE TO ACHIEVE SPECIAL EFFECTS

Filed April 22, 1968 5 Sheets-Sheet 1

FIG. 1



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FIG. 2

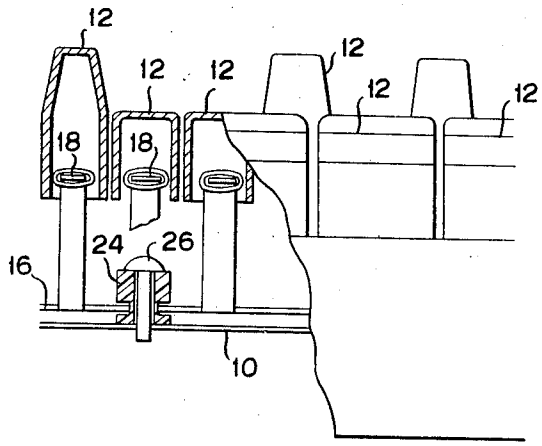
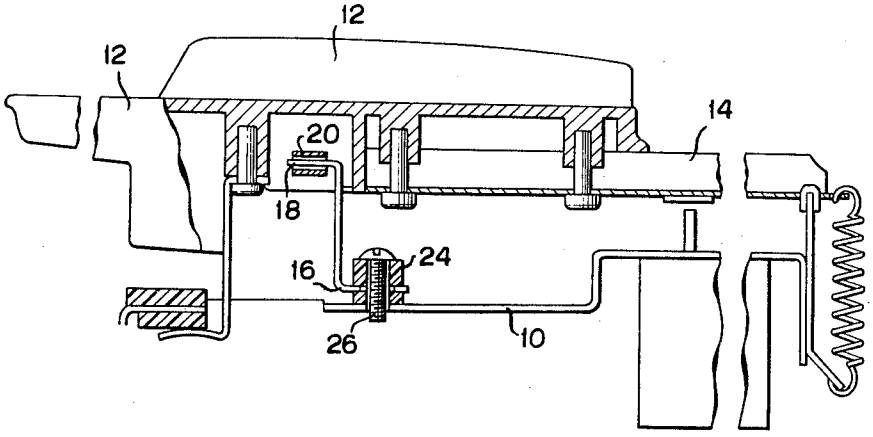


FIG. 3



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FIG. 4

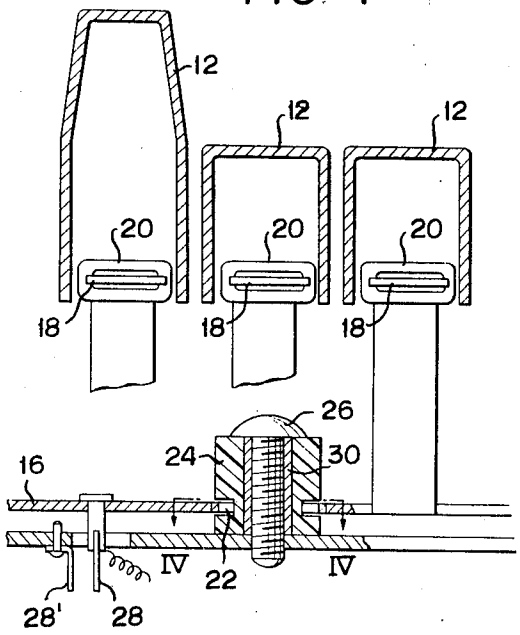


FIG. 4a

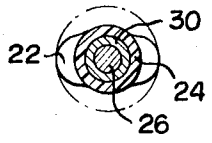


FIG. 5

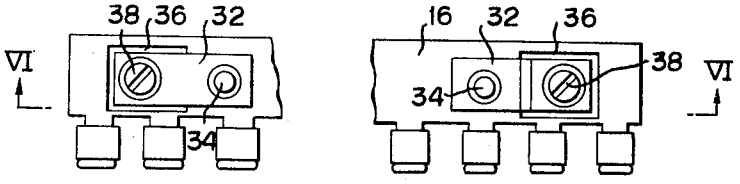
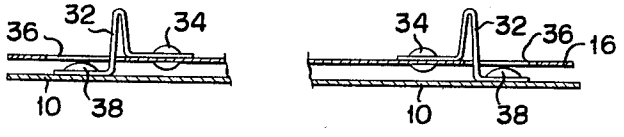


FIG. 6



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FIG. 7

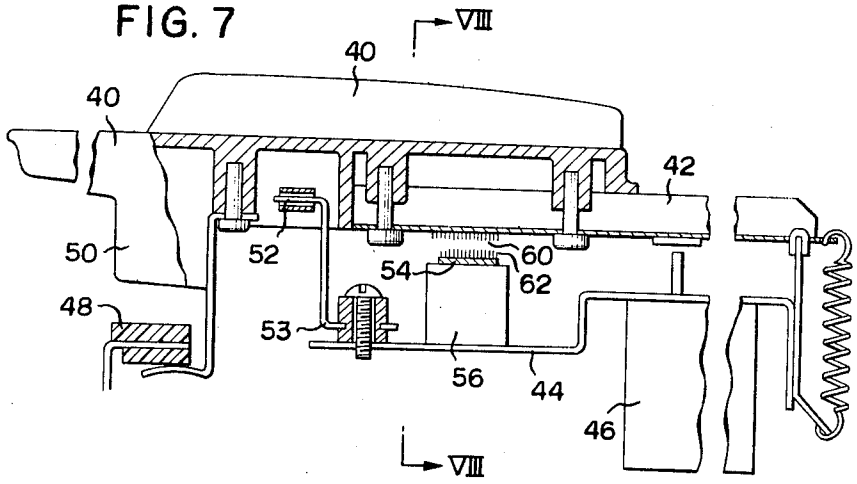


FIG. 8

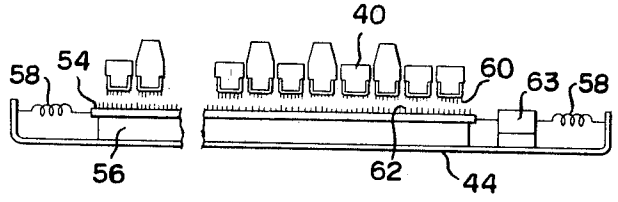
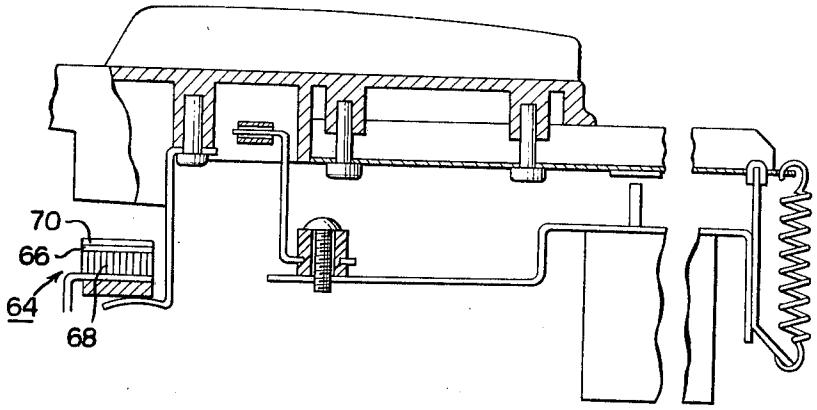


FIG. 9



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FIG. 10

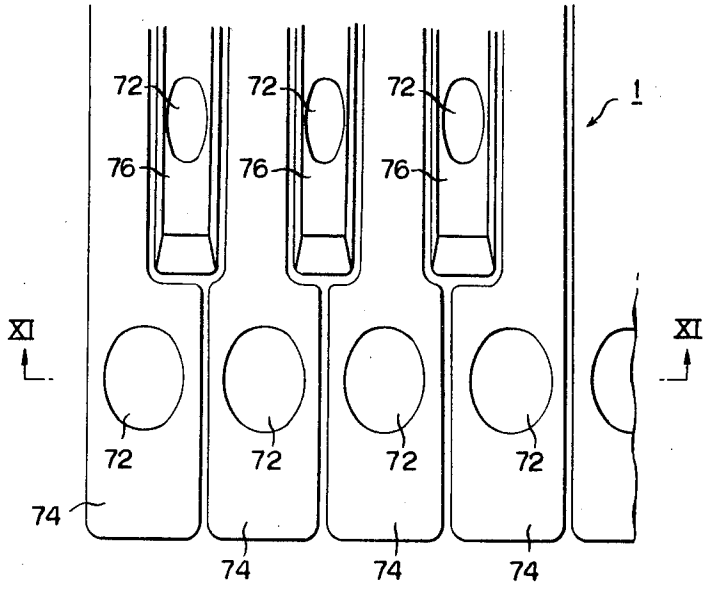


FIG. 11

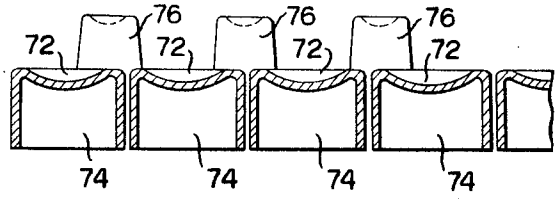
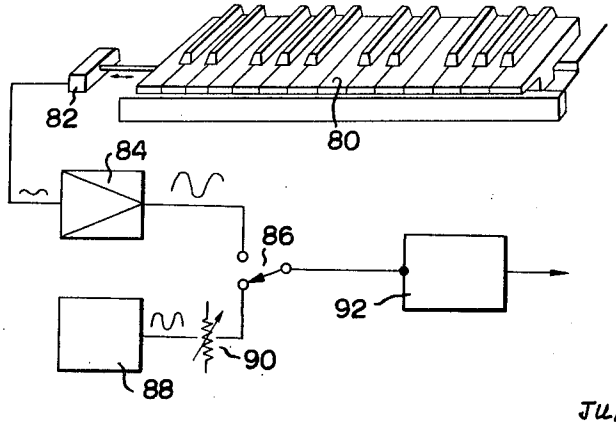


FIG. 12



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United States Patent Office 3,499,971 Patented Mar. 10, 1970

3,499,971

ELECTRICAL MUSICAL INSTRUMENT WITH KEY GUIDE PLATE ELASTICALLY CONNECTED TO KEYBOARD FRAME PERMITTING TRANSVERSE VIBRATORY MOTION OF PLATE TO ACHIEVE SPECIAL EFFECTS

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Claims priority, application Japan, Apr. 26, 1967, 42/34,746; Dec. 27, 1967, 43/108,599, 43/108,600
Int. Cl. G01h 3/06, 1/04
U.S. Cl. 84—1.17 3 Claims

ABSTRACT OF THE DISCLOSURE

A keyboard device for an electronic musical instrument which comprises a keyboard frame, keys supported on said frame, a key building plate having key guides each engaging with one of the keys to guide the vertical movement thereof and elastic members elastically connecting said key guiding plate to said keyboard frame so that the key guiding plate can be slightly moved in the transverse direction, permitting a player of the electronic musical instrument to vibrate the key to the right and the left while depressing the same. This vibrating movement of the key can be utilized to produce certain special musical effect.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to a keyboard device for an electronic musical instrument including a plurality of keys in which each key is pivotally supported at its rear end on a keyboard frame and guided at its forward portion by a key guide which engages with the key to guide the vertical movement thereof.

Description of the prior art

In a keyboard device for an electronic musical instrument of old types, the keys are pivotally supported at one end thereof so as simply to close contacts when they are depressed. However, there is a fatal drawback in such construction of the keyboard device in that these keys sway in the transverse directions when they are depressed, particularly when relatively long keys are used, causing clicking sounds due to hitting of the swaying key against the adjoining keys, since these keys are only unsecurely supported by the pivotal means alone.

Hence, in order to overcome the inconvenience, there has been developed a keyboard device for an electronic musical instrument in which a key guide is provided for each individual key to prevent the same from sidewise movements, affording much improved touch to a player.

That is, a keyboard device for an electronic musical instrument known heretofore employs a plurality of key guides fixed on the keyboard frame, each guide engaging with one of the keys to guide the movement thereof, whereby the key is prevented from moving in the transverse direction.

Summary of the invention

It is a principal object of the present invention to provide a keyboard device for an electronic musical instrument of the above type characterized in that the key guides are formed integrally with a single key guiding plate, which is mounted on the keyboard frame by means of elastic members so that the key guiding plate can be slightly moved in the transverse direction.

In accordance with an aspect of the present invention, there is provided a keyboard device for an electronic musical instrument which comprises a keyboard frame, keys supported on said frame, a key guiding plate having key guides each engaging with one of the keys to guide the vertical movement thereof and elastic members elastically connecting said key guiding plate to said keyboard frame so that the key guiding plate can be slightly moved in the transverse direction, permitting the transverse vibration of the keys.

In one form of the present invention there is provided a keyboard device for an electronic musical instrument of the above type, which further comprises an electric transducer having a movable element mounted on the key guiding plate, said electric transducer being energized by the transverse movement of the key guiding plate to produce electric signals which are used to produce vibrato, tremolo or the like musical effect.

In another form of the present invention, there is provided a keyboard device for an electronic musical instrument of the above type, which further comprises an unextensible tape transversely disposed below the keys at such height that any key comes into contact with the upper surface of said tape when it is depressed, and an electric transducer having a movable element mounted on said tape, said electric transducer being energized by the transverse movement of the tape caused by the transverse vibration of the key to produce electric signals which are used to produce musical effect.

Thus, in the electronic musical instrument of the present invention, under normal playing condition the vertical movement of the keys is guided by the key guides, so that the keys are prevented from swaying in the transverse direction. If, however, a relatively strong force is exerted to the key in the transverse direction, the key moves to the side, but this movement of the key causes the other keys to move in the same direction since the key guides are integrally connected with each other through a single guiding plate, so that any key cannot hit the adjoining key to cause clicking sound. When a player depresses and vibrates the key to the right and the left, keys are vibrated in the transverse direction and such movement can be used to generate certain musical effect. The key guiding plate is supported by means of elastic members, so that the key guiding plate is normally maintained in the proper position but is moved to the right and the left when the player vibrates the key.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings illustrate embodiments of the present invention, in which:

FIG. 1 is a plan view, partly broken, of the keyboard embodying the present invention;

FIG. 2 is a front view, partly broken, of the keyboard shown in FIG. 1;

FIG. 3 is a sectional view taken along line III—III in FIG. 1;

FIG. 4 is an enlarged sectional view of a portion of FIG. 2;

FIG. 4*a* is a sectional view taken along line IV—IV FIG. 4;

FIG. 5 is a plan view showing a modified form of elastic members for elastically connecting a key guiding plate onto a keyboard frame;

FIG. 6 is a sectional view taken along line VI—VI in FIG. 5;

FIG. 7 is a side view showing another embodiment of the present invention;

FIG. 8 is a sectional view, in reduced scale, taken along line VIII—VIII in FIG. 7;

FIG. 9 is a side view showing another embodiment of the present invention;

FIG. 10 is a plan view showing a modified form of keys;

FIG. 11 is a sectional view taken along line XI—XI in FIG. 10; and

FIG. 12 is a block diagram showing an electrical arrangement of the keyboard and tone generators with their associated elements.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, FIGS. 1–4 illustrate an embodiment of the present invention, which comprises a keyboard frame **10**, a plurality of keys **12** having a key arm **14** fixed on the underside of the rear portion thereof and pivotally supported at their rear ends on said keyboard frame, and a key guiding plate **16** for guiding the vertical movement of the keys.

The key guiding plate **16** has a plurality of key guides **18** of the same number as that of the keys **12**, and said key guide has a cushion such as felt **20** wound thereon and is adapted to engage in the key when it is moved downward. The key guiding plate **16** has a plurality of slots **22** of oblong shape, such as an ellipse, a rectangle or a circle having recesses at the opposite sides thereof. An elastic member **24**, such as rubber, is received in said slot **22**. The key guiding plate is supported on the keyboard frame **10** by means of the elastic members **24** which are fixed on said frame by screws **26**. A movable element **28** of an electric transducer is mounted on the key guiding plate **16** and said electric transducer is energized by the vibration of said key guiding plate **16** to produce electric signals which in turn produce vibrato or like musical effect.

The electric transducer may consist of a variable condenser, a variable resistor, a variable coil, a variable transformer, a switch, a photoelectric cell, a piezoelectric element, or the like. The movable element **28** of such electric transducer is attached to the key guiding plate **16** as described above. When the key **12** is vibrated in the transverse direction, the key guide **18** is moved to the right and the left to vibrate the guiding plate **16**, thus producing the vibration of the movable element **28**. A stationary element **28'** corresponding to the movable element **28** of the electric transducer is fixed to the keyboard frame **10** and the electric transducer is energized by the movement of the movable element relative to the stationary element.

The elastic member **24** is made of rubber or the like material having suitable elasticity, which is engaged in the oblong slot **22** and has a sleeve **30** (FIG. 4) inserted therein, through which a screw **26** passes and is fixed to the frame **10** to elastically connect the key guiding plate **16** to the keyboard frame.

The keyboard frame **10** has the stationary element **28'** of the electric transducer disposed in confronting relation to the movable element **28**, but in other respects the keyboard frame is the same as that of the conventional electronic musical instrument, the mechanism of which is well known in the art.

FIGS. 5 and 6 illustrate a modified form of elastic member for elastically connecting the key guiding plate **16** to the keyboard frame **10**. In this modified form, the key guiding plate **16** is supported on the keyboard frame **10** by means of elastic member **32** which is made of leaf spring bent in U-shape. One leg of said U-shape is fixed on the key guiding plate **16** by rivet **34** or the like, while the other leg extends downward through an aperture **36** in the plate and is fixed onto the keyboard frame **10** by a screw **38**. Thus, the key guiding plate **16** can be moved in the transverse direction relative to the keyboard frame **10**.

FIGS. 7 and 8 show another embodiment of the present invention. In the drawings, **40** is a key, **42** is a key arm fixed on the underside of the rear portion of the key, **44** is a keyboard frame for supporting the keys, **46** is a keyboard switch, **48** is a lower stopper for limiting the downward movement of the key, **50** is a downward projection of the key which is adapted to come into contact with said lower stopper when the key is depressed, and **52** is a key guide. The key guide **52** is integrally formed with a key guiding plate **53** which is elastically mounted on the keyboard frame **44** in the same manner as in the embodiment, as described above.

An unextensible tape **54** made of metal, plastics or the like material is transversely arranged below the keyboard at such height that the underside of the key comes into contact with the tape when the key is depressed. The tape **54** is supported on the keyboard frame **44** by a flexible support **56** made of flexible material, such as moltopren, rubber foam, and is kept tight by springs **58** and **58** at the opposite ends thereof. These springs may be omitted if the tape is made of rigid material. When any key of the keyboard is depressed and vibrated to the right and the left, the tape **54** is vibrated thereby. In order to prevent the underside surface of the key **40** from slipping on the tape **54**, their contacting surfaces may be covered with standing short fibres **60** and **62** deposited thereon. An electric transducer **63**, such as a piezoelectric element, a photoelectric element, a variable resistor, a variable inductance and the like, is provided at one end of the tape **54**, which is energized by the movement of the tape to produce electric signals which are utilized to control the musical effect, such as vibrato, of the electronic musical instrument. The underside surface of the projection **50** which contacts with the lower stopper **48** may be formed in slightly convex form as seen from the front side, in order to make the vibrating movement of the key more smooth.

The keyboard as mentioned above can produce the desired effect by depressing the key and then vibrating it to the right and the left. This keyboard utilizes a single tape extending transversely of the keyboard, which is used in common to all of the keys, and consequently it is sufficient to provide only one transducer for a keyboard. Thus the keyboard is simple in construction and can be manufactured at low cost. The key guiding plate may be formed as a single piece common to all of the keys of a keyboard of an electronic musical instrument or may be divided into several units each for twelve keys (one octave.)

FIG. 9 shows another embodiment of the invention, in which a lower stopper **64** for limiting the downward movement of the key is formed by an unextensible tape **66** of metal, plastics or the like, and a brush-like fibre layer **68** attached on the lower side of said tape is adhered onto the keyboard frame **65**. A cushioning material **70**, such as felt, is fixed on the upper side of the tape. The tape is kept tight by springs attached to the opposite ends thereof, and an electric transducer is provided at one end of the tape, in the same manner as those shown in the first embodiment. When the key is depressed and vibrated, the tape **66** is moved to the right and the left on the brush-like fibre layer **68** and the movement of said tape is picked up by the transducer, to produce the vibrato or the like effect.

Thus, a player can produce the desired musical effect such as vibrato effect by depressing any key and vibrating it to the right and the left.

FIGS. 10 and 11 show another embodiment of the invention in which recesses **72** are formed in the upper surfaces of keys **74** and **76**, said recess being formed in oval shape in plane so that it can snugly receive a tip of a finger of a player. The recess **72** serves to prevent the player's finger from slipping on the surface of the key when he vibrates the key transversely to produce the vibrato, tremolo or the like effect while playing. The provision of such recesses is particularly effective when the finger tip of the player becomes slippy by the sweat.

FIG. 12 is ablock diagram showing an electrical arrangement of the keyboard and tone generators with their

associated elements. In FIG. 12, the keyboard device includes an electric transducer **82**, which is adapted to be energized by keys **80** when the latter are moved to the right and the left. The transducer **82** is connected through an amplifier **84** to a selector switch **86**. Also a vibrato oscillator **88** is connected through a vibrato depth control **90** to said selector switch **86**. The switch **86** is connected to a tone generator **92** to modulate the tone signals produced by the tone generator. When the vibrato oscillator **88** is connected through the selector switch **86** to the tone generator, the vibrato effect is produced automatically in the usual manner, but when the amplifier **84** is connected through the selector switch **86** to the tone generator, the vibrato effect is obtained depending on the vibrating movement of the keys **80**.

I claim:

1. A keyboard device for an electronic musical instrument, comprising a keyboard frame, keys supported on said frame, a key guiding plate having key guides corresponding to the keys, said key guides engaging with the respective keys to guide the vertical movement thereof, and elastic members elastically connecting said key guiding plate onto said keyboard frame so that the key guiding plate can be slightly moved to the right and the left.

2. A keyboard device for an electronic musical instrument according to claim **1**, which further comprises an electrical transducer having a movable element mounted on the key guiding plate.

3. A keyboard device for an electronic musical instrument according to claim **1**, which further comprises an unextensible tape transversely disposed below the keys at such height that the key when depressed comes into contact with said tape and movably supported in the transverse direction on the keyboard frame, and an electric transducer having a movable element mounted on said tape.

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U.S. Cl. X.R.

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