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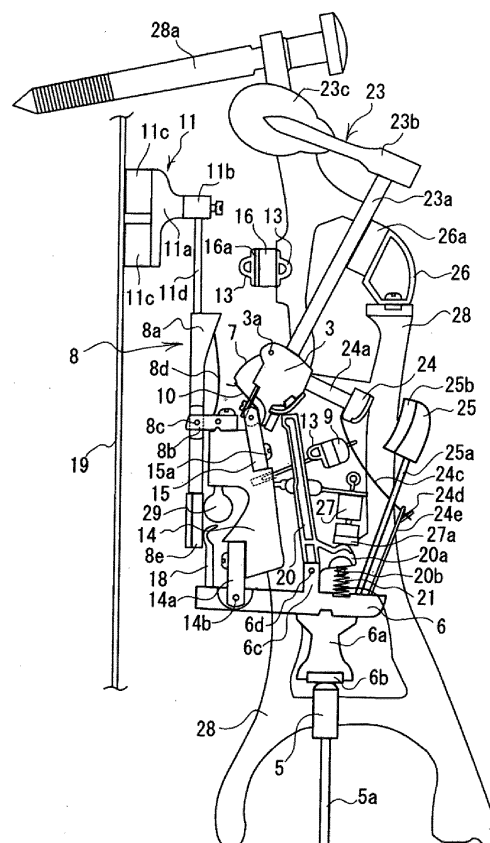
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(54) **UPRIGHT PIANO ACTION MECHANISM**

(57) The purpose of the present invention is to provide an upright piano action mechanism that improves sound quality relating to dynamic range and the like and facilitates repetition of the same note on the keyboard of the upright piano and any form of key pressing such as repetition and play-ing at half-touch while playing at pianissimo and half touch with the damper pedal depressed. The action mechanism is configured to either reinforce the spring force of a single hammer butt spring or use two hammer butt springs. When using two hammer butt springs, a butt range cord is provided with a twisted part to cause the hook of the two hammer butt springs to be caught by a ring-shaped part at the tip of the twisted part and the twisted part. The action mechanism uses a material with excellent lubricity for a hammer butt skin while reinforcing the elasticity of a jack spring, and is provided with a rubber-based cushion having a protrusion made of an elastic material with a through-hole along the rear surface of a jack stop rail and the front and rear surfaces of a damper stop rail.

Fig. 2



Description

Technical Field

[0001] The present invention relates to an upright piano action mechanism, and more particularly, to an upright piano action mechanism that improves sound quality related to repetition of the same note when a keyboard is continuously depressed, a half touch, a dynamic range, and the like. Note that in the following description, assume that the term "front side" refers to a side of a piano that is closer to a person playing the piano, and the term "back side" refers to a side of the piano that is farther from the person playing the piano.

Background Art

[0002] In conventionally-known grand pianos, strings are stretched horizontally and these strings are struck by hammers that pivot backward, and then the hammers can be rapidly returned to their original positions by their own weight. A grand piano uses a jack and a double escapement action that allows a repetition lever for returning the jack below the hammers to escape. This structure enables quick repetition of the same note on a grand piano.

[0003] On the other hand, an upright piano has a structure in which strings are stretched vertically and when jacks push up hammer butts in association with a keyboard-depressing operation, hammers supported by the hammer butts pivot in the direction in which the strings are arranged and the strings stretched vertically are struck by the hammers. Accordingly, in the upright piano, the own weight of each hammer is less likely to act, unlike in the grand piano, and thus the upright piano has a structure in which the hammers are forcibly returned to their original positions by a spring force to be ready for the subsequent key-pressing operation. Thus, the upright piano has drawbacks that the upright piano has a complicated structure and is inferior to the grand piano in terms of repetition of the same note.

[0004] However, a vertical upright piano has such advantages as being more compact than a horizontal grand piano and being more inexpensive than the grand piano. Therefore, various modifications have been conventionally made on the upright piano to improve the repetition of the same note which is a drawback of the upright piano, and to achieve a sense of touch during key-pressing operation and a dynamic range in terms of sound quality that are comparable to those of a grand piano.

[0005] In this regard, refer to Patent Document 1 as related art. In this related art, after a hammer is caused to pivot backward to strike a string, a hammer butt spring urging force for urging a hammer butt supporting the hammer is reinforced to return the hammer forward. Accordingly, in the structure disclosed in this document, a stopper is provided below a hammer butt flange cord that supports a hammer butt spring. However, in the structure

disclosed in this document, since it is necessary to provide a stopper separately in addition to the existing components, the structure has a disadvantageous in that the structure of the hammer butt spring is more complicated.

[0006] Note that in the present invention, it is desirable to improve an upright piano to have an action structure to be easily modified, instead of making the complicated action structure of the upright piano more complex, a mounting work or the like can be performed not only on new upright pianos to be produced but also on the existing upright pianos, by a piano tuner or the like.

[0007] Further, Patent Document 2 discloses a structure in which a spindle is attached to any one of the operation members, such as a hammer butt, a swing shank (hammer shank), a swing member (hammer), a catcher, and a catcher shank, which are members that constitute an upright piano action mechanism, so as to achieve the perception of a sense of touch which is rich in the mass feeling like in grand pianos. In this structure, each spindle is attached so that a load acts in a direction opposite to the direction in which the operation members pivot during key pressing, thereby achieving the perception of a sense of touch during key pressing that is comparable to that on a grand piano.

[0008] However, this sense of touch is perceived by fingers and hands of a performer. It is more important to improve the phenomenon in which no sound is produced at half-touch, which is one of well-known drawbacks of upright pianos. In other words, there is a demand for improving the structure of an upright piano so as to be able to produce a softest sound, such as a pianissimo sound, even when a key board is depressed and then depressed halfway again without returning the key to a non-key-pressing position.

Prior Art Document

Patent Document

[0009]

Patent Document 1

Japanese Patent Laid-Open No. 2008-90169

Patent Document 2

Japanese Patent Laid-Open No. 2011-203477

Summary of the Invention

Technical Problem

[0010] In the upright pianos described above, after a key is pressed, the keyboard needs to be returned to its original position to produce the next sound. However, in the upright pianos of related art, when a keyboard is continuously pressed, the hammer butt returns earlier than the return of the jack to the position below the hammer butt, which inhibits the return of the jack. Accordingly, when a quick touch or half touch is implemented in the

subsequent key pressing operation, the jack fails to push up the hammer butt, so that an idle strike occurs.

[0011] Therefore, in order to enable the repetition of the same note and the production of a softest sound such as a pianissimo sound by half touch on the upright piano, it is necessary to return the jack rapidly. However, for example, even if only the jack spring is improved to assist the return of the jack, there are inconveniences such as an occurrence of a time lag in the operations for other parts. For this reason, there is a need to improve each part of the action mechanism comprehensively that are related to the jack returning operation.

[0012] The present invention has been made in view of the above-mentioned circumstances, and an object of the present invention is to provide an upright piano action mechanism which can deal with various keyboard pressing operations on an upright piano, such as repetition of the same note when a keyboard is continuously depressed, playing at pianissimo, playing at half-touch, and repetition of the same note and a half touch with the damper pedal depressed, and which achieves an improvement in sound quality related to a dynamic range and the like.

Solution to Problem

[0013] To solve the above-mentioned object, an upright piano action mechanism of the present invention is an upright piano action mechanism including: a jack that performs an upward push-up operation in association with a keyboard-depressing operation; a hammer butt that pivots backward, which is a string side, by the push-up operation of the jack; a hammer shank supported by the hammer butt; a hammer that strikes a string provided at a leading end of the hammer shank; a damper stop rail that damps a motion of a damper wire; a hammer butt skin provided on a push-up surface of the hammer butt; a hammer butt spring that urges the hammer forward after the string is struck; a jack spring that urges the jack in a returning direction which is an opposite to a direction in which a key is pressed; and a jack stop rail that regulates inclination of the jack after keyboard pressing and controls a motion range of the jack. In the upright piano action mechanism, a long rubber-based cushion member is provided to exert an elastic force related to a resistance force and a restoring force by forming, along a rear surface of the jack stop rail, a protrusion with a through-hole formed in an elastic member; and a return of the jack is elastically urged when the jack comes into contact with the cushion member immediately after escaping from the hammer butt skin.

[0014] It is preferable that an upright piano action mechanism according to the present invention is characterized in that two elastic wires are used as the hammer butt spring and a butt flange cord is provided with a twisted part to allow hooks of the two hammer butt springs to be respectively hooked to the twisted part and a ring-shaped part at a tip of the twisted part.

[0015] It is preferable that an upright piano action mechanism according to the present invention is characterized in that a long rubber-based cushion member is provided to exert an elastic force related to a resistance force and an restoring force by forming, along a front surface and a rear surface of the damper stop rail, a protrusion with a through-hole formed in an elastic member; and the hammer shank and the damper wire come into contact with the cushion member when the string is struck, a resistance is applied to a motion of the hammer shank and the damper wire and an elastic force is urged in a returning direction of the hammer shank and the damper wire.

[0016] It is preferable that an upright piano action mechanism according to the present invention is characterized in that EPDM (ethylene propylene diene monomer rubber) is used as a rubber-based cushion member to be attached along a rear surface of the jack stop rail, and to be attached along front and rear surfaces of the damper stop rail.

Advantageous Effects of Invention

[0017] According to the present invention, the elastic force of the hammer butt spring is reinforced to thereby allow the hammer butt to be rapidly returned to the subsequent attitude to be pushed up by the jack. This contributes to an increase in the number of repetition of the same note during a performance and attainment of a half touch (in particular, playing at pianissimo and repetition of the same note and a half touch with the damper pedal depressed).

[0018] As for the material of the hammer butt skin, since a material having excellent lubricity is processed like in the present invention, or artificial leather having excellent lubricity is used, the removal of the jack from the push-up surface of the hammer butt is facilitated, and a response to the motion of the hammer butt is improved. With this structure, a returning velocity for a quick return to the subsequent attitude to be subsequently pushed up by the jack can be improved. This contributes to an improvement in a sense of touch during key pressing, an increase in the number of repetition of the same note during a performance, and attainment of a half touch, in particular, repetition of the same note and a half touch when a pianissimo sound is produced.

[0019] The elastic force of the jack spring is reinforced to thereby allow the jack to be rapidly returned, so that the jack is rapidly brought into a stand-by state and returned to the position below the push-up surface of the hammer butt. This contributes to attainment of repetition of the same note and a half touch.

[0020] Further, during a key-pressing operation at pianissimo or half-touch, when the jack comes into contact with the cushion member which is attached along the rear surface of the jack stop rail, immediately after escaping from the hammer butt skin, in a state where the keyboard is depressed to a lowermost position, the re-

sistance of the cushion member allows the motion range of the jack to be regulated in the range immediately after the escape from the hammer butt skin. With this structure, the repetition of the same note can be reliably achieved and a delicate sound can be expressed.

[0021] During a key-pressing operation at fortissimo or all touch, the jack comes into contact with the cushion member, which is attached along the rear surface of the jack stop rail, immediately after escaping from the butt skin, to elastically urge the return of the jack to release the keyboard depression, so that the jack is rapidly returned to the position (below the push-up surface of the hammer butt) immediately after the escape after key pressing by the restoring force and elastic force of the cushion member. This structure allows the jack to rapidly return to the position below the push-up surface of the hammer butt, enables repetition of string striking, increase the accuracy of the key pressing function, and enable a performance with a dynamic range.

[0022] Furthermore, the hammer shank comes into contact with the cushion members which are attached along the front surface and the rear surface of the damper stop rail during string striking, thereby a resistance is applied to the motion of the hammer shank and an elastic force is urged in the returning direction of the hammer shank. Thus, the resistance is applied to the motion of the hammer shank in the state where the keyboard is depressed to the lowermost position at pianissimo or half-touch, and it is possible to reproduce aftertouch, which is unique to a grand piano, on the upright piano as well.

[0023] The elastic force of the cushion member that is obtained when the hammer shank is hit during string striking allows the hammer shank to be elastically urged in the returning direction, so that the hammer can be assisted to move promptly and delicately.

[0024] Note that the above-mentioned term "aftertouch" refers to a sense of touch when the performer feels a slight hooked feeling during keyboard pressing in the structure of a grand piano. This aftertouch is not felt at all on conventional upright pianos and electronic pianos.

[0025] However, the cushion members which are attached along the front surface and the rear surface of the damper stop rail of the present invention are cushion members which have a protrusion with a through-hole formed in an elastic member. Because of this, the cushion members allow the elastic force related to the resistance force and the restoring force to be exerted, and have flexibility in dealing with various key pressing operations. Accordingly, in an initial stage in which the hammer shank comes into contact with the cushion members during string striking, the protrusion having the through-hole of each cushion member is pressed with a small pressing force, and in a later stage in which the protrusion is pressed, the depressed keyboard is pressed by applying a large elastic force, thereby it is possible to reproduce the above-mentioned aftertouch.

[0026] Therefore, according to the present invention

described above, a synergistic improvement for increasing the returning velocity of the jack can be provided, and the repetition of the same note that is comparable to or more than that on a grand piano can be achieved.

[0027] Furthermore, when the depressed key is depressed again, a half touch that is comparable to or more than that on a grand piano can be achieved, and a dynamic range in terms of sound quality and the like can be improved.

[0028] Moreover, according to the present invention, each part of the upright piano can be modified using the existing members as they are. Therefore, it is possible to easily improve the used pianos, or the pianos used by users, in the case of repairing each part of the existing pianos, as well as in the case of producing new upright pianos.

Brief Description of Drawings

[0029]

Figure 1 is a side view showing an upright piano action mechanism according to an embodiment of the present invention.

Figure 2 is an enlarged view showing parts related to the upright piano action mechanism according to the embodiment of the present invention.

Figure 3(a) is an overall view of a hammer butt spring in the upright piano action mechanism according to the embodiment of the present invention; Figures 3(b) and 3(c) are rear views of the hammer butt attached with a hammer butt spring; Figures 3(d) and 3(e) are front side views of a hammer butt flange having a butt flange cord mounted thereon; and Figure 3(f) is a side view of the structure shown in Figure 3(c).

Figures 4(a) and 4(b) are partial side views for explaining the hammer butt spring, a hammer butt skin, and the like of a hammer butt in the upright piano action mechanism according to the embodiment of the present invention; and Figures 4(c) to 4(f) are perspective views and a side view for explaining cushion members which are attached along a front surface and a rear surface of a damper stop rail.

Figures 5(a) and 5(b) are partial side views for explaining a relationship between a hammer butt skin and a jack in the upright piano action mechanism according to the embodiment of the present invention.

Figures 6(a) to 6(e) are partial side views for explaining a jack stop rail and the cushion member in the upright piano action mechanism according to an embodiment of the present invention.

Description of Embodiment

[0030] Embodiment of the present invention will be described with the drawings.

Embodiment

[0031] First, the overall structure of an upright piano action mechanism according to an embodiment of the invention will be described. Referring to Figure 1, white keys 1a constituting a keyboard 1 are provided on the side of the piano at which a player plays the piano. Methacrylate resin (Product name: Acrypet or Acrylic) is used nowadays to form the white keys 1a, while ivory was once used to form the white keys 1a. The keyboard 1 is arranged based on the rule of the octave, i.e., W, W, H, W, W, W, H (W = whole tone, H = half tone). Each octave has eight white keys 1a and five black keys 1b. As the material of the black keys 1b, ebony was used once, but nowadays phenol resin is generally used in many cases.

[0032] A front bushing cloth 2a is provided in a recess which is formed in a lower portion of each white key 1a in the vicinity of the leading end thereof. During key pressing, the front bushing cloth 2a is brought into contact with a front pin 2b which is provided under the front bushing cloth 2a, thereby the right and left positions of the keyboard 1 is stabilized. Note that the front pin 2b is formed into an oval shape, as it is also known as an oval pin, and the contact area of the front pin 2b is increased to thereby reduce friction of the front bushing cloth 2a.

[0033] A front punching cloth 2c is attached to a lower portion of the keyboard 1 so as to prevent the generation of noise during key pressing of the keyboard 1 when it comes into contact with the front pin 2b. A keyboard reed 2d is a base on which the keyboard 1 is placed. A back rail cloth 1c which is provided at a lower portion of a rear end of the keyboard 1 regulates the positions in the height and depth of the keyboard 1 and functions as a cushion material to prevent the generation of noise when the keyboard 1 returning.

[0034] Further, a keyboard middle seat plate 4 is provided at substantially the center of the keyboard 1. The keyboard middle seat plate 4 has a balance hole (not shown) through which a balance pin 4b that is fixed to a base 4a passes. In this balance hole, a red balance bushing cloth 4c is generally attached in a state where the balance pin 4b is sandwiched therebetween. An appropriate gap formed by the balance bushing cloth 4c and the slippage of the balance bushing cloth 4c thereof stabilize the motion of the keyboard 1. Note that the each of keyboards 1 is supported by a balance punching cloth 4d which is provided on an upper part of the base 4a. The balance punching cloth 4d functions as a buffer for preventing the generation of noise during key pressing, and is important for adjustment of the height of the keyboard 1.

[0035] A keyboard back seat plate 1d which is a base made of wood, is provided on an upper portion of the rear end of the keyboard 1 and is fixed to a capstan button 5 via a post wire 5a which is supported on an upper portion of the keyboard back seat plate 1d. As shown in Figure 2, the capstan button 5 is a component which has a round upper portion and a vertical length of about 2 cm, and

has a function of transmitting an upward motion of the keyboard 1 to the action mechanism provided above the keyboard 1. The capstan button 5 is adjusted in the vertical direction to thereby transmit a force generated by the motion of the keyboard 1 without loss.

[0036] As shown in Figure 2, a wippen heel 6a which is fixed to a lower portion of a wippen 6 is provided above the capstan button 5, and a wippen heel cloth 6b which is provided at a lower portion or a recess of the wippen heel 6a is lifted by an upper end of the capstan button 5. At this time, the wippen heel cloth 6b functions as a buffer for preventing the generation of noise between the wippen heel 6a and the capstan button 5.

[0037] A damper spoon 18 is attached to an upper front portion of the wippen 6. The damper spoon 18 has a function of allowing the damper assembly 8 to move, and is movable backward during key pressing to allow a damper lever 8a which is in contact with a string 19 to be separated from the string 19, so that a damper felt 11c of a damper head 11 is separated from the string 19 and thus the string 19 is ready to vibrate. Note that the way the damper spoon 18 touches the damper lever 8a is changed by finely adjusting the position of the damper spoon 18 in the front-rear direction, so that a change is produced in the touch of the keyboard 1. In general, as the damper spoon 18 touches the damper lever 8a rapidly, the player feels a heavy key touch, and as the damper spoon 18 touches the damper lever 8a slowly, the player feels a light key touch.

[0038] As shown in Figure 2, the damper lever 8a described above is pivotally attached to a damper flange 8b which is fixed to an upper end of a center rail 14, with a damper flange center pin 8c. The damper lever 8a is fixed to a damper block 11b which is provided at a rear portion of a damper wood 11a. The damper wood 11a is attached to an upper portion via a damper wire 11d. The damper lever 8a is provided with a damper spring 8d, and the damper felt 11c which is provided at a rear portion of the damper wood 11a presses the string 19 by the damper spring 8d. Note that deterioration in the lubrication at a contact portion between the damper spring 8d and the damper lever 8a causes noise.

[0039] In front of the damper wire 11d, a damper stop rail 16 is provided. The damper stop rail 16 regulates the motion of the damper wire 11d. In such a structure, the damper stop rail 16 also operates as a cushion for the damper wire 11d to be separated from the string 19 by the motion transmitted from the damper spoon 18.

[0040] On the other hand, at an upper rear portion of the wippen 6, a wippen flange 14a which is fixed to the center rail 14 is pivotally attached with a wippen flange center pin 14b. Further, a hammer butt flange 15 is fixed to an upper rear portion of the center rail 14 by a hammer butt flange screw 15a, and a hammer butt 3 is pivotally attached to an upper portion of the hammer butt flange 15 with a hammer butt flange center pin 15b. As shown in Figures 3(d), 3(e), and 3(f), the hammer butt flange center pin 15b is inserted into a pin groove 3c which is

provided in the hammer butt 3, and the hammer butt 3 is fixed by a press fitting (butt plate) 12 which is screwed into the rear surface of the hammer butt 3 with a fixing screw (butt plate screw) 12a.

[0041] Further, as shown in Figure 3(f), the tension of a hammer butt spring 7 which is attached to a rear portion of the hammer butt 3 is held by allowing a hook 7a, which is formed at the leading end of the hammer butt spring 7, to be hooked to a hammer butt flange cord 10 which is attached to the hammer butt flange 15. Note that as shown in Figures 3(d) 3(e), and 3(f), two mounting grooves 15c are formed in the front surface of the hammer butt flange 15, and each end of the hammer butt flange cord 10 is attached to the corresponding mounting groove 15c by being bonded thereto.

[0042] A jack flange 6c is fixed to an upper portion in the middle of the wippen 6, and a jack 20 is pivotally attached to the jack flange 6c through a jack flange center pin 6d. An upper end of the jack 20 functions to push up the hammer butt 3. At a front portion of a lower end of the jack 20, a jack tail 20a is formed so as to project forward, and an upper portion of a jack spring 21 is fit to a projection 20b which is provided on a lower surface of the jack tail 20a, and a lower portion of a jack spring 21 is supported by a recess 6e which is formed in an upper surface of the wippen 6, so that the motion of the jack 20 is urged during key pressing.

[0043] At a lower portion on the front side of the hammer butt 3, a hammer butt felt 22a shown in Figure 3(f) is provided and a hammer butt skin 22 is provided on the front side thereof. The hammer butt felt 22a prevents the generation of noise during the motion of the jack 20. The hammer butt skin 22 is formed of leather having excellent slippage so as to smooth the motion of the jack 20 which is brought into contact with the hammer butt skin 22.

[0044] As shown in Figure 2, a hammer 23 is attached to an upper portion of the hammer butt 3. The hammer 23 is composed of a hammer shank 23a which corresponds to an arm of the hammer 23, a hammer wood 23b which is a base portion of the hammer 23, and a hammer felt 23c which is also referred to as a music wire and produces a sound by striking the string 19.

[0045] A hammer rail 26 is attached to an action bracket 28 to stabilize the hammer 23 which has returned after string striking. A hammer felt 26a is fixed to a rear portion of the hammer rail 26 as a buffer, and prevents the generation of a hitting sound when the hammer shank 23a returns to the hammer rail 26 side.

[0046] Next, as shown in Figure 2, a catcher 24 which is made of wood and has a catcher skin 24b bonded on the front side thereof is fixed at a leading end of a catcher shank 24a which is attached to the front side of the hammer butt 3. On the other hand, in front of the catcher 24, a back check 25 is provided via a back check wire 25a which is attached to the wippen 6. A back check felt 25b is provided on a rear surface of the back check 25. A bridle chip 24d is provided at an end of a band-like bridle tape 24c which is attached to the catcher 24. The bridle

chip 24d is locked at a leading end of a bridle wire 24e which is raised upward from the wippen 6.

[0047] With this structure, after the hammer 23 strikes the string, the catcher 24 is stopped by the back check felt 25b of the back check 25 via the catcher skin 24b, so that the motion of the hammer 23 is inhibited after string striking. The position of the hammer 23 that is stopped after striking the string 19 is determined depending on the position in the front-rear direction where the catcher 24 is stopped. At this time, the catcher skin 24b absorbs an impact and the back check felt 25b also absorbs an impact, thereby the generation of noise is prevented.

[0048] Note that since the upright piano has a structure in which the action mechanism is vertically placed, it is difficult to return a hammer mechanism to its original position by its own weight, unlike in a grand piano. Accordingly, an auxiliary component such as the bridle tape is required to rapidly return the hammer mechanism to its original position after key pressing.

[0049] A damper rod 29 is fixed to a rear portion in the middle of the center rail 14. The damper rod 29 is connected to a damper pedal which is not shown. The damper pedal is a rightmost long note pedal among three pedals which are generally mounted on a piano. When the damper pedal is depressed, all dampers are moved at once, so that every note can sustain after key pressing. When the damper pedal is released, the dampers are returned, so that sustained notes are cut off. Note that a damper lever cloth 8e which is brought into contact with the damper spoon 18 is attached to a lower portion of the damper lever 8a, and prevents friction with the damper spoon 18 to thereby prevent the generation of noise.

[0050] On the other hand, a regulating screw 27 is fixed to the front side in the middle of the center rail 14. The regulating screw 27 is rotatable in the right-left direction by a dedicated tool, and can adjust the raising angle of the jack 20. Specifically, when the regulating screw 27 is rotated leftward, namely counterclockwise, a regulating button 27a which is attached to the regulating screw 27 moves upward, a time when the regulating button 27a comes into contact with the jack tail 20a increases, and the time required for the jack 20 to escape from the hammer butt 3 increases. Further, as the escape of the hammer 23 approaches the string 19, the time required for transmitting the motion to the hammer 23 increases. As a result, the sound volume is increased and the control for producing a pianissimo sound is facilitated during a performance. On the contrary, when the regulating screw 27 is rotated rightward, namely clockwise, the regulating button 27a moves downward, so that an effect opposite to that of the above-mentioned case is provided.

[0051] With this structure, the motion of the jack tail 20a which is provided on the jack 20 can be controlled and the motion of the hammer 23 by the jack 20 that is applied by key depressing can be changed. Note that the adjustment of the regulating screw 27 is called an approach adjustment, and is especially important among

the adjustments of the action of the upright piano. Accordingly, when the jack tail 20a is raised, the position where the jack tail 20a is reliably supported in a bitten manner at the center of the cloth provided at a lower end of the regulating button 27a is important. During key pressing, the jack tail 20a is raised upward and brought into contact with the regulating button 27a, so that the hammer 23 approaches the string 19, and thus the position for escape of the hammer 23 before contacting the string 19 is determined. If the hammer 23 is located extremely close to the string 19, the sound is cut off. If the hammer 23 is located extremely far from the string 19, it is difficult to produce a forte sound, and especially, a pianissimo sound.

[0052] Note that the action mechanism described above is held at a predetermined height by the action bracket 28 which is attached to a piano body side with an action bolt nut 28a.

[0053] In the upright piano action mechanism having the structure as described above, in order to reinforce the elastic force of the hammer butt spring 7 in this embodiment, as shown in Figure 3, the elastic force of one hammer butt spring 7 is reinforced, or two hammer butt springs 7 are used.

[0054] Specifically, when one hammer butt spring 7 is used, as shown in Figure 3(a), an elastic wire member which is made of phosphor bronze or the like and has a diameter greater than that of the conventional hammer butt spring 7 is used. The hammer butt spring 7 has a structure in which the hook 7a is provided at one end thereof, a wound portion 7b formed by winding a wire member at the other end thereof by two or three turns is provided, and a linear stretching portion 7c stretches from the wound portion 7b.

[0055] Next, in the case of attaching one hammer butt spring 7, as shown in Figure 3(b) or Figure 4(a), the wound portion 7b of the hammer butt spring 7 is attached with a hammer butt spring pin cord 3a which is made of felt or the like and is provided on the hammer butt 3, and the stretching portion 7c is supported by a back portion 3b of the hammer butt 3, so that the hook 7a is hooked to the hammer butt flange cord 10. This structure enables reinforcement of the elastic force compared to the conventional hammer butt spring 7.

[0056] As shown in Figure 3(c) or 3(f), when two hammer butt springs 7 are used, an elastic wire member which is made of phosphor bronze or the like and has the same diameter as that of the conventional elastic wire member, or an elastic wire member having an adjusted diameter is used, and the hook 7a at one end thereof and form the wound portion 7b and the stretching portion 7c at the other end thereof is formed as shown in Figure 3(a).

[0057] Note that in Figures 3(c) and 3(f) or Figure 4(b), two hammer butt springs 7, 7 from each other is distinguished, so that they are referred to as a first hammer butt spring 7(1) and a second hammer butt spring 7(2), respectively. For example, a hook 7a(1) is a portion related to the first hammer butt spring 7(1), and a hook

7a(2) is a portion related to the second hammer butt spring 7(2). In this manner, (1) or (2) is appended to a number or an alphabet denoting each component.

[0058] As shown in Figure 3(f) or Figure 4(b), a wound portion 7b(1) of the first hammer butt spring 7(1) is attached with the hammer butt spring pin cord 3a of the hammer butt 3, and a stretching portion 7c(1) is supported by the back portion 3b of the hammer butt 3. A stretching portion 7c(2) of the second hammer butt spring 7(2) is inserted between the wound portion 7b(1) and the rear surface portion 3b of the hammer butt 3 from above the wound portion 7b(1) of the first hammer butt spring 7(1), so that the stretching portion 7c(2) is allowed to be hooked to the wound portion 7b(1) of the first hammer butt spring 7(1). This structure can facilitate the attachment merely by preparing the second hammer butt spring 7(2) separately. Note that, at this time, the stretching portion 7c(1) of the first hammer butt spring 7(1) and the stretching portion 7c(2) of the second hammer butt spring 7(2) may be fixed by bonding them to the back portion 3b of the hammer butt 3.

[0059] Further, at a leading end of the typical hammer butt flange cord 10 shown in Figure 3(d), a twisted part 10a is provided as shown in Figure 3(e). As shown in Figure 3(c) or Figure 3(f), the hooks 7a(1) and 7a(2) of the two hammer butt springs 7(1) and 7(2) are respectively hooked to the twisted part 10a and a ring-shaped part 10b which is formed at a tip of the twisted part 10a. In this case, the second hammer butt spring 7(2) is formed with the same length as that of the first hammer butt spring 7(1), and the hammer butt flange cord 10 is formed with a length that is slightly longer than the length of the second hammer butt spring 7(2). The hook 7a(1) of the first hammer butt spring 7(1) may be hooked to the twisted part 10a shown in Figure 3(e), and the hooks 7a(2) of the second hammer butt spring 7(2) may be hooked to the ring-shaped part 10b.

[0060] As described above, not only when one thick hammer butt spring 7 is used, but also when two hammer butt springs 7(1) and 7(2) are used, the elastic force can be reinforced in comparison with the case where one conventional hammer butt spring is used, and the hammer butt 3 can be rapidly returned to the subsequent attitude to be pushed up by the jack 20. This contributes to an increase in the number of repetition of the same note during a performance and an attainment of a half touch (in particular, playing at pianissimo and repetition of the same note and a half touch with the damper pedal depressed).

[0061] In this embodiment, as the material of the hammer butt skin 22 having excellent lubricity as shown in Figures 5(a) and 5(b), the hammer butt skin that is ironed and coated with graphite, or artificial leather which is thinner than wash-leather may be used, and artificial leather such as polyurethane which has excellent lubricity, may be used on the graphite or the thinner artificial leather.

[0062] In the structure described above, as shown in Figures 5(a) and 5(b), the hammer butt 3 has a structure

in which an undercloth 22b and an underfelt 22c are attached to a recess which is formed in the push-up surface 17 that is located at a lower front portion thereof. The hammer butt skin 22 is attached in an inclined manner so as to cover the undercloth 22b and the underfelt 22c. Accordingly, the elasticity of the undercloth 22b and the underfelt 22c improves the state in which the leading end of the jack 20 which is in contact with the hammer butt skin 22 is supported in a bitten manner. In this bitten state, the jack 20 is raised so that the push-up function of the hammer butt 3 can be reinforced and an excellent sense of touch during key pressing can be provided.

[0063] Further, the frictional resistance between the leading end of the jack 20 and the hammer butt skin 22 can be reduced by the lubricity of the hammer butt skin 22, and when the jack tail 20a comes into contact with the regulating button 27a and the leading end of the jack 20 reaches the inclined surface, the jack 20 is slipped and disconnected from the inclined surface of the hammer butt skin 22 at once. At this time, the push-up force of the jack 20 rapidly decreases, so that player perceives a sense of touch that the player is rapidly released from the resistance of key pressing when the keyboard 1 is depressed.

[0064] The operation of the jack 20 as described above improves the removal from the push-up surface 17 of the hammer butt 3, as a result, the response of the motion of the hammer butt 3 is improved, and it is capable of improving in the returning velocity for a rapid return to the subsequent attitude to be pushed up by the jack 20. This contributes an improvement in a sense of touch during key pressing as described above, an increase in the number of repetition of the same note during a performance, and attainment of a half touch (in particular, playing at pianissimo and repetition of the same note and a half touch with the damper pedal depressed).

[0065] Further, in this embodiment, as shown in Figure 6(b), an upper thin portion 21a of the jack spring 21 is fit to the projection 20b which is located at a lower portion of the jack tail 20a of the jack 20, and the recess 6e in the upper surface of the wippen 6 supports the thin portion 21b at a lower portion of the jack spring 21. In such a structure, the elastic force of the jack spring 21 can be adjusted by shifting the vertical position where the upper thin portion 21a of the jack spring 21 is fit to the projection 20b of the jack tail 20a. Further, the elastic force of the jack spring 21 can be reinforced by increasing one or two turn the number of turns of the jack spring 21, while the conventional number of turns is 13.

[0066] This structure allows the jack 20 to be returned rapidly, so that the jack 20 is rapidly brought into a standby state to the position below the push-surface 17 of the hammer butt 3. This contributes to attainment of repetition of the same note and half touch.

[0067] Further, in this embodiment, as shown in Figures 6(a) to 6(d), the long rubber-based cushion member 13 which has a protrusion 13b with a through-hole 13a formed in an elastic material and has an elastic force

related to a resistance force and a restoring force is attached along the rear surface of the jack stop rail 9. Note that the position of the protrusion 13b of the cushion member 13 is provided at an upper portion along the jack stop rail 9 as shown in Figure 6(a). Alternatively, the protrusion 13b may be provided at a lower portion along the jack stop rail 9 as shown in Figure 6(b), or may be provided at a central portion along the jack stop rail 9 as shown in Figure 6(c).

[0068] As the material of the rubber-based cushion members 13, EPDM (ethylene propylene diene monomer rubber) which has a light weight and an excellent elastic force may be used. As shown in Figures 6(a) to 6(c), the cushion member 13 has a long length and has a structure in which one end is flat and the protrusion 13b having the through-hole 13a is formed at the other end thereof. This structure has a shape advantageous for exerting the elastic force related to the resistance force and the restoring force. The cushion member 13 can be attached to the rear surface of the conventional jack stop rail 9 formed of wood or the like, or can be attached to a jack stop rail felt 9a which is fixed to the rear surface of the conventional jack stop rail 9.

[0069] In any of the above structures, an adjustment may be made such that the jack 20 pushes down the cushion member 13 by about 2 mm in the state where the keyboard 1 (see Figure 1) is depressed to a lowermost position. Note that in the case of a small upright piano which has only a limited space, a regulating rail may be used instead of the jack stop rail 9. Also in this case, when the cushion member 13 is provided on the regulating rail in the same manner as described above, the same advantageous effect as that described above can be obtained.

[0070] With this structure, when the jack 20 depresses the cushion member 13 in the state where the keyboard 1 (see Figure 1) is depressed to the lowermost position and then the depression of the keyboard 1 is released, the elastic force related to the resistance force and the restoring force of the cushion members 13 allows the jack 20 to be rapidly returned to the position below the push-up surface 17 of the hammer butt 3 and brought into a state where the jack 20 is prepared for the next key pressing. This contributes to attainment of a sense of touch with a feeling of removal which is unique to an upright piano during key pressing, in particular, attainment of a half touch when a pianissimo sound is produced and the damper pedal is depressed, and further to an increase in the number of repetition of the same note.

[0071] Further, in this embodiment, as shown in Figure 2, the damper stop rail 16 is fixed to an upper side portion of the action bracket 28 which is upright at both ends of the existing upright piano action mechanism. On the rear surface of the damper stop rail 16, a damper stop rail felt 16a for regulating the motion of the damper wire 11d which is supported by the damper lever 8a is provided. In this embodiment with such a structure, since the damper stop rail 16 is used and the hammer shank 23a is

brought into contact with the cushion member 13 which is attached along the front surface of the damper stop rail 16 during string striking, it is possible to apply a resistance to the motion of the hammer shank 23a and apply an elastic force in the returning direction of the hammer shank 23a. Further, in this embodiment, the cushion member 13 is also attached to the rear surface of the damper stop rail 16, and the damper wire 11d comes into contact with the cushion members 13 (pressed by about 1 mm), so that an elastic force in the returning direction of the damper wire 11d is applied and the return of the wippen 6 through the damper spoon 18 is urged.

[0072] In the structure described above, the cushion members 13 which are attached along the front surface and the rear surface of the damper stop rail 16 shown in Figures 4(a) and 4(b) (in these figures, the illustration of the action bracket 28 is omitted) are similar to the cushion member 13 shown in Figure 6. Accordingly, the long rubber-based cushion members 13 are attached in such a manner that the cushion members 13 having the protrusion 13b with the through-hole 13a formed in an elastic material are formed to exert the elastic force related to the resistance force and the restoring force.

[0073] In the structure described above, the cushion member 13 is attached to the rear surface of the damper stop rail 16. In detail, the cushion member 13 is attached in a range in which the damper wire 11d presses the cushion member 13 by about 1 mm at a distance of 4 mm from the damper wire 11d. Accordingly, it is possible to rapidly return the damper and assist the return of the entire wippen 6, in particular, to promote repetition of the same note and a half touch when a pianissimo sound is performed and the damper pedal is depressed.

[0074] Note that also in the above-mentioned case, EPDM (ethylene propylene diene monomer rubber) which has a light weight and has an excellent elastic force may be used as the rubber-based cushion members 13. Further, the position of the protrusion 13b is provided at a central portion along the front surface and the rear surface of the damper stop rail 16 as shown in Figure 4(c). Alternatively, the protrusion 13b may be provided at a lower portion along the front surface and the rear surface of the damper stop rail 16 as shown in Figure 4(d), or may be provided at an upper portion along the front surface and the rear surface of the damper stop rail 16 as shown in Figure 4(e). Although not illustrated, the position of the protrusion 13b may be provided at an upper portion or a lower portion of the damper stop rail 16 along the front surface and the rear surface thereof. Note that the cushion members 13 need to be attached while retaining a sense of aftertouch and without inhibiting string striking.

[0075] In each cushion member 13, the protrusion 13b having the through-hole 13a of the cushion member 13 is pressed with a small pressing force in the initial stage (see Figure 4(f)) at which the hammer shank 23a comes into contact with the cushion member 13 during string striking. In the later stage at which the protrusion 13b is pressed (in the state where the protrusion 13b is

crushed), a large elastic force is exerted and the depressed keyboard 1 is pressed back. Accordingly, the aftertouch which is unique to a grand piano and has been conventionally difficult to reproduce on an upright piano, can be reproduced on the upright piano.

[0076] In the upright piano action mechanism according to the embodiment described above, synergistic improvements that the returning velocity of the jack 20 can be increased by comprehensively improving each part related to the returning velocity of the jack 20 and the motion range can be feely controlled depending on the way of key pressing can be achieved. Note that after conducting key pressing tests on the upright piano according to this embodiment, the inventor of this application has confirmed that the number of repetition of the same note, i.e., the repetition of the same note when the same keyboard 1 is continuously pressing can be increased to 14 or more per second, which is comparable to that of a grand piano.

[0077] Moreover, as a half touch when the same keyboard 1 is depressed again after key pressing, i.e., a half touch comparable to that on a grand piano, repetition of the same note and a half touch when a forte or pianissimo sound is produced can be achieved by depressing the keyboard 1 by a half or one-third of the depth of each key. Also, in terms of sound quality, an advantageous effect of remarkable sound quality with an increase in the extent of the dynamic range and the like can be obtained.

Industrial Applicability

[0078] An upright piano action mechanism according to the present invention can deal with various key pressing operations, such as repetition of the same note when a keyboard of an upright piano is continuously depressed, playing at pianissimo, playing at half-touch, and a repetition of the same note and a half touch when a damper pedal is depressed, and can also be used as an upright piano action mechanism which has achieved an improvement in sound quality related to a dynamic range and the like.

Reference Signs List

[0079]

1	Keyboard
1a	White key
1b	Black key
1c	Back rail cloth
1d	Keyboard back seat plate
2a	Front bushing cloth
2b	Front pin
2c	Front punching cloth
2d	Keyboard reed
3	Hammer butt
3a	Hammer butt spring pin cord
3b	Back portion

3c Pin groove
 4 Keyboard middle seat plate
 4a Base
 4b Balance pin
 4c Balance bushing cloth
 4d Balance punching cloth
 5 Capstan button
 5a Post wire
 6 Wippen
 6a Wippen heel
 6b Wippen heel cloth
 6c Jack flange
 6d Jack flange center pin
 6e Recess
 7 Hammer butt spring
 7a Hooks
 7b Wound portion
 7c Stretching portion
 7(1) First hammer butt spring
 7(2) Second hammer butt spring
 7a(1) Hook
 7a(2) Hook
 7b(1) Wound portion
 7b(2) Wound portion
 7c(1) Stretching portion
 7c(2) Stretching portion
 8 Damper assembly
 8a Damper lever
 8b Damper flange
 8c Damper flange center pin
 8d Damper spring
 8e Damper lever cloth
 9 Jack stop rail
 9a Jack stop rail felt
 10 Hammer butt flange cord
 10a Twisted part
 10b Ring-shaped part
 11 Damper head
 11a Damper wood
 11b Damper block
 11c Damper felt
 11d Damper wire
 12 Press fitting (Butt plate)
 12a Fixing screw (butt plate screw)
 13 Cushion member
 13a Through-hole
 13b Protrusion
 14 Center rail
 14a Wippen flange
 14b Wippen flange center pin
 15 Hammer butt flange
 15a Hammer butt flange screw
 15b Hammer butt flange center pin
 15c Mounting groove
 16 Damper stop rail
 16a Damper stop rail felt
 17 Push-up surface
 18 Damper spoon

19 String
 20 Jack
 20a Jack tail
 20b projection
 5 21 Jack spring
 21a Thin portion
 21b Thin portion
 22 Hammer butt skin
 22a Hammer butt felt
 10 22b Undercloth
 22c Underfelt
 23 Hammer
 23a Hammer shank
 23b Hammer wood
 15 23c Hammer felt
 24 Catcher
 24a Catcher shank
 24b Catcher skin
 24c Bridle tape
 20 24d Bridle chip
 24e Bridle wire
 25 Back check
 25a Back check wire
 25b Back check felt
 25 26 Hammer rail
 26a Hammer felt
 27 Regulating screw
 27a Regulating button
 28 Action bracket
 30 28a Action bolt nut
 29 Damper rod

Claims

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1. An upright piano action mechanism comprising:

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a jack that performs an upward push-up operation in association with a keyboard-depressing operation;

a hammer butt that pivots backward, which is a string side, by the push-up operation of the jack; a hammer shank that is supported by the hammer butt;

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a hammer that strikes a string provided at a leading end of the hammer shank;

a damper stop rail that damps a motion of a damper wire;

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a hammer butt skin that is provided on a push-up surface of the hammer butt;

a hammer butt spring that urges the hammer forward after the string is struck;

a jack spring that urges the jack in a returning direction which is an opposite direction in which a key is pressed; and

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a jack stop rail that regulates inclination of the jack after key pressing and controls a motion range of the jack, wherein

a long rubber-based cushion member is provided to exert an elastic force related to a resistance force and a restoring force by forming, along a rear surface of the jack stop rail, a protrusion with a through-hole formed in an elastic member, and
a return of the jack is elastically urged when the jack comes into contact with the cushion member immediately after escaping from the hammer butt skin.

2. The upright piano action mechanism according to claim 1, wherein two elastic wire members are used as the hammer butt spring and a butt flange cord is provided with a twisted part to allow hooks of the two hammer butt springs to be respectively hooked to the twisted part and a ring-shaped part at a tip of the twisted part.
3. The upright piano action mechanism according to claim 1 or 2, wherein
a long rubber-based cushion member is provided to exert an elastic force related to a resistance force and a restoring force by forming, along a front surface and a rear surface of the damper stop rail, a protrusion with a through-hole formed in an elastic member, and
the hammer shank and the damper wire come into contact with the cushion member when the string is struck, thereby a resistance is applied to a motion of the hammer shank and the damper wire and an elastic force is urged in a returning direction of the hammer shank and the damper wire.
4. The upright piano action mechanism according to any one of claims 1 to 3, wherein EPDM (ethylene propylene diene monomer rubber) is used as a rubber-based cushion member to be attached along a rear surface of the jack stop rail, or to be attached along a front surface and a rear surface of the damper stop rail.

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Fig. 1

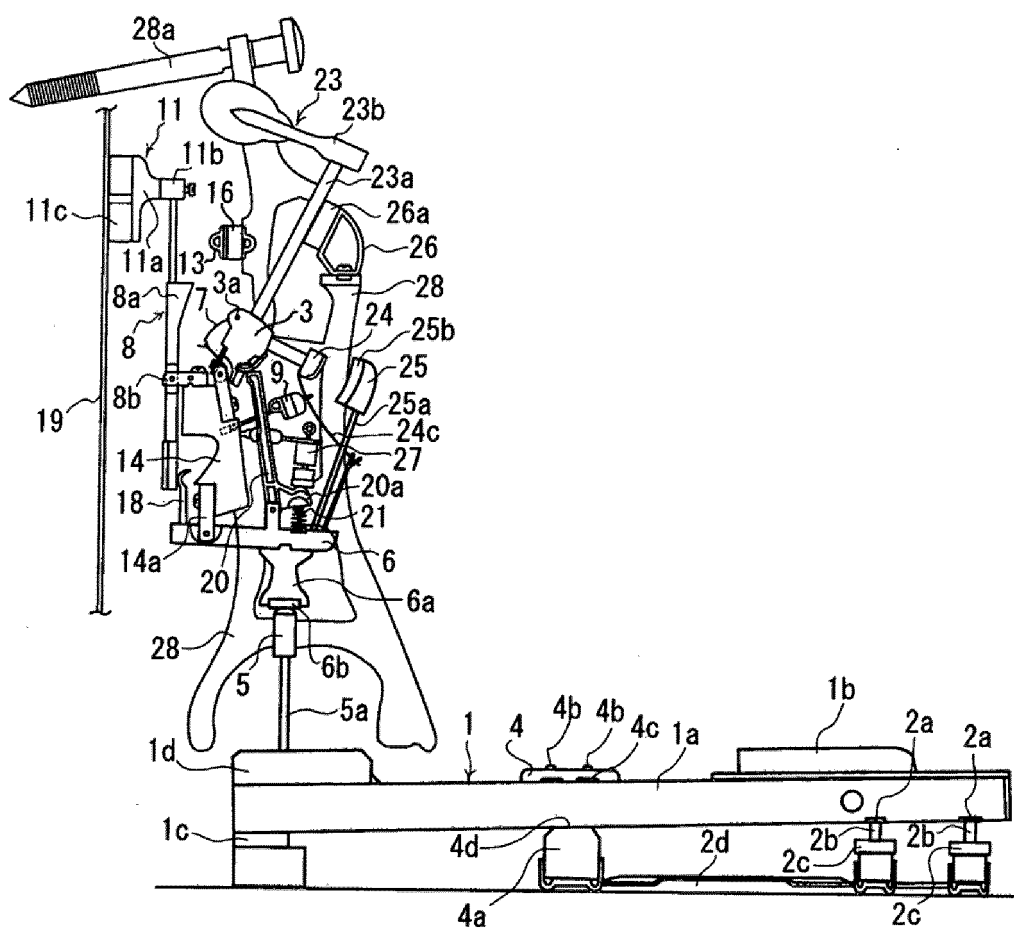


Fig. 2

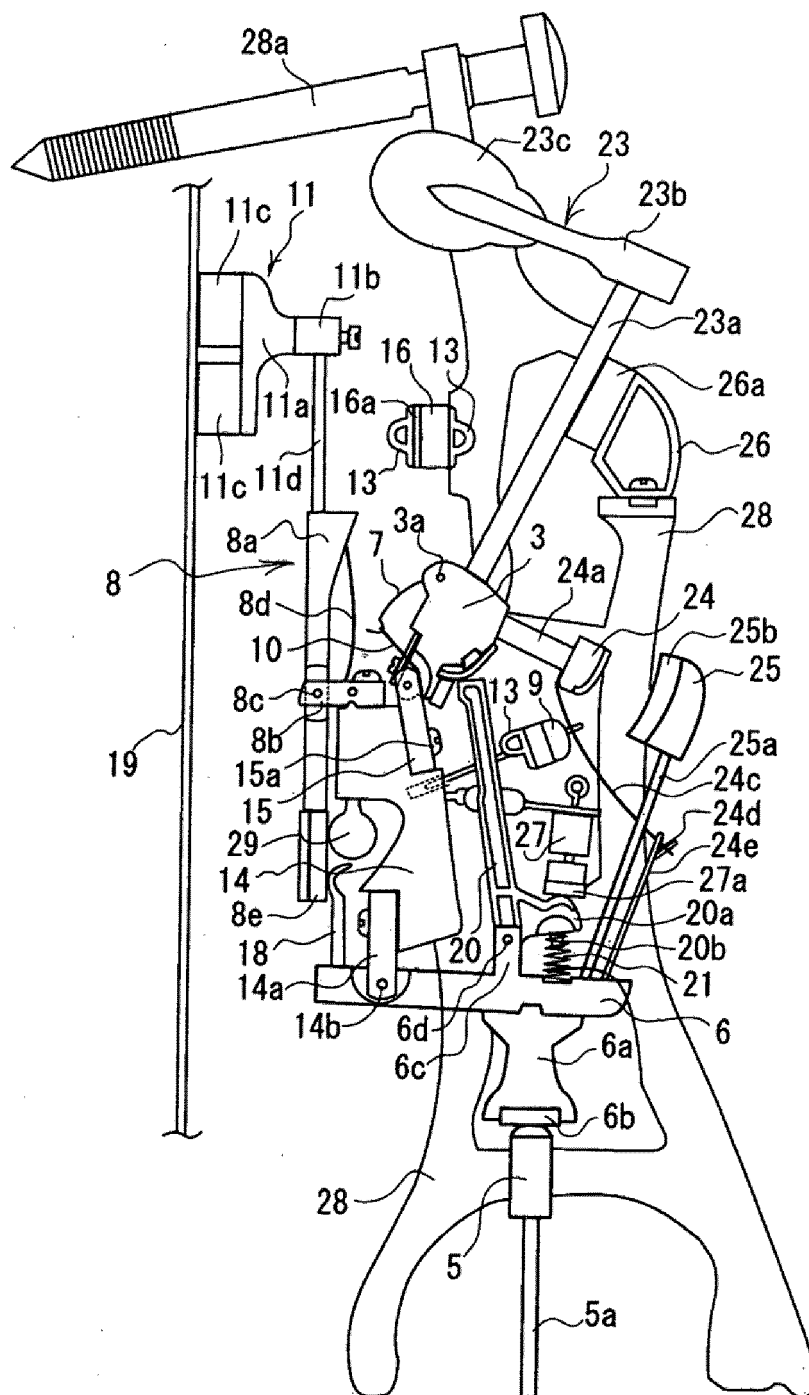


Fig. 3

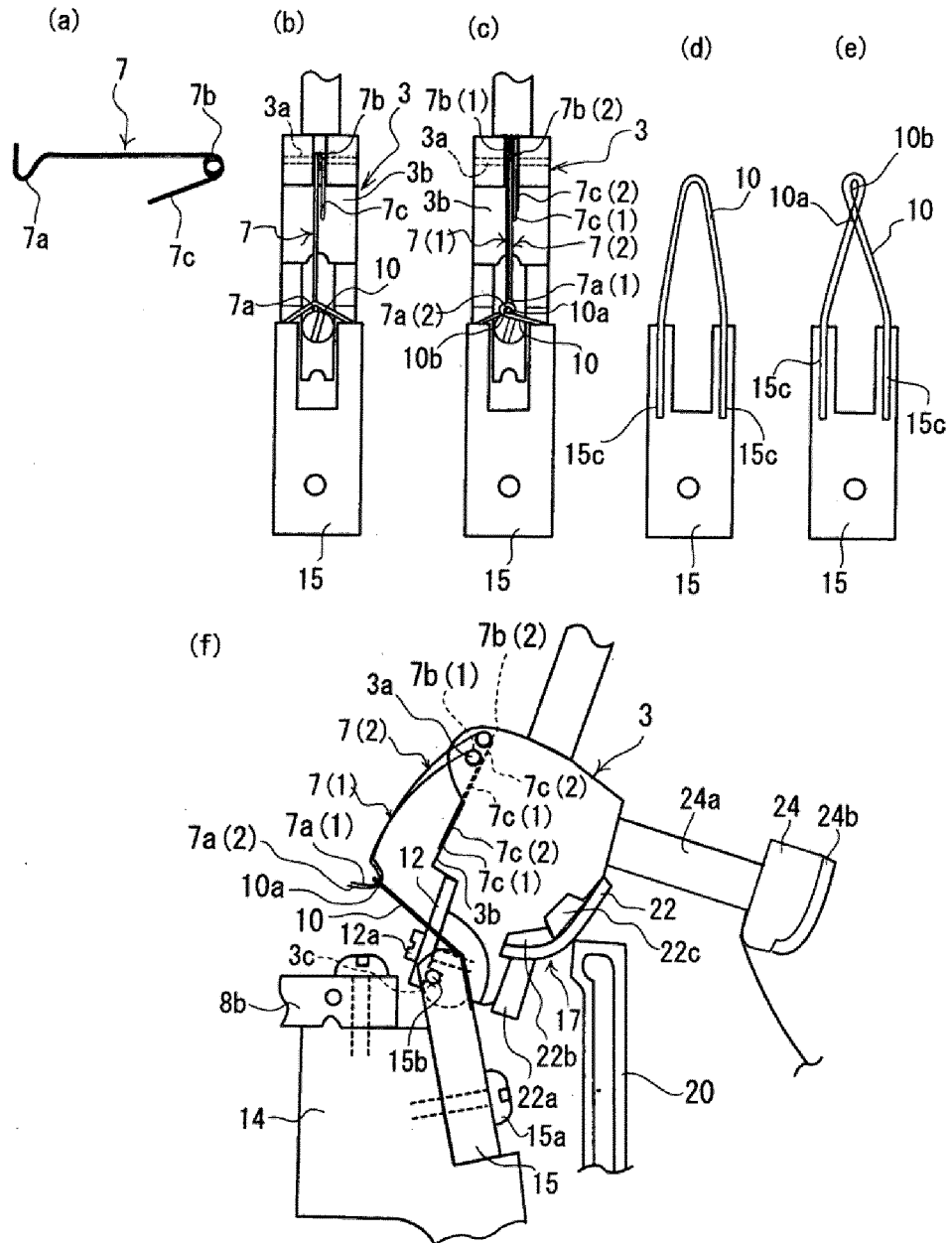


Fig. 4

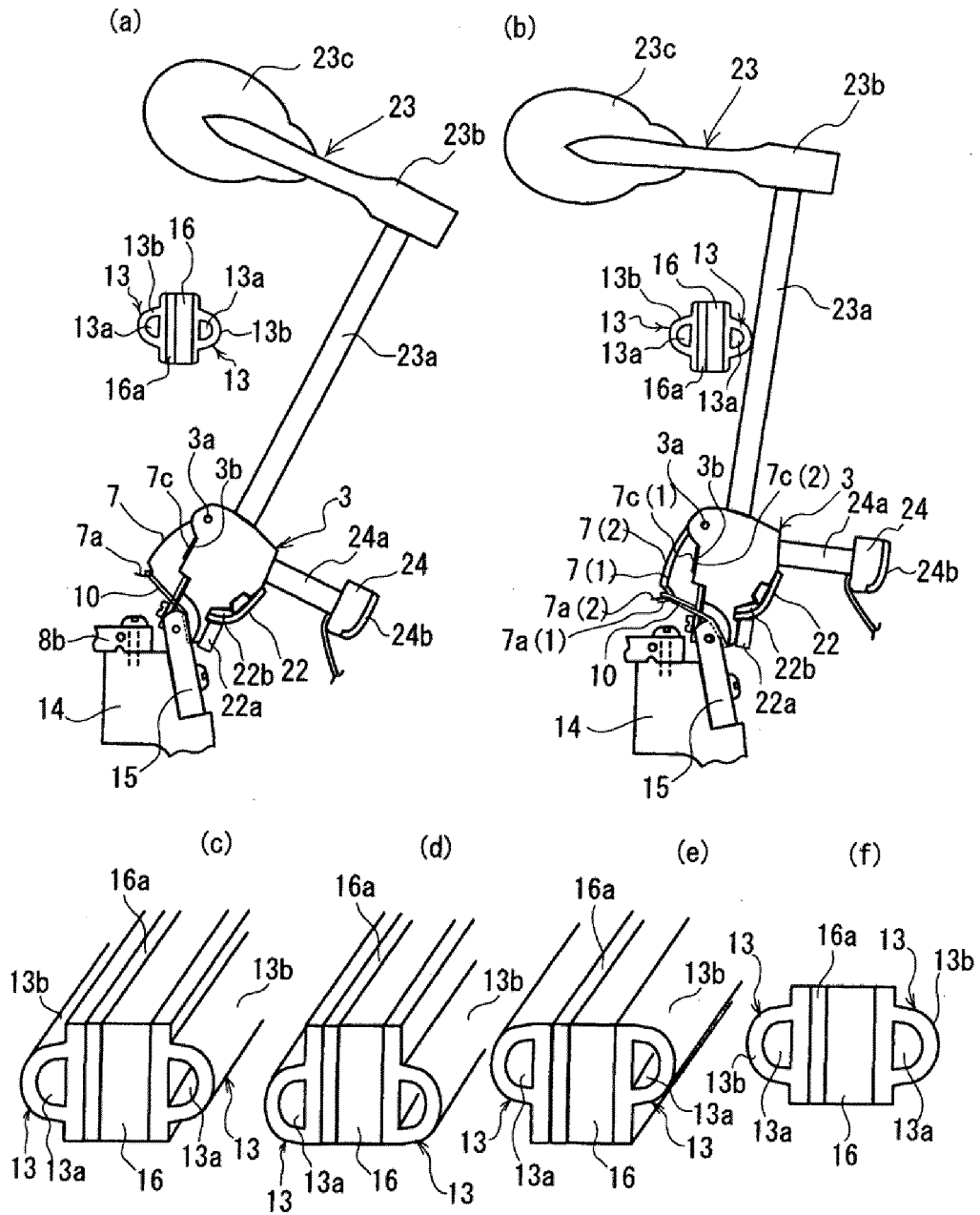


Fig. 5

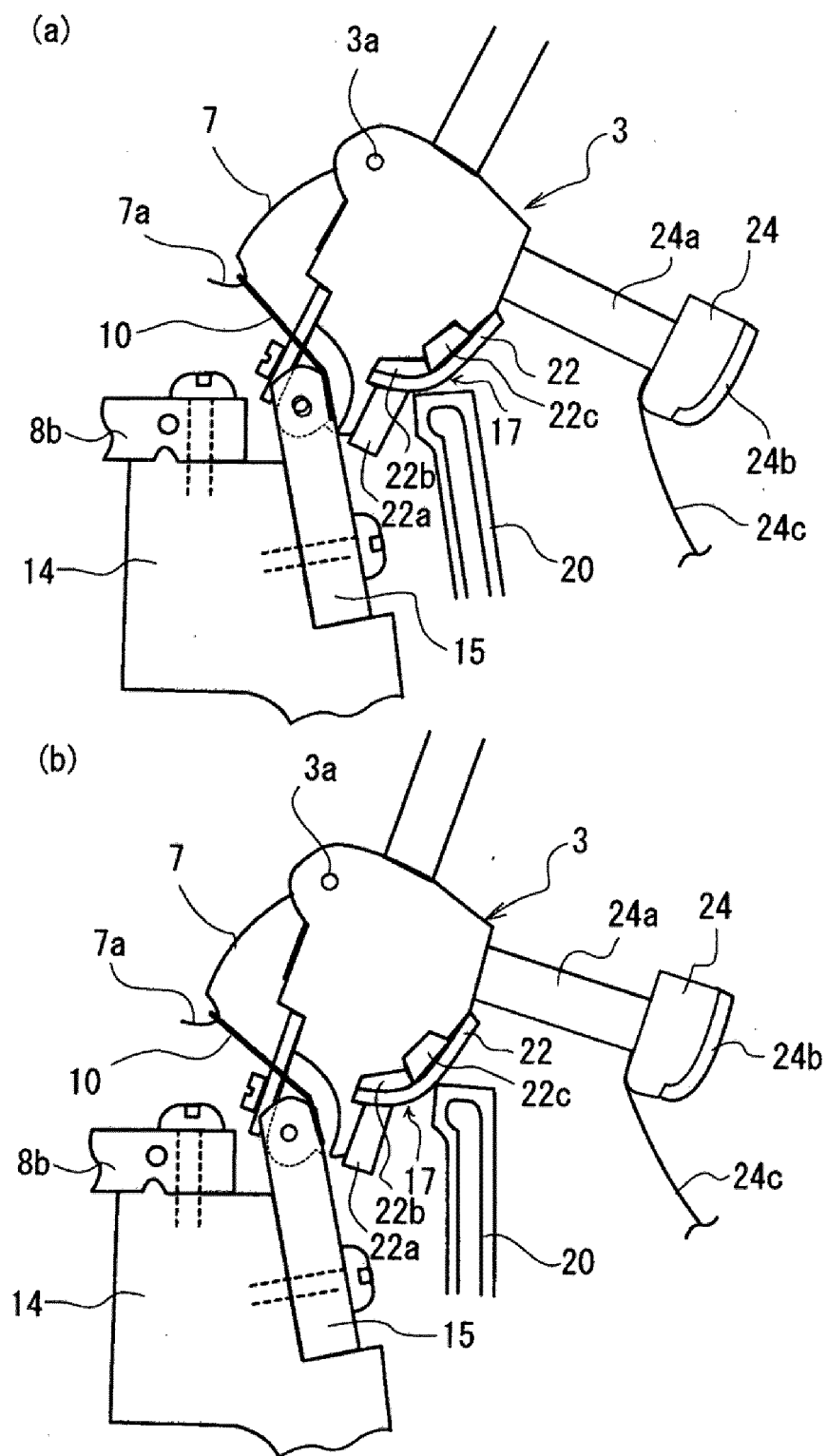
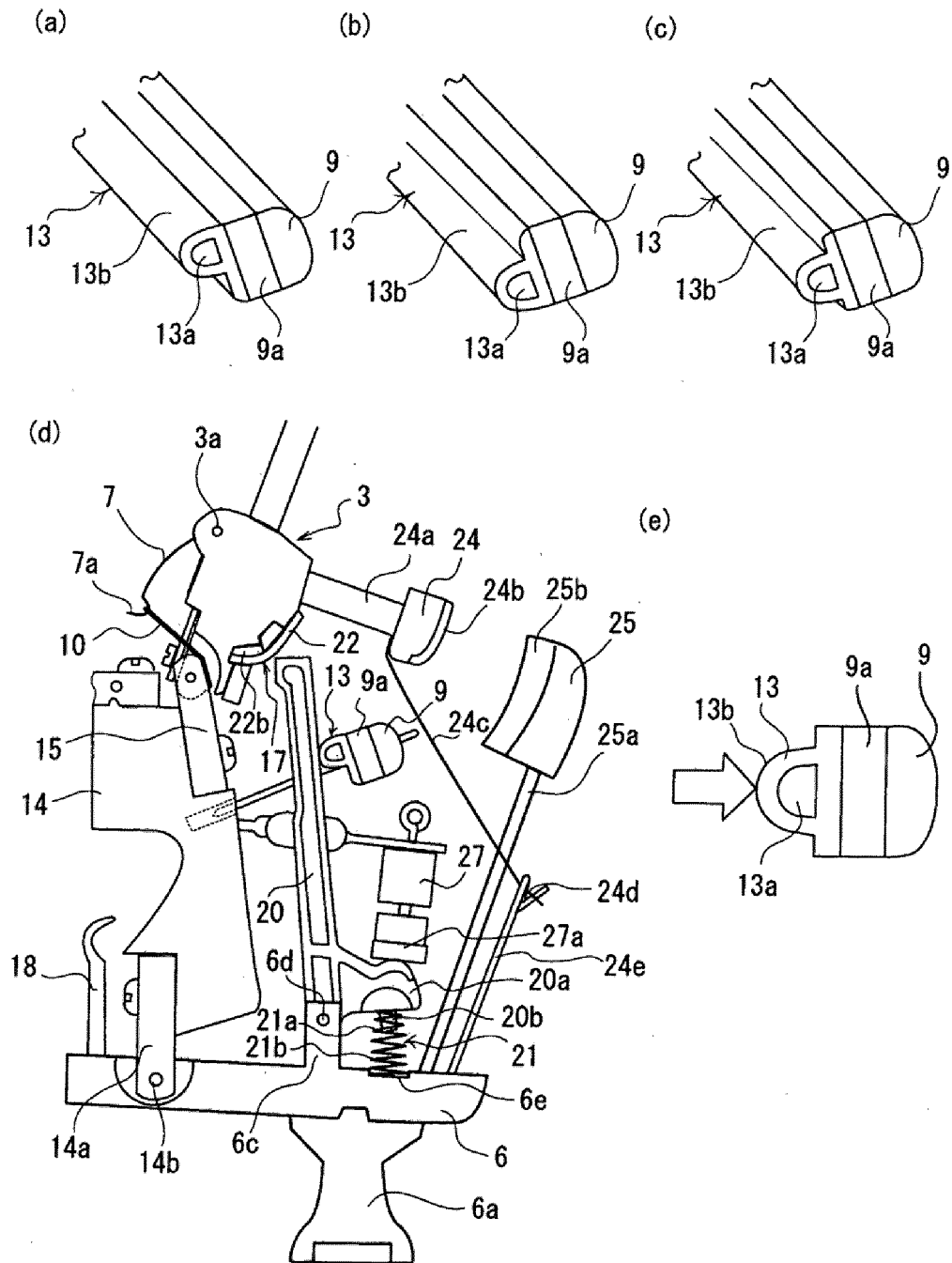


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/071178

A. CLASSIFICATION OF SUBJECT MATTER

G10C3/16(2006.01)i, G10C1/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G10C3/16, G10C1/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2007-108661 A (Kawai Musical Instruments Mfg. Co., Ltd.), 26 April 2007 (26.04.2007), paragraphs [0024] to [0067]; all drawings (Family: none)	1-4
A	JP 2007-155964 A (Kawai Musical Instruments Mfg. Co., Ltd.), 21 June 2007 (21.06.2007), paragraphs [0014] to [0041]; all drawings (Family: none)	1-4
A	JP 2011-203474 A (Yamaha Corp.), 13 October 2011 (13.10.2011), entire text; all drawings & US 2011/0232457 A1 & EP 2372689 A2 & CN 102201227 A	1-4

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

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Date of the actual completion of the international search
17 August 2015 (17.08.15)Date of mailing of the international search report
01 September 2015 (01.09.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/071178

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006-91516 A (Kawai Musical Instruments Mfg. Co., Ltd.), 06 April 2006 (06.04.2006), entire text; all drawings (Family: none)	1-4
A	JP 4489140 B1 (Yugen Kaisha Fujii Piano Service), 23 June 2010 (23.06.2010), entire text; all drawings & JP 2011-28147 A & US 2012/0180614 A1 & WO 2011/013334 A1 & EP 2461319 A1 & CN 102473401 A & HK 1169882 A	1-4
A	JP 49-35026 A (Nippon Gakki Co., Ltd.), 01 April 1974 (01.04.1974), entire text; all drawings (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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