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### Keyboard instrument, key base molding method, and key base molding mold

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#### Abstract

A keyboard instrument includes a key which includes a weight, and a key base including a top plate and at least one rib configured to fix the weight by holding the weight from below in such a state that the weight is kept in abutment with a lower surface of the top plate.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This patent application is based upon and claims the benefit of priority under 35 USC 119 to Japanese Patent Application No. 2022-074166 filed on Apr. 28, 2022, the entire disclosure of which, including the specification, claims, drawings and abstract, is incorporated herein by reference in its entirety.

BACKGROUND

Technical Field

(2) The present disclosure relates to a keyboard instrument, a key base molding method, and a key base molding mold.

Description of the Related Art

(3) There have conventionally been disclosed keyboard instruments in which a weight is provided in a key base as a counterweight to obtain an appropriate feeling of heaviness when a key is depressed. For example, Japanese Unexamined Patent Application Publication No. 2008-268654 (JP-A-2008-268654) discloses a keyboard instrument in which a rectangular parallelepiped weight elongated in a front-back direction of a key is accommodated in a key base including a slit-shaped opening portion provided only in a lower surface side of the key base in such a manner as to be elongated in the front-back direction. A black key including this key base is formed through insert molding.

## SUMMARY

(4) According to an aspect of the present disclosure, there is provided a keyboard instrument including a key including a weight and a key base including a top plate and at least one rib configured to fix the weight by holding the weight from below in such a state that the weight is kept in abutment with a lower surface of the top plate.

(5) According to another aspect of the present disclosure, there is provided a key base molding method including inserting a weight in a weight inserting portion provided in a core mold of a mold to dispose the weight in place in the weight inserting portion, clamping the core mold and a cavity mold of the mold together, and injecting a molten resin into the mold so clamped to mold a key base including a rib configured to fix the weight.

(6) According to a further aspect of the present disclosure, there is provided a key base molding mold including a cavity provided in a cavity mold, and a core block provided in a core mold, wherein the core block includes a weight inserting portion including a rib molding portion, wherein the weight inserting portion is formed into a recess having a shape of a frustum in which a base side having a larger surface area is disposed outwards of the recess, and wherein the rib forming portion is formed into a groove extending from an outer circumferential surface of the weight inserting portion having the shape of the frustum to a base side having a smaller surface area.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. 1 is a perspective view showing a keyboard instrument according to an embodiment of the present disclosure;

(2) FIG. 2 is a plan view of a left side of the keyboard instrument according to the embodiment of the present disclosure, showing the relevant part in an enlarged fashion;

(3) FIG. 3A is a sectional view of the keyboard instrument according to the embodiment of the present disclosure, taken along a line III-III in FIG. 2;

(4) FIG. 3B is a circled enlarged view of a portion P in FIG. 3A, that is, a perspective view of the portion P as viewed from above;

(5) FIG. 4 is a sectional view of the keyboard instrument according to the embodiment of the present disclosure, taken along a line IV-IV in FIG. 2;

(6) FIG. 5 is a perspective view showing a white key of the keyboard instrument according to the embodiment of the present disclosure;

(7) FIG. 6 is a partially enlarged bottom view of a wider portion and a portion near thereto of the white key of the keyboard instrument according to the embodiment of the present disclosure, as viewed from a lower surface side thereof;

(8) FIG. 7 is a partially sectional perspective view of the white key of the keyboard instrument according to the embodiment of the present disclosure, taken along a line VII-VII in FIG. 6;

(9) FIG. 8 is a perspective view showing a black key of the keyboard instrument according to the embodiment of the present disclosure;

(10) FIG. 9 is a bottom view of the black key of the keyboard instrument according to the

embodiment of the present disclosure, as viewed from a lower surface side thereof;

(11) FIG. **10** is a sectional view of the black key of the keyboard instrument according to the embodiment of the present disclosure, taken along a line X-X in FIG. **9**;

(12) FIGS. **11A** to **11C** are schematic sectional views for explaining a molding method of molding a key base using a key base molding mold according to the embodiment of the present disclosure, showing a state in which, a weight is inserted;

(13) FIG. **12** is a schematic sectional view for explaining the molding method of molding a key base using the key base molding mold according to the embodiment of the present disclosure, showing a state in which, an injection molding is being performed with the mold clamped; and

(14) FIGS. **13A** to **13C** are schematic sectional views for explaining the molding method of a key base using the key base molding mold according to the embodiment of the present disclosure, showing a state in which, a molded product has been removed by opening the mold.

#### DESCRIPTION OF THE EMBODIMENT

(15) Hereinafter, an embodiment of the present disclosure will be described based on drawings. A keyboard instrument **10** shown in FIG. **1** includes a full-scale (88-note) keyboard **50** including plural white keys **30** and plural black keys **40**, which make up a large number of keys or 88 keys of the keyboard **50**, and a case **20**. In the following description, a front to the keys in the keyboard **50** in a front-back direction FB is referred to as a front side F, and a rear or back to the keys in the keyboard **50** in the front-back direction FB is referred to as a back side B. When facing the keyboard **50** from a front side F thereof, a left of the keyboard **50** is referred to as a left side L, and a right of the keyboard **50** is referred to as a right side R. In the keyboard **50**, the keys are aligned in a left-right direction, which is referred to as a key alignment direction LR. When viewing the keyboard instrument **10** in an upper-lower direction UL thereof, an upper side is referred to as an upper side Up, and a lower side is referred to as a lower side Lo. In the present embodiment, while the keyboard instrument **10** is described as an electronic piano, the present disclosure may be applied to any other keyboard instruments as long as they are a musical instrument configured to produce notes in response to key depressing operations by a player (a user).

(16) The case **20** has substantially a rectangular plate shape whose longitudinal direction follows the left-right direction. The case **20** is divided into an upper case **21** and a lower case **22**. The upper case **21** and the lower case **22** are each formed from a resin material. A circuit board, a battery functioning as a power supply, and the like are accommodated inside the case **20**. A control section **11** including a knob and a dial for volume control and various types of settings is provided on a left-hand side upper surface **21a** of the upper case **21**. In addition, an earphone jack **12** is provided in a left-hand side front surface of the upper case **21**.

(17) The upper surface **21a** of the upper case **21** which lies adjacent to the keyboard **50** at a left side of the upper case **21** and an upper surface **21b** of the upper case **21** which lies adjacent to the keyboard **50** at a right side of the upper case **21** are both formed into an inclined surface which is inclined obliquely downwards from a back side towards a front side of the upper case **21**. In addition, an upper surface **21c**, which is provided at a central upper portion of the upper case **21** in such a manner as to be long in the left-right direction, is also formed into an inclined surface which is inclined similarly. Although not shown, a hole portion is provided in a back side of the upper case **21** in such a manner as to correspond to a speaker.

(18) As shown in FIG. **2**, the plural black keys **30** are provided in such a manner as to match a scale of notes A to F. In the following description, while a white key for a note F (a white key **30F**) will be described as representing the plural white keys **30**, the present disclosure can also be applied to the remaining white keys **30** for the remaining notes in the scale of notes A to F. On the other hand, all the black keys **40** have the same shape.

(19) As shown in FIG. **3A** showing a section of the white key **30** and FIG. **4** showing a section of the black key **40**, the upper case **21** and the lower case **22** are assembled together into the case **20** by, for example, thread joining together a lower boss portion set upright upwards from the lower

case **22** and an upper boss portion **24** set upright downwards from the upper case **21** with a bolt. An inner case **25** is provided inside the case **20**. The inner case **25** is formed long in the key alignment direction LR, and in the sectional views in FIGS. **3A** and **4**, the inner case **25** has substantially a U-shaped section in which the inner case **25** is opened towards the lower side Lo. A circuit board **60** is provided on an upper surface of the inner case **25**. Plural switched **61** are provided on the circuit board **60** in such a manner as to correspond to the plural white keys **30** and black keys **40** so as to detect a key depression.

(20) Also, as shown in FIG. **3B**, which is a circled enlarged view of a portion P in FIG. **3A**, that is, a perspective view of the portion P as viewed from above, the switch **61** is provided substantially as a rectangular parallelepiped which is elongated in a front-back direction FB of the key. Corners of the switch **61** are rounded, as a result of which the switch **61** has semi-circular arc-shaped ends. The switch **61** is formed from an elastic material such as a rubber material. Circular holes are provided in an upper surface of the switch **61** so that a back pressing portion **61a** and a front pressing portion **61b** are provided. The back pressing portion **61a** and the front pressing portion **61b** are each formed into a bottomed circular recess and have bottom portions **61a1**, **61b1**, respectively. The bottom portion **61b1** of the front pressing portion **61b** is formed longer or thicker towards the lower side Lo than the bottom portion **61a1** of the back pressing portion **61a**. Additionally, a thin and flexible annular deforming portion **61c** is provided on a lower side Lo of the switch **61**. Two switch contacts (not shown) are provided on the circuit board **60** in such a manner as to correspond to the respective bottom portions **61a1**, **61b1** of the back pressing portion **61a** and the front pressing portion **61b**. When the two switch contacts are depressed simultaneously, a key depression is detected, whereby a predetermined note is made. The configuration of the switch **61** is common for the white key **30** and the black key **40**.

(21) As shown in FIGS. **3A** and **3B**, a switch pressing portion **33** is provided in the white key **30** in a position corresponding to the switch **61** for the relevant white key **30**. A support shaft **25a** is provided at the back of the inner case **25** so as to support the white key **30** rotatably. Plural support shafts **25a** are provided in such a manner as to correspond to the plural white keys **30** and black keys **40**. Plural hammer members **70** are provided inside the inner case **25**. Each hammer member **70** includes a weight portion **71** provided on a back side B thereof. An arm portion **72** extends from the weight portion **71** towards the front side F and is rotatably supported by a support shaft **25b** provided inside the inner case **25**.

(22) A hammer cap **73** is provided at a distal end of the arm portion **72** so as to be brought into engagement with a hammer pressing portion **31** which extends from the white key **30** towards the lower side Lo. A hole portion **31a** is provided in the hammer pressing portion **31** so that the hammer cap **73** is brought into engagement therewith. A hook-shaped restricting projection **32** is provided at a front end portion of the white key **30** in such a manner as to extend towards the lower side Lo and then to project towards the back side B at a distal end portion thereof. As will be described later, the restricting projection **32** has a left plate-shaped restricting projection **32a** and a right plate-shaped restricting projection **32b**. A white key guide portion **120** is provided at a front end portion of the inner case **25** in such a manner as to lie between the left restricting projection **32a** and the right restricting projection **32b**. The white key guide portion **120** slides on inner surfaces of the left restricting projection **32a** and the right restricting projection **32b** so as to guide a movement of the restricting projection **32** in the upper-lower direction UL. As a result, when the white key **30** is depressed, a lateral oscillation of the relevant white key **30** in the key alignment direction LR is reduced.

(23) As shown in FIG. **4**, the black key **40** includes a switch pressing portion **43** provided for the switch **61** for the relevant black key **40**. Additionally, hammer members **80** are also provided individually for the black keys **40**. The hammer members **80** for the black keys **40** also each include a weight portion **81**, an arm portion **82**, and a hammer cap **83**. The hammer cap **83** is in engagement with a hole portion **41a** formed in a hammer pressing portion **41** provided on the black

key **40**. As will be described later, the hammer pressing portion **41** of the black key **40** includes left and right side plates **403** which are provided in such a manner as to extend downwards. A black key guide portion **220** is provided inside the inner case **25** in such a manner as to lie between the left and right side plates **403** so extending. The black key guide portion **220** slides on respective inner surfaces of the left and right side plates **403** so extending so as to guide a movement of the black key **40** in the upper-lower direction UL. As a result, when the black key **40** is depressed, a lateral oscillation of the relevant black key **40** in the key alignment direction LR is reduced.

(24) When the white key **30** is depressed, the hammer pressing portion **31** of the white key **30** depresses the hammer cap **73**. Then, the weight portion **71** of the weight member **70**, which is provided opposite to the hammer cap **73** across the support shaft **25b**, is raised. In this way, the player or user can depress the white key **30** while feeling a sensation of heaviness that is like to a sensation of heaviness that the player or user feels when he or she plays a real piano, not an electronic keyboard instrument. Then, the weight portion **71** so raised is brought into abutment with an upper cushion **26** provided for the relevant hammer member **70**.

(25) On the other hand, the restricting projection **32** is pushed downwards as a result of the depression of the white key **30**, whereby the restricting projection **32** is brought into abutment with a lower cushion **29** provided in such a manner as to correspond to the relevant restricting projection **32**. In addition, when the white key **30** is depressed, the switch **61** is depressed by the switch pressing portion **33** provided on the relevant white key **30**, whereby a note is made which corresponds to the white key **30** so depressed. Then, when the player or user releases his or her finger from the white key **30**, the weight portion **71** of the hammer member **70** is lowered to be brought into abutment with a lower cushion **27**, and a jaw portion of the restricting projection **32** is brought into abutment with an upper cushion **28**, thereby resulting in a state shown in FIG. 3A.

(26) In addition, with the black key **40**, when the player or user depresses the black key **40**, the hammer member **80** rotates, whereby the player or user can depress the black key **40** while feeling a sensation of heaviness that the player or user feels when he or she plays a real piano, not an electronic keyboard instrument. As in the case of the weight portion **71** for the white key **30**, the weight portion **81** for the relevant black key **40** is brought into abutment with an upper cushion **26** and a lower cushion **27** at an upper limit for a rising operation and a lower limit for a lowering operation of the hammer member **80**, respectively.

(27) When the white key **30** and the black key **40** are depressed, the upper surfaces of the switches **61** are depressed by the switch pressing portions **33**, **43**, whereby notes corresponding to the white key **30** and the black key **40** which are so depressed are made. When the white key **30** and the black key **40** are depressed, initially, the switch pressing portions **33**, **43** are brought into abutment with the upper surfaces of back side portions of the switches **61**. Then, the deforming portions **61c** flex, and the bottom portions **61a1** of the back pressing portions **61a** lower first. When the white key **30** and the black key **40** which are depressed become substantially horizontal, the switch pressing portions **33**, **43** are brought into full abutment with the upper surfaces of the switches **61** over a length in the front-back direction FB of the key. Then, lower surface positions of the bottom portions **61a1**, **61b1** of the back pressing portion **61a** and the front pressing portion **61b** become substantially the same, whereby the two switch contacts of the switches **61** are depressed simultaneously by lower surfaces of the bottom portions **61a1**, **61b1**, and notes corresponding to the keys depressed are made.

(28) Further, the weights **100**, **200** are provided in the white key **30** and the black key **40**, respectively, as counterweights. The weights **100**, **200** are intended to improve the key-depressing feeling felt by the player or user when he or she depresses the keys. That is, when the keys are depressed lightly, reaction forces relative to the hammer members **70**, **80** are given to the tips of the fingers of the player or user to make the player or user feel light at the time of depressing the keys. On the other hand, when the keys are depressed strongly, the player or user can be made to feel heavy at the time of forcibly depressing the keys due to the inertial force produced by the weights

**100, 200.** The weights **100, 200** are both formed into a shape of a frustum of cone or pyramid. The weight **100** provided in the white key **30** has a shape of a frustum of cone. On the other hand, the weight **200** provided in the black key **40** has a shape of frustum of quadrangular pyramid. The weight **200** provided in the black key **40** is elongated in the front-back direction FB of the key.

(29) An attaching portion of the weight **100** in the white key **30** will be described based on FIGS. 5 to 7. In FIGS. 5 to 7, a white F key **30F** is illustrated as an example of the white key **30**. As shown in FIG. 5, the white key **30** includes wood members **310, 320**, which are attachment members provided individually on a left side L and a right side R of the white key **30**, and a key base **300** (refer to FIGS. 6 and 7 for the wood member **320**). The key base **300** includes a top plate **301** of which an upper surface **301p** constituting a top surface is made into a key depressing surface. A step portion **305** is provided on a right side R of the top plate **301** of the key base **300**. The step portion **305** constitutes a portion of the white key **30** which corresponds to the black key **40** when the relevant white key **30** is disposed in the keyboard **50**. A portion of the top plate **301** which is situated further towards the front side F than the step portion **305** is made into a wider portion **301a**, and a portion situated further towards the back side B than the step portion **305** is made into a narrower portion **301b**.

(30) A front plate **302** is provided at a front end portion of the top plate **301** in such a manner as to extend downwards towards the lower side Lo from a lower surface **301q** of the front end portion of the top plate **301**. The front plate **302** is disposed in such a manner that plate surfaces thereof are made to face the front-back direction FB and has a width substantially equal to that of the wider portion **301a** of the top plate **301**. The restricting projection **32** includes the left plate-shaped restricting projection **32a** and the right plate-shaped restricting projection **32b** which are provided on a back surface of the front plate **302**.

(31) As shown in FIGS. 6 and 7, the key base **300** includes side plates **303** (a left side plate **303a**, a right side plate **303b**) which are provided individually on a left side L and a right side R of the top plate **301** in such a manner as to extend perpendicularly downwards from a lower surface of the top plate **301**. The side plates **303** are provided in such a manner as to correspond to the wider portion **301a** of the top plate **301**. The left side plate **303a** of the side plates **303**, which is provided on the left side L, and the right side plate **303b** of the side plates **303**, which is provided on the right side R, are provided in such a manner as to face each other.

(32) The key base **300** includes a longitudinal plate **306** which is provided to a back side B of the step portion **305** in such a manner as to correspond to the narrower portion **301b**. A side surface **303a1** of the left side plate **303a** and a left side surface **306a** of the longitudinal plate **306** constitute substantially a continuous surface. The wood member **310**, which is configured as a single unit, is provided in such a manner as to extend over the side surface **303a1** of the left side plate **303a** and the left side surface **306a** of the longitudinal plate **306**. On the other hand, the right side plate **303b** connects to the longitudinal plate **306** at the step portion **305** via a connecting plate **305a**, which intersects the right side plate **303b** at right angles. A front wood member **321** of the wood member **320** is provided on a side surface **303b1** of the right side plate **303b** on the front side F, and a back wood member **322** of the wood member **320** is provided on a right side surface **306b** of the longitudinal plate **306** on the back side B.

(33) As shown in FIG. 7, two recessed groove portions **110** are provided individually at upper and lower locations on each of the left side plate **303a** and the right side plate **303b**. An extra portion of an adhesive is stored in the recessed groove portions **110** in the case that such an extra portion is produced when the wood members **310, 320** are attached respectively to the side surface **303a1** of the left side plate **303a** and the side surface **303b1** of the right side plate **303b** with the adhesive. In addition, projecting plates **307** are provided in such a manner as to project horizontally outwards individually at a lower end of the right side plate **303b** and a lower end of the longitudinal plate **306** at the back side B thereof. These projecting plates **307** constitute receiving portions for receiving the wood members **310, 320** which function to prevent the wood members **310, 320** from falling

inside the keyboard instrument **10** in the even that the wood members **310**, **320** come off to fall from the corresponding side surfaces. A rotational hole portion **308**, which is rotatably supported on the support shaft **25a**, is provided in a back end portion of the key base **300**.

(34) As shown in FIGS. **6** and **7**, the weight **100** and ribs **500** for fixing the weight **100** are provided on the lower surface **301q** of the top plate **301** of the key base **300**. The ribs **500** include a first rib **350** and a second rib **360**. Additionally, the key base **300** has auxiliary ribs **370** (a left auxiliary rib **371**, a right auxiliary rib **372**).

(35) The first rib **350** and the second rib **360** of the ribs **500** are both disposed in the front-back direction FB on the lower surface **301q** of the top plate **301**. The ribs **500** (the first rib **350**, the second rib **360**) fix at least either of a front and a back of the weight **100** in the front-back direction FB of the key. Specifically speaking, the first rib **350** is provided at a front side F of the weight **100**, and the second rib **360** is provided at a back side B of the weight **100**. The first rib **350** and the second rib **360** have substantially hook-shaped holding portions **351**, **361**, respectively, which are provided in such a manner as to follow an external shape of the weight **100**. The holding portions **351**, **361** have respectively outer circumferential wall portions **351a**, **361a** which are provided in such a manner as to follow an outer circumferential surface **102** of the weight **100** and lower wall portions **351b**, **361b** which are provided to lie on a lower surface **101** of the weight **100** while being given a width which is substantially the same as that of the outer circumferential wall portions **351a**, **361a**. A back surface of the outer circumferential wall portion **351a** and a front surface (a surface facing the weight **100**) of the outer circumferential wall portion **361a** are brought into abutment with the outer circumferential surface **102** of the weight **100**. Upper surfaces (surfaces facing the weight **100**) of the lower wall portions **351b**, **361b** are brought into abutment with the lower surface **101** of the weight **100**.

(36) In the case of the abutment of the ribs **500** with the lower surface **101** and the outer circumferential surface **102** of the weight **100**, at least one of the first rib **350** and the second rib **360** of the ribs **500** only needs to be brought into abutment with the lower surface **101** and the outer circumferential surface **102**. In addition, either of the holding portions **351**, **361** only needs to be provided on at least either of the first rib **350** and the second rib **360**.

(37) Rib portions **352**, **362** are provided individually on a front surface of the outer circumferential wall portion **351a** of the holding portion **351** and a back surface of the outer circumferential wall portion **361a** of the holding portion **361** (the front surface and the back surface being surfaces situated opposite to or farther away from the weight **100**). The rib portions **352**, **362** are disposed on a center line of the weight **100** in the front-back direction FB of the key and are each provided in the form of a plate which is set upright downwards from the lower surface **301q** of the top plate **301** with plate surfaces thereof disposed in such a manner as to be parallel to the front-back direction FB of the key. In other words, the ribs **500** (the rib portion **352**, **362**) are disposed on a vertical plane which is parallel to the center line of the weight **100** in the front-back direction FB of the key. The rib portion **352** of the first rib **350** is connected to a back surface of a reinforcement rib **304** which connects the left and right side plates **303** together at a front end thereof. The reinforcement rib **304** reinforces the side plates **303** in the key alignment direction LR. In this way, the first rib **350** connects with the reinforcement rib **304** which connects the left and right side plates **303** of the key base **300** together. The rib portion **362** of the second rib **360** connects to a front surface of the connecting plate **305a** at a back end thereof. As shown in FIG. **7**, facing corner portions of the rib portions **352**, **362** are chamfered so as to be formed into chamfered portions **352a**, **362a**, respectively.

(38) The key base **300** has auxiliary ribs **370** (a left auxiliary rib **371**, a right auxiliary rib **372**) for fixing the weight **100** from the key alignment direction LR. The auxiliary ribs **370** are each provided as a hook-shaped plate. The auxiliary ribs **370** are provided in such a manner that plate surfaces thereof intersect the rib portions **352**, **362** at right angles (become parallel to the key alignment direction LR). Of the auxiliary ribs **370**, a back side (a side opposite to or farther away



from the weight **100**) of the left auxiliary rib **371** connects to an inner surface (a right side surface) of the left side plate **303a**. Of the auxiliary ribs **370**, a back side (a side opposite to or farther away from the weight **100**) of the right auxiliary rib **372** connects to an inner surface (a left side surface) of the right side plate **303b**. The auxiliary ribs **370** hold the weight **100** from the lower surface **101** thereof at hook-shaped portions at distal end portions thereof so as to fix the weight **100** to the key base **300**. The weight **100** is brought into abutment with the lower surface **301q** of the top plate **301** on an upper surface **103** (refer to FIGS. **3A** and **3B**) thereof to be fixed thereto.

(39) A space portion **380** is provided on a front side F of the reinforcement rib **304** (the first rib **350**) in such a manner as to be surrounded by the reinforcement rib **304**, the top plate **301**, the left and right side plates **303**, and the front plate **302**. This space portion **380** constitutes a space which is used for assembly, for example, when an application nozzle is inserted to apply a grease to inner surfaces of the left restricting projection **32a** and the right restricting projection **32b** on which the white key guide portion **120** slides at the time of assembly of the keyboard instrument **10**.

(40) Referring to FIGS. **8** to **10**, as well as FIG. **4**, the black key **40** will be described. As shown in FIG. **8**, the black key **40** has a key base **400** and the weight **200** (refer to FIG. **4**). The black key **40** is formed substantially into a rectangular parallelepiped which is opened on a lower side Lo thereof and is elongated in the front-back direction FB of the key. The black key **40** includes a rotational hole portion **408** which is rotatably supported on the support shaft **25a** at a back end portion thereof. The key base **400** includes a top plate **401** of which an upper surface **401p** is made into a key depressing surface, a front plate **402** which is provided at a front side F of the top plate **401**, and left and right side plates **403** (a left side plate **403a**, a right side plate **403b**) which are provided in such a manner as to extend perpendicularly downwards from left and right edge portions of the top plate **401**, respectively. An upper portion of the front plate **402** is made into an inclined front plate **402a**. The front plate **402** and portions of the side plates **403** at a front side F thereof extend towards the lower side Lo so as to define a hammer pressing portion **41**.

(41) As shown in FIGS. **9** and **10**, the key base **400** has the weight **200** and ribs **510** (a first rib **450**, a second rib **460**), which are disposed individually at a front and a back of a lower surface **401q** of the top plate **401** in the front-back direction FB of the key so as to fix the weight **200** in place.

(42) As shown in FIG. **4**, the first rib **450** of a plate shape which is disposed on the front side F is disposed in such a manner that plate surfaces thereof are made parallel to the front-back direction FB of the key and has a hook-shaped distal end portion (lower end portion). A side of the first rib **450** which faces the weight **200** is brought into abutment with a lower surface **201** and an outer circumferential surface **202** of the weight **200**. On the other hand, the second rib **460** of a plate shape which is disposed on the back side B is disposed in such a manner that plate surfaces thereof are made parallel to the front-back direction FB of the key and includes a hook-shaped portion provided on a side (a front side F) thereof which faces the weight **200**, whereby the second rib **460** is brought into abutment with the lower surface **201** and the outer circumferential surface **202** (refer to FIG. **9**) of the weight **200**. An upper surface **203** of the weight **200** is brought into abutment with the lower surface **401q** of the top plate **401**. In this way, the weight **200** is fixed to the key base **400** of the black key **40**. In the case of the abutment of the ribs **510** with the lower surface **201** and the outer circumferential surface **202** of the weight **200**, at least one of the first rib **450** and the second rib **460** of the ribs **510** only needs to be brought into abutment with the lower surface **201** and the outer circumferential surface **202**. That is, also with the black key **40**, either of the ribs **510** (the first rib **450**, the second rib **460**) fixes the weight **200** at either of the front and back thereof. Then, the ribs **510** (the first rib **450**, the second rib **460**) are disposed on a vertical plane which is parallel to a center line of the weight **200** in the front-back direction FB of the key.

(43) As shown in FIG. **9**, the second rib **460** includes two switch depressing ribs **461**, which are made up of two plate-shaped ribs which intersect the second rib **460** at right angles. The switch depressing ribs **461** connect to the left and right side plates **403**. The two switching depressing ribs **461** are disposed at an interval which matches an interval defined between centers of the back

pressing portion **61a** and the front pressing portion **61b** of the switch **61**. That is, as shown in FIG. **9**, the switch depressing ribs **461** are disposed at the centers of the back pressing portion **61a** and the front pressing portion **61b**. In addition, as shown in FIG. **10**, the second rib **460** and the switch **61** are disposed in such a manner that a center of the second rib **460** in a thickness direction thereof matches a center line CL of the switch **61** in a left-right direction thereof (the center line CL also constituting a center line of the weight **200**). As a result, portions (two portions) where the two switch depressing ribs **461** intersect the second rib **460** at right angles are disposed at center axes of the circular holes defining the rear pressing portion **61a** and the front pressing portion **61b**. In this way, the second rib **460** (the switch depressing ribs **461**) is provided in such a manner as to correspond to the switch **61**. A length of the second rib **460** defined in the front-back direction FB of the key is made sufficiently longer than a length in the front-back direction FB of the key on the upper surface of the switch **61** with which the second rib **460** is brought into abutment.

(44) Additionally, a reinforcement rib **404** is provided between the first rib **450** and the second rib **460** in order to reinforce the side plates **403** in the key alignment direction LR. The reinforcement rib **404** is a plate-shaped rib which is provided in such a manner as to intersect the first rib **450** and the second rib **460** at right angles so as to connect the left side plate **403a** and the right side plate **403b** together. The reinforcement rib **404** is provided in such a manner as to extend transversely over the weight **200** while being brought into abutment with the outer circumferential surface **202** and the lower surface **201** of the weight **200**.

(45) A space **480** is provided to a front side F of the first rib **450**. This space portion **480** can be used for assembly, for example, when an application nozzle is inserted to apply a grease between the sliding black key guide portion **220** and the left and right side plates **403** which extend towards the hammer pressing portion **41** and over which the black key guide portion **220** is configured to slide at the time of assembly of the keyboard instrument **10**.

(46) Next, a molding method of molding the key base **400** of the black key **40** using a mold **800** will be described based on FIGS. **11A** to **13C**. The mold **800** includes a core mold **600** and a cavity mold **700**. The key base **400** is molded from a resin material through injection molding using the cavity **800**. The core cavity **600** includes a substantially plate-shaped core block **650**. The core block **650** includes a hammer pressing portion molding portion **601** for molding the hammer pressing portion **41**, a rotational hole portion molding portion **608** for molding the rotational hole portion **408**, a weight inserting portion **630**, and the like.

(47) The weight inserting portion **630** is provided as a recess where to place the weight **200** in such a state that of bases of the weight **200** having a shape of a frustum of quadrangular pyramid, a base having a larger surface area (the upper surface **203**) is made to face outwards (upwards). The weight inserting portion **630** includes a first rib molding portion **610** and a second rib molding portion **620** which make up a rib molding portion **651**. The first rib molding portion **610** and the second rib molding portion **620** are disposed in such a manner that the first rib molding portion **610** is disposed forwards and the second rib molding portion **620** is disposed backwards in the front-back direction FB of the key. The first rib molding portion **610** and the second rib molding portion **620** are disposed to face each other.

(48) The first rib molding portion **610** and the second rib molding portion **620** are each provided as a groove which extends over an area ranging from the outer circumferential surface **202** to the other base (the lower surface **201**) having a smaller surface area of the weight **200**. A molten resin is introduced into the first rib molding portion **610** and the second rib molding portion **620** so as to mold the first rib **450** and the second rib **460**, respectively.

(49) The cavity mold **700** includes a cavity **710** which is provided as a recess matching an external shape of the black key **40**.

(50) In the molding method of molding the key base **400** through injection molding using the mold **800**, firstly, as show in FIG. **12**, a step is performed in which the weight **200** is inserted in the weight inserting portion **630** provided in the core mold **600** of the mold **800** to be disposed in place

therein. The weight **200** is so inserted from the lower surface **201** (the base having the smaller surface area of the shape of the frustum of quadrangular pyramid). As a result, even though there is a slight deviation in position between the weight **200** and the weight inserting portion **630**, the weight **200** and the weight inserting portion **630** are automatically aligned in position with each other by the inclined outer circumferential surface **202** of the weight **200**, whereby the weight **200** is well disposed in the weight inserting portion **630**.

(51) Then, a step is performed in which the core mold **600** and the cavity mold **700** are clamped together. As this occurs, the core block **650** is inserted into the cavity **710**. Subsequently, a step is performed in which a molten resin is injected into the mold **800** so clamped so as to mold the key base **400** including the first rib **450** and the second rib **460** which are disposed forwards and backwards in the front-back direction FB of the key to fix the weight **200**.

(52) Next, as shown in FIGS. **13A** to **13C**, a molded product removing step is performed in which the cavity mold **700** and the core mold **600** are opened to remove a molded product, that is, the key base **400**. In this way, the weight **200** is attached to the key base **400** as through insert molding. Similarly, the white key **30** including the weight **100** can be molded as through insert molding.

(53) For disposal of the white keys **30** and the black keys **40**, the key bases **300**, **400** which are molded from the resin material can be separated from the weights **100**, **200** which are made of metal as below. With the white key **30**, for example, the reinforcement rib **304** is cut at, for example, two locations with a pair of cutting nippers and is then collapsed to the front side F, whereby the weight **100** can be removed. Alternatively, the rib portions **352**, **362** of the first rib **350** and the second rib **360** and/or the auxiliary ribs **370** are cut with a pair of cutting nippers to be removed, or the holding portion **351** is caused to collapse in the left-right direction, whereby the weight **100** can be removed.

(54) In the case of the black key **40**, similarly, portions of the first rib **450** and the second rib **460** which lie near to the weight **200** are cut to be removed with a pair of cutting nippers or are caused to collapse in the left-right direction so as to deviate from the weight **200**, whereby the weight **200** can be removed.

(55) With the black key described in JP-A-2008-268654 described before, the resin material forming the key base is kept tightly adhering to the upper surface, the left and right surfaces, the front and back surfaces, and the lower surface of the weight excluding the portion corresponding to the opening portion. As a result, the weight is never easily removed from the key base. However, for disposal of the keyboard instrument, the weight made of metal often needs to be separated from the key base which is made from the resin material. For separation of the metal weight from the resin key base, the resin material adhering to the circumference of the weight needs to be scraped off for removal, which is not easy.

(56) On the other hand, according to the embodiment of the present disclosure, the keyboard instrument **10** includes the weights **100**, **200** and the key bases **300**, **400** which include the ribs **500**, **510** for fixing the weights **100**, **200**.

(57) As a result, the weights **100**, **200** can be attached to the key bases **300**, **400**, respectively, in an ensured fashion, and the weights **100**, **200** can be removed from the corresponding key bases only by cutting the ribs **500**, **510** (the first ribs **350**, **450** or the second ribs **360**, **460**). Thus, the keyboard instrument **10** can be provided which includes the keyboard **50** which facilitates the separation of the resin material from the metal material for disposal.

(58) The ribs **500**, **510** fix the weights **100**, **200** at, at least, either of the front and back thereof in the front-back direction FB of the key. As a result, the weights **100**, **200** can be attached to the key bases **300**, **400** respectively in a more ensured fashion.

(59) The ribs **500**, **510** are disposed on the vertical planes parallel to the center lines of the weights **100**, **200** in the front-back direction FB of the key. As a result, the weights **100**, **200** can be fixed with good balance, whereby the weights **100**, **200** can preferably be used as counterweights.

(60) In addition, the key base **300** has the auxiliary ribs **370** which fix the weight **100** from the key

alignment direction LR. As a result, the weight **100** can be attached to the key base **300** in a much more ensured fashion.

(61) The rib **500** (the first rib **350**) connects to the reinforcement rib **304** which connects together the left and right side plates **303** of the key base **300**. As a result, the weight **100** can easily be removed also by cutting the reinforcement rib **304**.

(62) The ribs **500**, **510** include the ribs **510** provided on the black key **40**. The ribs **510** provided on the black key **40** include the second rib **460** (the switch depressing rib **461**) which is the rib disposed in such a manner as to correspond to the switch **61** for detecting a key depression. As a result, the switch **61** can be depressed in an ensured fashion.

(63) The molding method of molding the key bases **300**, **400** includes the step of inserting the weights **100**, **200** in the weight inserting portion **630** provided in the core mold **600** of the mold **800** to be disposed in place therein, the step of clamping together the core mold **600** and the cavity mold **700** of the mold **800**, and the step of molding the key bases **300**, **400** including the ribs **500**, **510** for fixing the weights **100**, **200** by injecting the molten resin into the mold **800** so clamped.

(64) As a result, the molding method of molding the key bases **300**, **400** can be provided which facilitates the removal for separation of the weights **100**, **200** only by cutting the ribs **500**, **510** (the first ribs **350**, **450**, and the second ribs **360**, **460**) while enabling the weights **100**, **200** to be fixed in an ensured fashion.

(65) The mold **800** for molding the key bases **300**, **400** has the cavity **710** provided in the cavity mold **700** and the core block **650** provided in the core mold **600**. The core block **650** has the weight inserting portion **630** which includes the rib molding portion **651**, and the weight inserting portion **630** is provided as the recess having the shape of the frustum of cone or pyramid with the base having the wider surface area disposed outwards. The rib molding portion **651** is provided as the groove extending from the outer circumferential surface to the base having the smaller surface area of the weight inserting portion **630** having the shape of the frustum of cone or pyramid.

(66) As a result, the molding method of molding the key bases **300**, **400** can be provided which facilitates the removal for separation of the weights **100**, **200** only by cutting the ribs **500**, **510** (the first ribs **350**, **450**, and the second ribs **360**, **460**) while enabling the weights **100**, **200** to be fixed in an ensured fashion.

(67) While the embodiment of the present disclosure has been described heretofore, the embodiment is presented as the example, and hence, there is no intention to limit the scope of the present invention by the embodiment. The novel embodiment can be carried out in other various forms, and various omissions, replacements and modifications can be made thereto without departing from the spirit and scope of the present invention. Those resulting embodiments and modified examples thereof are included in the scope and gist of the present invention and are also included in the scope of inventions claimed for patent under claims below and their equivalents.

## Claims

1. A keyboard instrument comprising: a key comprising: a weight; and a key base comprising a top plate and at least one rib configured to fix the weight by holding the weight from below in such a state that the weight is kept in abutment with a lower surface of the top plate, wherein the at least one rib is at least one rib provided on a black key, and wherein the at least one rib provided on the black key is configured to come into contact with a switch configured to detect a key depression when the black key is depressed.
2. The keyboard instrument according to claim 1, wherein the at least one rib comprises a first rib and a second rib, wherein the key base further comprises left and right side plates which are connected to and extend downward from the top plate, and wherein the weight, the first rib, and the second rib are provided between the left and right side plates.
3. The keyboard instrument according to claim 1, wherein the at least one rib comprises a first rib,

and wherein the first rib is configured to fix the weight at one of a front and a back of the weight in a front-back direction of the key.

4. The keyboard instrument according to claim 3, wherein the at least one rib further comprises a second rib, and wherein the second rib is configured to fix the weight at the other of the front and the back of the weight in the front-back direction of the key.

5. The keyboard instrument according to claim 1, wherein the at least one rib extends along a vertical plane which is parallel to a center line of the weight in a front-back direction of the key.

6. The keyboard instrument according to claim 1, wherein the key base further comprises an auxiliary rib which extends along an alignment direction of the key and which is configured to fix the weight by holding the weight from below in such a state that the weight is in abutment with the lower surface of the top plate.

7. The keyboard instrument according to claim 1, wherein the key base further comprises left and right side plates which are connected to and extend downward from the top plate, and wherein the at least one rib connects to a reinforcement rib which connects the left and right side plates to each other.

8. The keyboard instrument according to claim 1, wherein the key base further comprises left and right side plates which are connected to and extend downward from the top plate, wherein the at least one rib provided on the black key comprises a first switch depressing rib connecting to the left and right side plates and a second switch depressing rib configured to fix a back of the weight in a front-back direction of the black key, the first switch depressing rib and the second switch depressing rib being provided in such a manner as to intersect each other at right angles, and wherein a portion where the first plate-shaped switch depressing rib and the second switch depressing rib intersect each other at right angles is configured to come into contact with the switch when the black key is depressed.

9. A key base molding method comprising: inserting a weight in a weight inserting portion provided in a core mold of a mold to dispose the weight in place in the weight inserting portion; clamping the core mold and a cavity mold of the mold together; and injecting a molten resin into the mold having been clamped to thereby mold a key base comprising a rib which extends in a vertical direction and which fixes the weight.

10. A key base molding mold comprising: a cavity provided in a cavity mold; and a core block provided in a core mold, wherein the core block comprises a weight inserting portion comprising a rib molding portion, wherein the weight inserting portion is formed into a recess having a shape of a frustum in which a base side having a larger surface area is disposed outwards of the recess, and wherein the rib forming portion is formed into a groove extending from an outer circumferential surface of the weight inserting portion which has the shape of the frustum to a base side having a smaller surface area.

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