May 10, 1949. H. B. RHODES 2,469,667

PIANO

Filed June 12, 1945 3 Sheets-Sheet 1

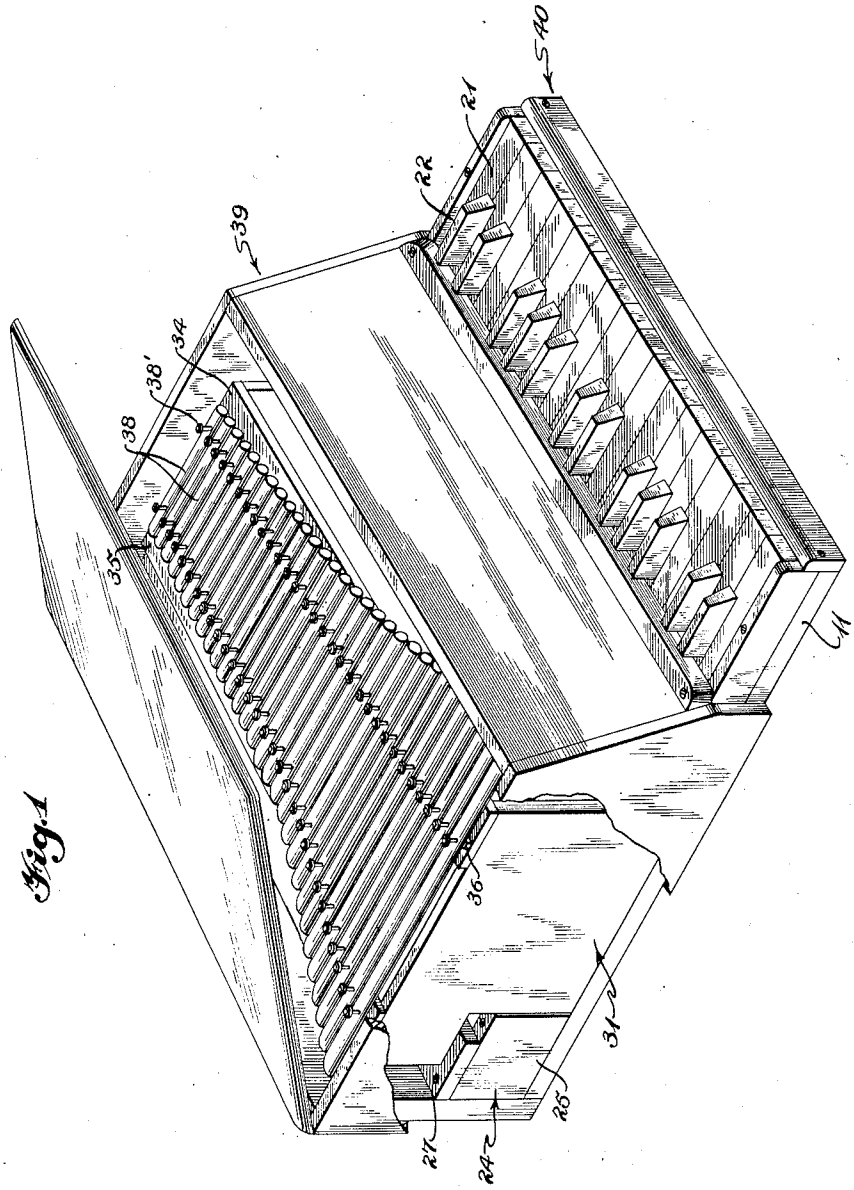


Fig. 1

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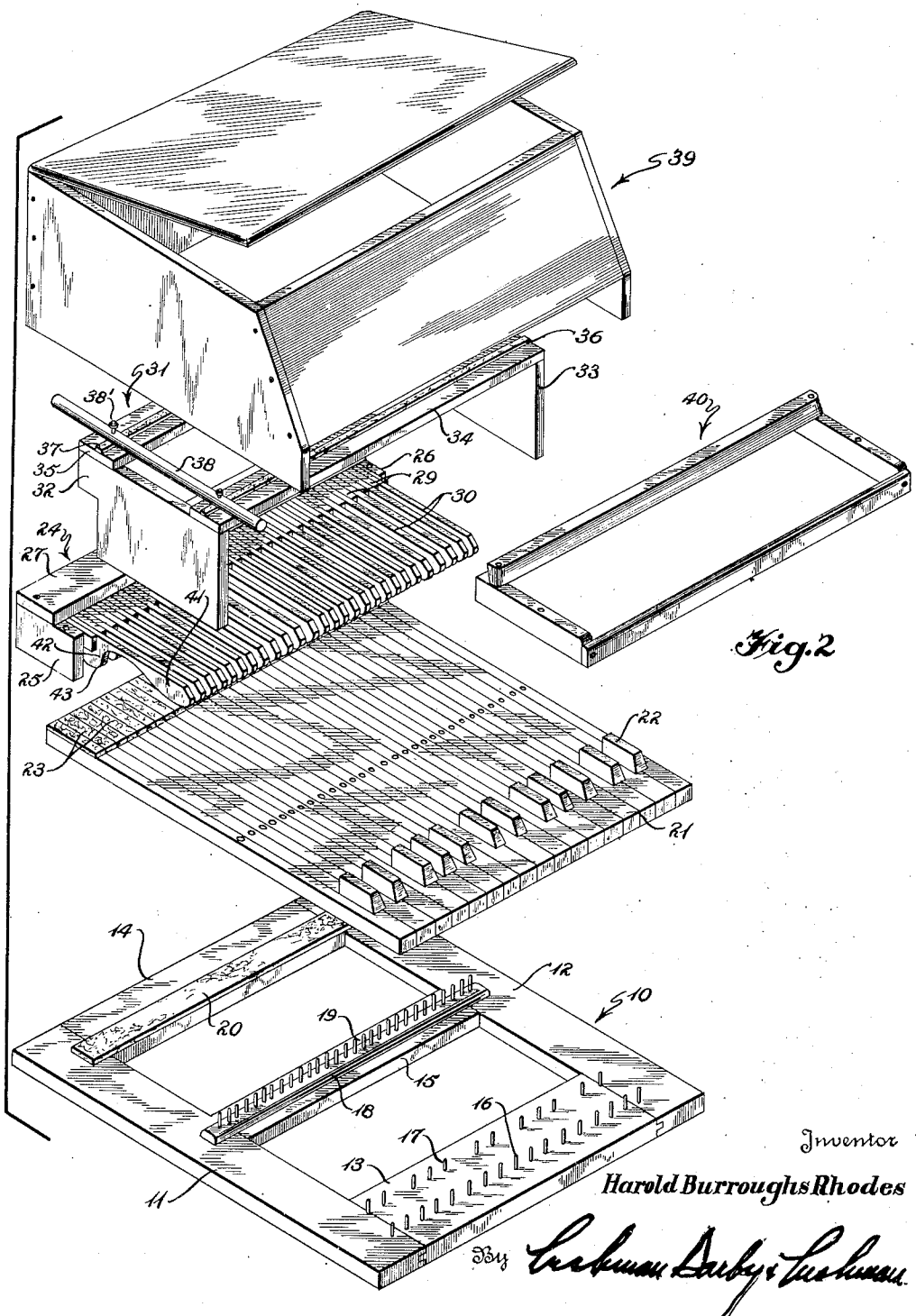


Fig. 2

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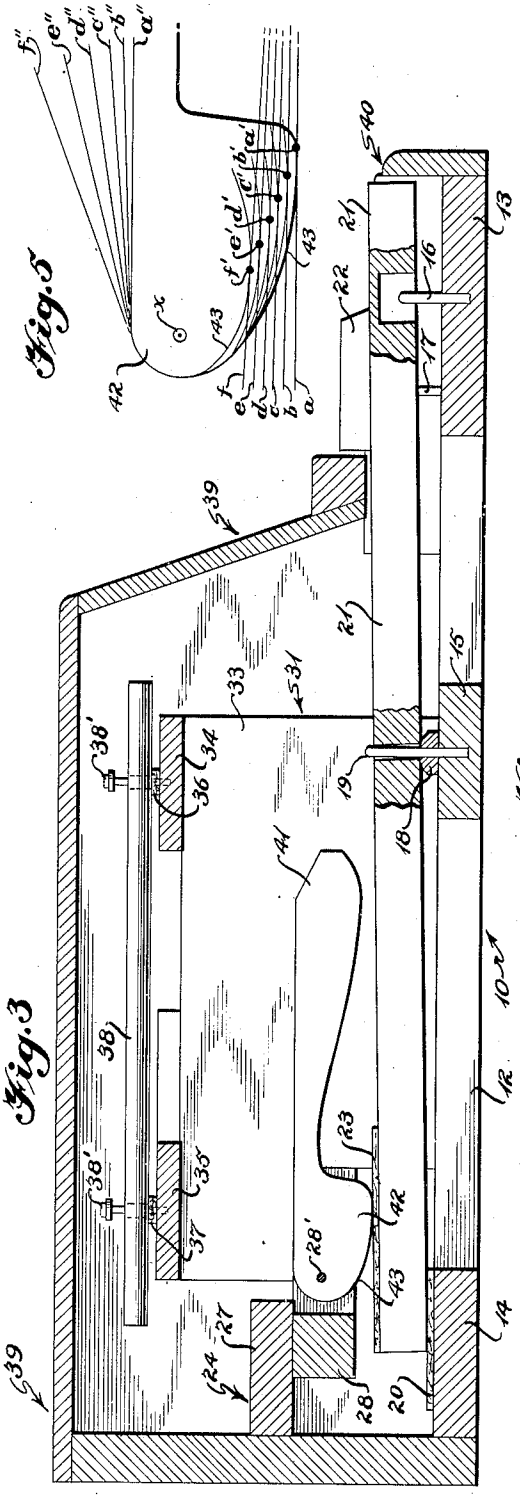
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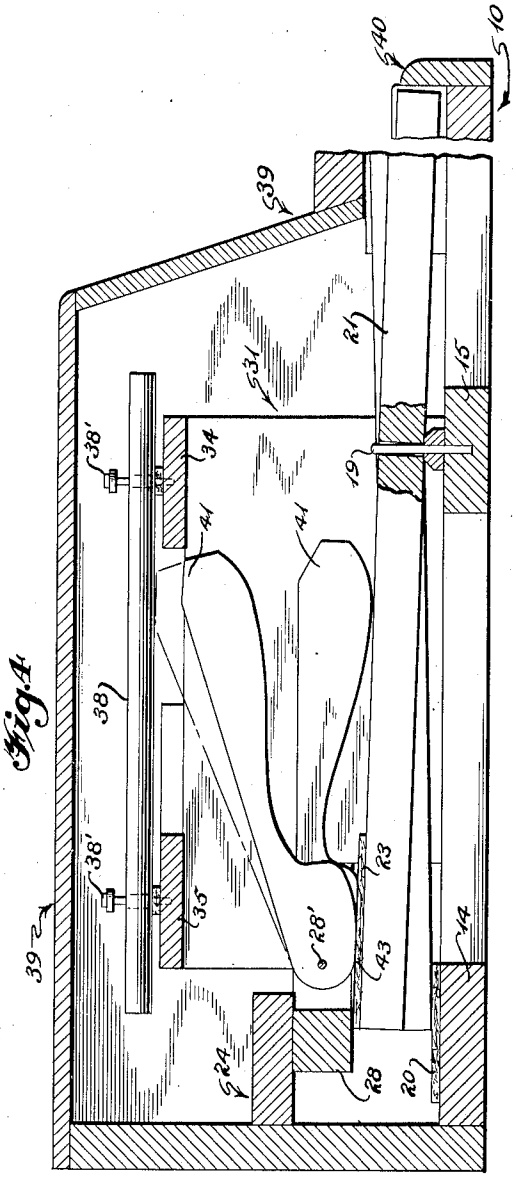
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Filed June 12, 1945 3 Sheets-Sheet 3





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UNITED STATES PATENT OFFICE

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PIANO

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3 Claims. (Cl. 84—404)

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This invention relates to pianos and in particular to piano actions. A main object of the invention is to provide an extremely simple yet fully effective, quiet action.

In the effort to devise actions which are rapid and as noiseless as possible considerable complexity has been heretofore introduced so that a major expense in piano manufacture is the production and assembly of the actions. In accordance with the present invention the action comprises but two parts, a key and a hammer, with contacting surfaces of which at least one is convexly curved so that during movement of the hammer while driving pressure is being applied thereto from the key the point of contact of the surfaces moves continuously toward the hammer axis with accelerating effect on the hammer until a free throw is imparted thereto. Upon rebound of the hammer from the vibratory member, which may be of any suitable type, contact of the said surfaces is instantaneously and noiselessly resumed and repeated, effective, throws can be imparted at any speed of which the player is capable.

In the accompanying drawings I have shown the new action embodied in a miniature piano but it is to be understood that the action is equally applicable to full size pianos, upright or grand. However, as regards miniature pianos in particular, another object of the invention is to provide a piano made up of a minimum number of easily assembled, simple units, in fact, a piano which any reasonably skillful person can build for himself.

In the drawings,

Figure 1 is an isometric view of a piano in accordance with the invention,

Figure 2 is an exploded view showing the parts included in the piano of Figure 1,

Figure 3 is a fore and aft section of the piano taken longitudinally of a key and hammer in rest position,

Figure 4 is the same as Figure 3 except that the key and hammer are shown in actuated position, and

Figure 5 is a diagram illustrating progressive relations of the key and hammer.

Reference numeral 10, Figure 2, designates generally a flat base portion comprising side members 11 and 12, front and rear cross members 13 and 14 and an intermediate cross member 15. Set in the cross member 13 and adjacent portions of the side members are series of pins 16 and 17 of which the former served to guide the white keys and the latter the black keys. Ex-

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tending along the intermediate member 15 is a balance rail 18 in which are set a line of guide pins 19 for the keys. The top of rail 19 is rounded as particularly shown in Figures 3 and 4. Reference numeral 20 designates a strip of felt or equivalent cushioning material extending along the rear member 14.

Reference numeral 21 designates a series of white keys and reference numeral 22 a complement of black keys. As particularly shown in Figure 3 the pins as at 16 are received in bottom slots of the keys and the keys have intermediate vertical openings flaring somewhat upwardly fore and aft and receiving the pins 19, the keys resting directly on the balance rail 18 for free rocking movement. At their aft ends the keys include top strips or pads 23 of felt or other suitable cushioning material.

Reference numeral 24, Figure 2, designates a bridge including upright portions 25 and 26 and a cross portion 27 secured thereto. Secured to portion 27 therebeneath is a comb or action bar 28 between the tines 29 of which are pivoted hammers 30 on a horizontal pin 28'.

Reference numeral 31 designates a second bridge including upright end portions 32 and 33 and front and rear cross strips 34 and 35 of which the former is in rectangular relation to the upright portions and the latter inclines inwardly to the right Figures 1 and 2. Reference numerals 36 and 37 designate strips of felt or equivalent cushioning material disposed on the top surfaces of members 34 and 35. Reference numeral 38 designates vibratory members here shown as being lengths of tubing of suitable metal, such as aluminum alloy. Each tube is provided with vertical diametrical holes which receive nails 38' driven through the felt strips into the cross members 34 and 35. The holes are large enough so as not to bind the nails and the heads of the nails are sufficiently above the tubes so that the latter can freely lift, when struck, but are maintained against endwise or lateral displacement. In the use of such tubes I have found that for the best results they must be supported one quarter of their length in from each end.

In assembly the keys are mounted on the balance rail. Bridge 24 is disposed along the rear margin of the base frame and the upright portions 25 and 26 are secured to the margins of pieces 11 and 12 as by nailing, screwing or gluing so that a hammer 30 is positioned above each key. The bridge 31 is then set in straddling relation to the hammers and its upright portions 32 and 33, aligned with portions 25 and 26, are

secured to members 11 and 12. It will be noted that members 32 and 33 are undercut at their rear ends so that their top portions overlie the ends of bridge 24. The tubes 38 are so arranged that when bridge 31 is thus secured in place a tube will overlie each hammer 30 in position to be struck thereby and the lengths of the tubes is such as to give the proper pitch when struck. The assembly is completed by placing a case 39, with hinged lid, over the keys and units 24 and 31, and a guard 40 of rectangular form is secured in position at the forward ends of the case in rimming relation to the accessible forward ends of the keys 21 and 22.

From the above it will be evident that all parts are supported directly by the base frame 10 and that as to the keys and bridges this support is entirely independent of the case 39 so that the latter can be assembled or removed as a whole without in any way disturbing the operating parts. The same applies to the guard 40.

Each hammer 30 comprises a head 41 and a foot or cam 42 having a bottom edge 43 convexly curved away from the key and toward the hammer axis and which, in the rest position of the parts, with the aft end of the key resting on strip 20, has substantially a point contact with the pad 23 so that the hammer is supported in forwardly extending relation above the key and with the hammer head free of the latter, Figure 3. When the key is depressed the point of contact between the hammer and key moves toward the hammer axis and the hammer is driven upwardly until the aft end of the key, as cushioned by the pad 23, strikes the bottom of comb 28 whereupon the hammer completes its throw under its own momentum and strikes the associated vibratory member. In Figure 4 the hammer 30 shown in section is in the position reached when the after end of the key reaches its upper limit, the dash line indicating the final position of the hammer.

In Figure 5 lines *a*, *b*, *c*, *d*, *e* and *f* designate successive equidistant spacings of the top plane of the rear end of the key in moving from bottom to upper limit position, and reference letters *a'* to *f'* designate successive points of contact between these lines and the curved edge 43. Reference numeral *a''* to *f''* designate successive positions of the hammer as enforced by the rolling contact between the curved edge 43 and the top of the key, line *a''* indicating rest position and line *f''* representing the position occupied just as the free final throw begins. The spacing of lines *a''* to *f''* represents a geometrical progression with the ratio, in the illustrated relation, about one and a half, although the ratio may be varied as required. It will be evident from the diagram, therefore, that a constantly accelerating movement is imparted to the hammer, upon depression of the key, while the foot or cam portion of the hammer remains in contact with the key. When the hammer has reached the position shown in section in Figure 4 it is free to leave the key since at this point the curve 43 falls away more abruptly toward the hammer axis to clear the pad so that the hammer continues in the absence of any restricting frictional contact with the key. With the accelerating action illustrated in the diagram, points *a'* to *f'* are equidistantly spaced as multiples of the spacing between lines *a* to *f*. The curve of edge 43 may be described as a portion of an ellipse whose major axis, in rest position, extends longitudinally of the key, and of which a focus is substantially at the pivoting axis which in Figure 5 is marked *x*.

If a key is immediately re-struck the rebounding hammer will re-establish almost instantaneous contact with the key at a point at or adjacent the point *f'*, Figure 5, and the stroke may be repeated with the greatest rapidity and always with an effective carry-through of the hammer. It will be further noted that on the downward movement of the hammer, contact is again resumed with the key at the point of least possible movement at the cam edge per unit movement of the hammer head, thus insuring the elimination of any jarring sensation or disturbing noise upon the resumption of contact between hammer and key. Even in the absence of the cushioning pad 23 there is a substantial absence of noise and jar.

I have shown the cam on the hammer and as an integral part thereof for the reason that this is the simplest arrangement. The invention is not limited in this respect, however, but contemplates any key and hammer construction and association securing, through a combination of drive-imparting surfaces of which at least one is convexly curved with respect to the other, an accelerating drive of the hammer during the period the surfaces are in contact, release of the hammer for a free final arc of throw, and a quick, substantially shockless, pickup of the hammer upon rebound with fully effective re-throw if the key is again immediately struck. Other variations in the form and arrangement of parts are contemplated under the claims which follow.

I claim:

1. A piano action comprising a generally horizontally disposed key pivotally mounted on a horizontal axis intermediate its ends and having an accessible forward end, means limiting the pivoting movement of said key in both directions, and a hammer pivotally mounted on a horizontal axis at the after end of said key and normally extending along and above said key toward the forward end thereof, said hammer including a foot portion adjacent its pivoting axis having an elongated lower edge convexly curved downwardly and forwardly and said key having a substantially plane upper surface at its after end with which said lower edge has point contact for the support of the hammer in rest position, said convex curve being approximately a portion of an ellipse, of which a focus is substantially at said hammer axis and whose major axis extends forwardly along the key when the hammer is in said rest position, the arrangement being such that when the key is depressed the point of contact between said edge and surface, while driving pressure is being applied, continuously moves by a rolling contact toward the vertical plane of said hammer axis with accelerating effect on the hammer until the upper limit of the after end of the key is reached and a throw is imparted to the hammer.

2. A piano action comprising a key having a plane upper surface at its rear end and being pivotally mounted intermediate its ends, means for limiting the vertical pivoting movement of the key, and a substantially horizontally disposed, forwardly projecting hammer pivoted adjacent its rear end above the rear end of the key, for upward swinging movement, said rear portion of the hammer having a lower edge of substantial length disposed above the key and in contact with the upper surface thereof, when in the rest position, at a point spaced well forwardly of the vertical plane of the pivoting axis of the hammer,

said lower edge being curved upwardly and rearwardly from said point to the rear end on a curve of decreasing radius, the engagement between the hammer and the key, when the key is struck, being a rolling contact, with increase in movement of the hammer relative to the movement of the key being substantially in accordance with a geometrical progression.

3. A piano action comprising a key having a plane upper surface at its rear end and being pivotally mounted intermediate its ends, means for limiting the vertical pivoting movement of the key, and a substantially horizontally disposed, forwardly projecting hammer pivoted adjacent its rear end above the rear end of the key, for upward swinging movement, said rear portion of the hammer having a lower edge of substantial length disposed above the key and in contact with the upper surface thereof, when in the rest position, at a point spaced well forwardly of the vertical plane of the pivoting axis of the hammer, said lower edge being curved upwardly and rearwardly from said point to the rear end on a curve

which is a section of an ellipse, the engagement between the hammer and the key, when the key is struck, being a rolling contact, with increase in movement of the hammer relative to the movement of the key being substantially in accordance with a geometrical progression.

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