July 26, 1955 D. G. CLINE 2,713,804

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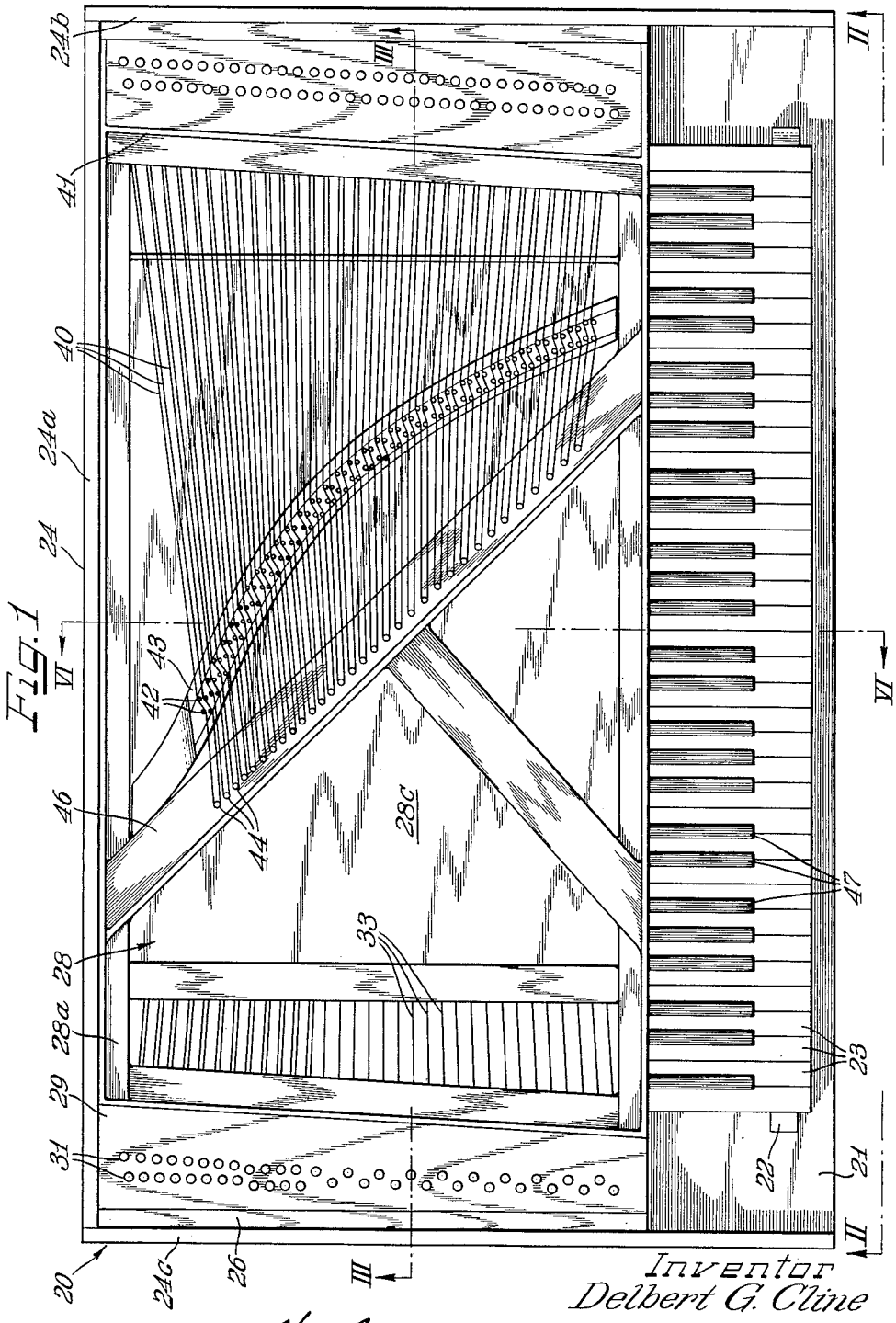


Fig. 1

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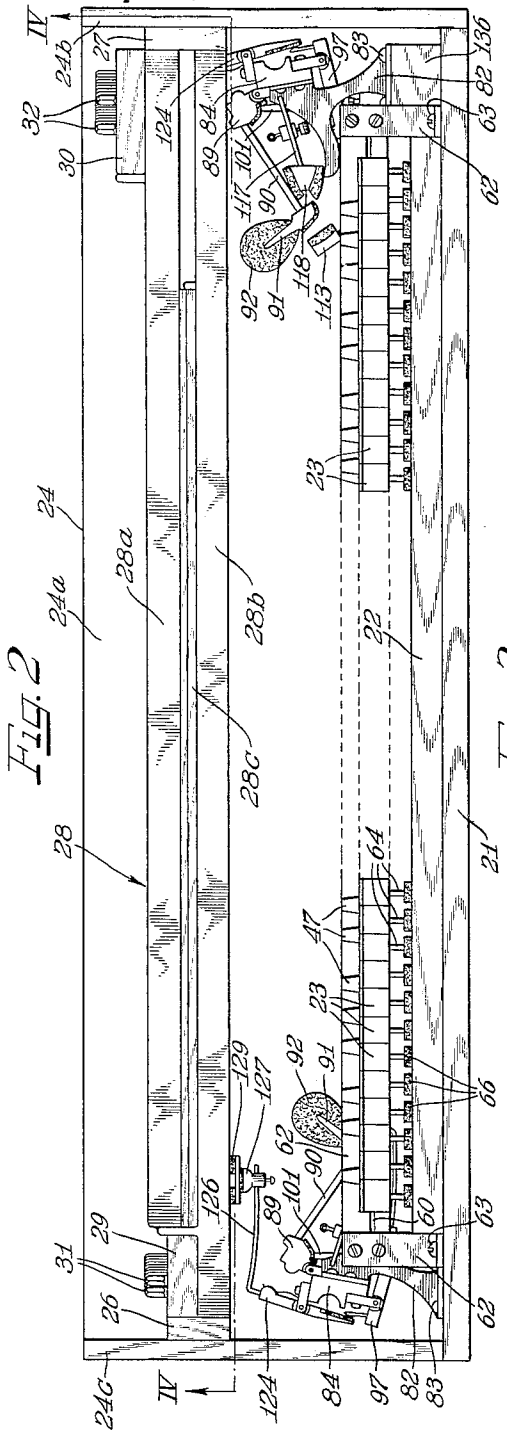


Fig. 2

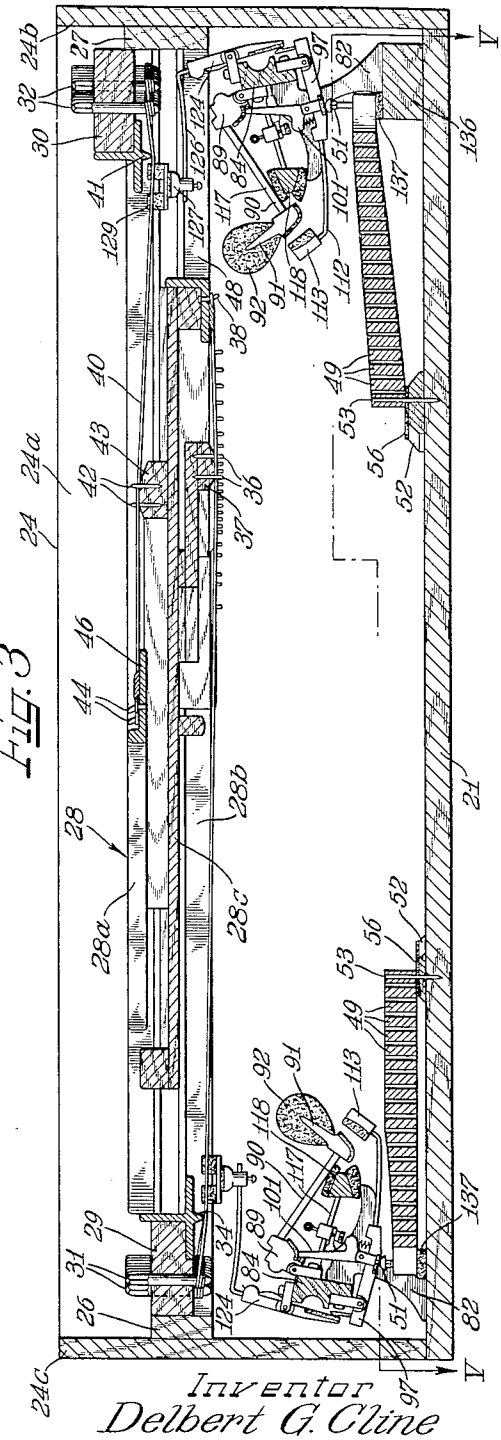


Fig. 3

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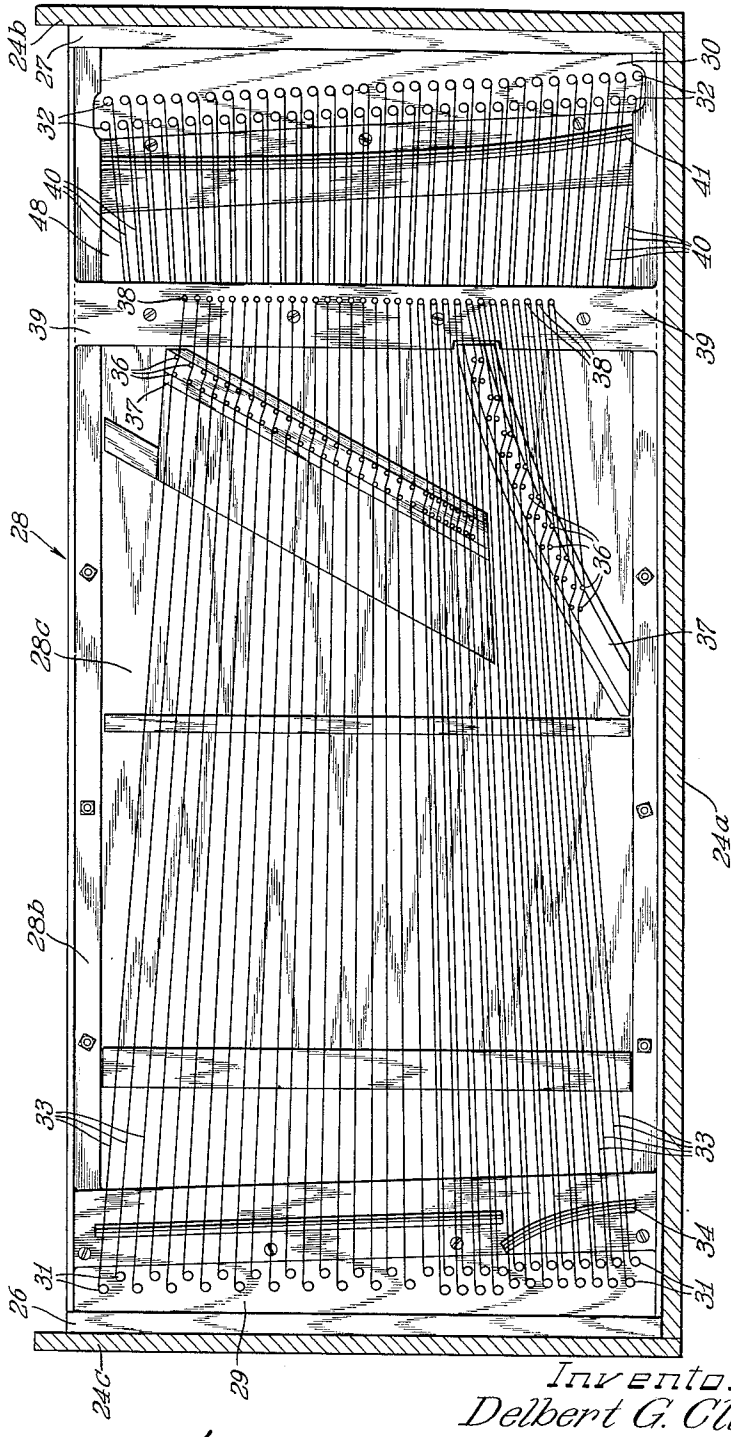


Fig. 4

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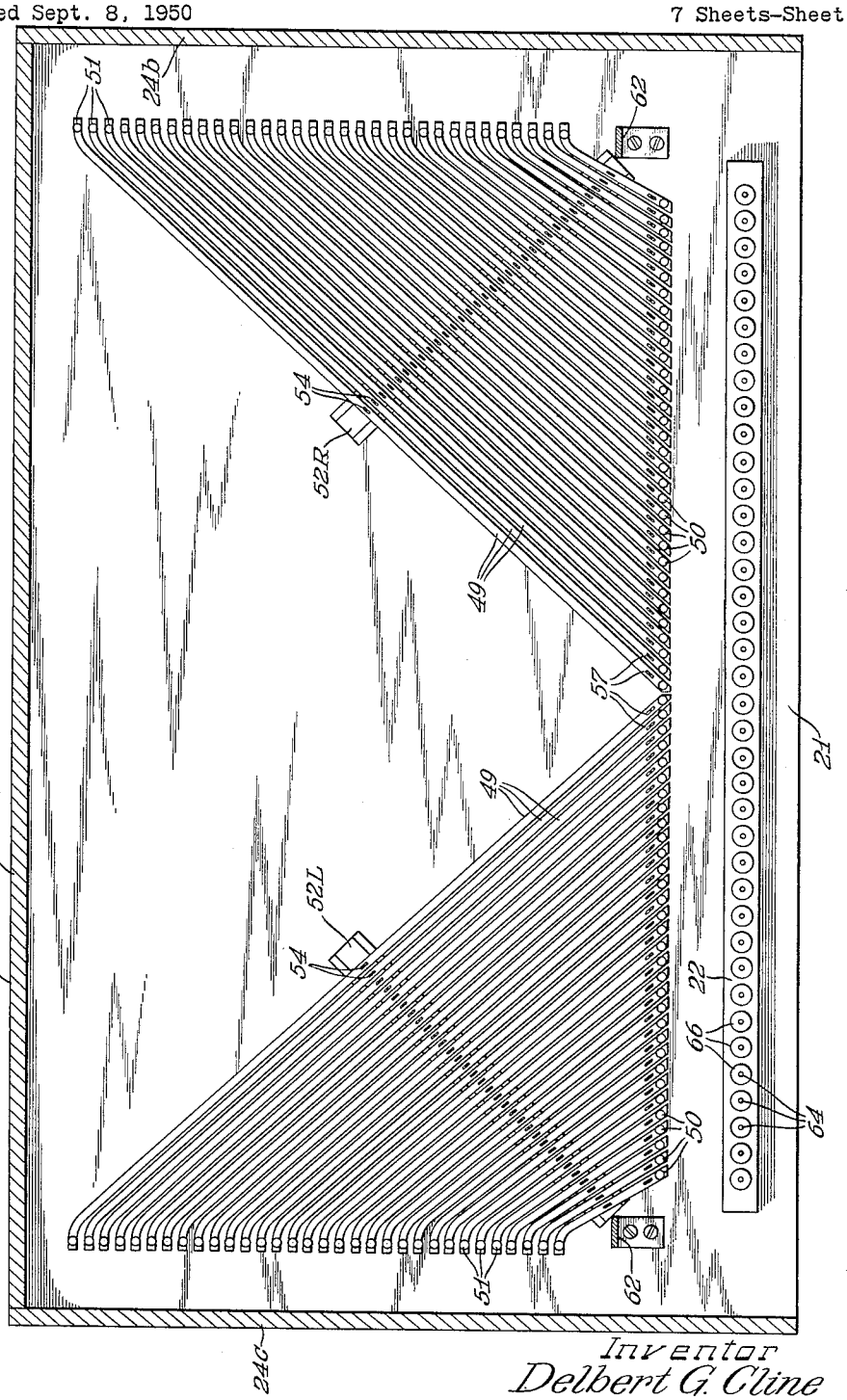


Fig. 5

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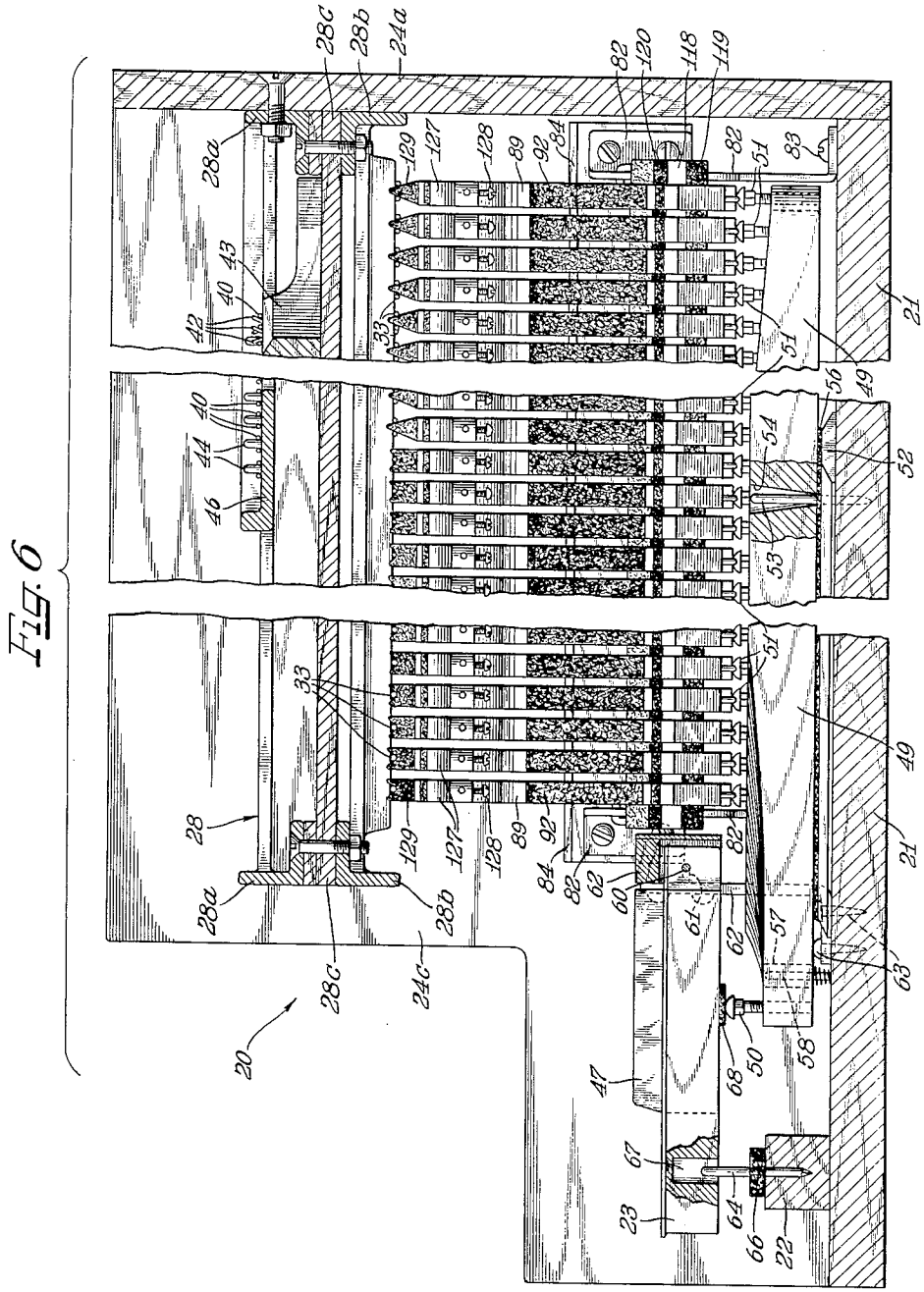


Fig. 6

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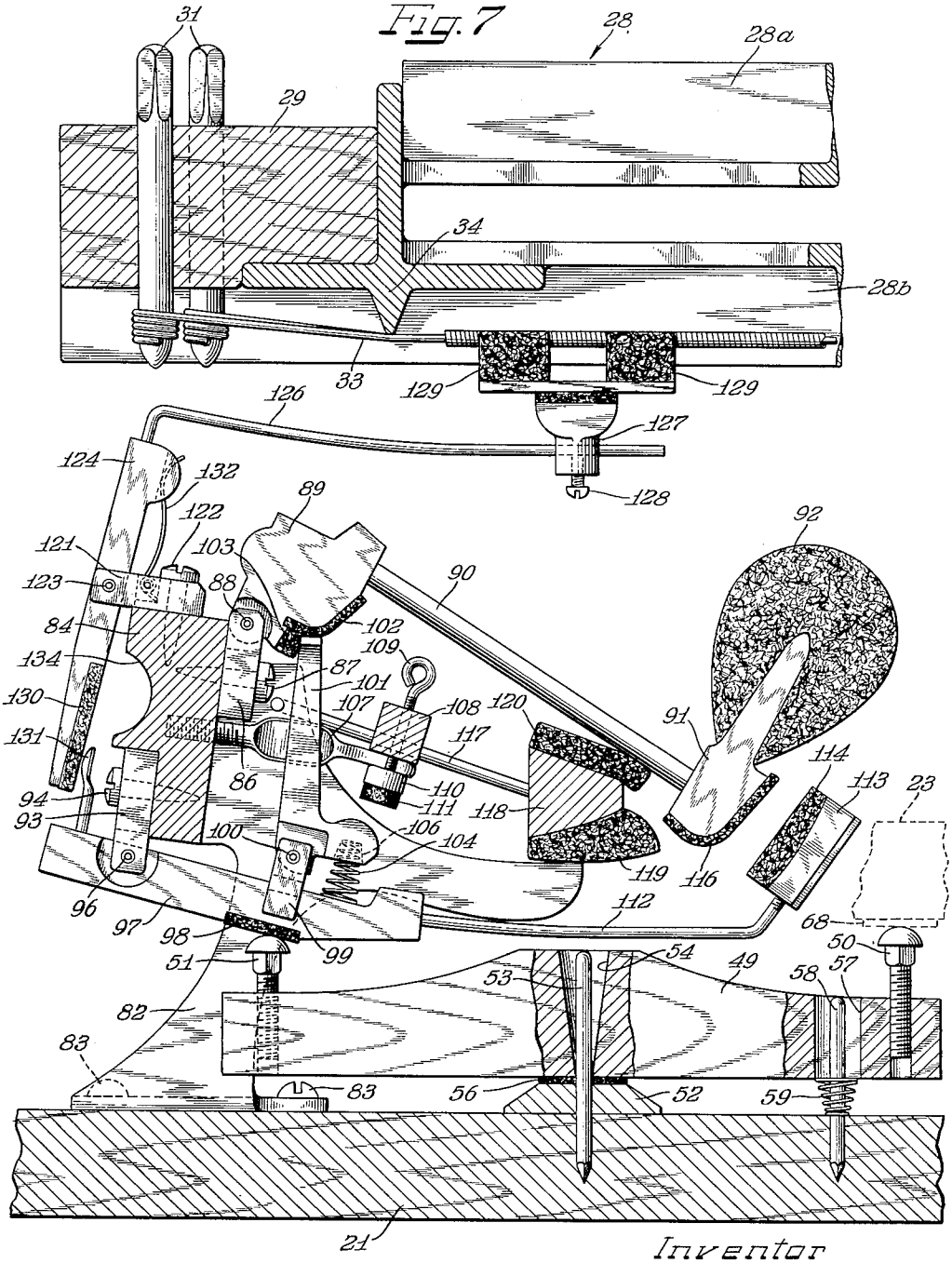
by Kill, Thomson, Mason, Gross & Griffin Attys

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Fig. 7



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Fig. 8

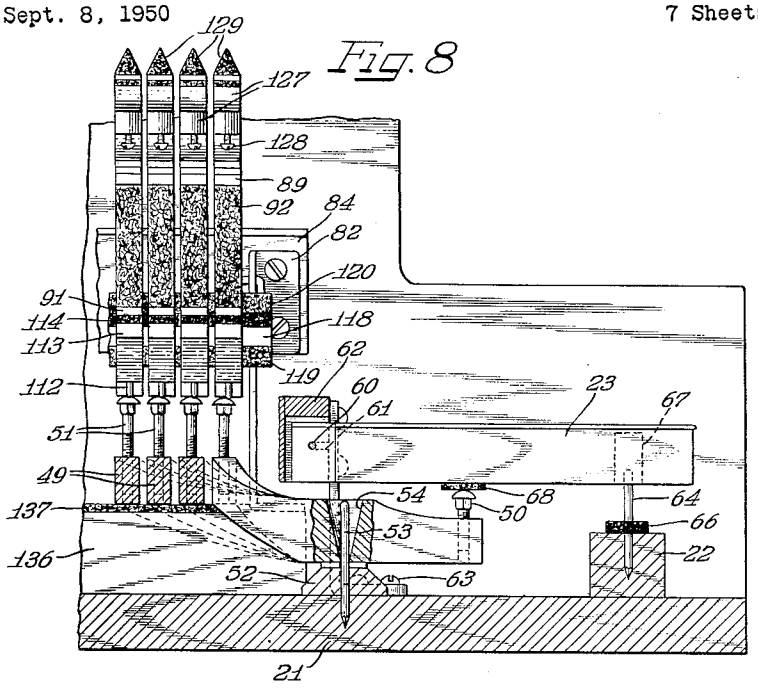
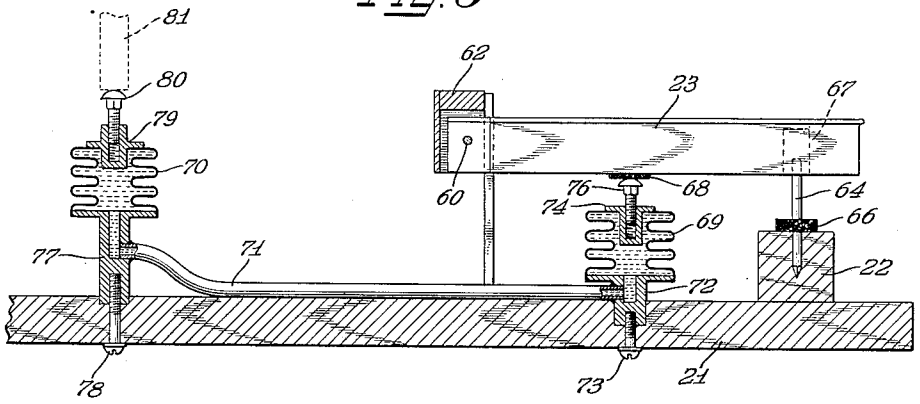


Fig. 9



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United States Patent Office

2,713,804

Patented July 26, 1955

2,713,804

PIANO

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Application September 8, 1950, Serial No. 183,827

15 Claims. (Cl. 84—174)

This invention relates generally to a musical instrument such as a piano, and more particularly to a stringed instrument of the type having a sounding board with strings positioned on both sides thereof, there being two sets of actions to strike the strings located on opposite ends of the sounding board. The sounding board is provided with a suitable aperture at one end to permit the hammers of one of the sets of actions to pass therethrough in order to contact the strings on the far side of the sounding board.

One of the important considerations in constructing a stringed instrument such as a piano is to maintain the so-called "crown" or "bulge" in the sounding board. Conventionally constructed pianos, for example, have the strings disposed on only one side of the sounding board, hence, string pressure tends to flatten out the "crown" or "bulge" with a resultant loss of tone due to the insufficiency of down bearing.

According to the general features of the present invention, the necessity for "crown" is eliminated and a construction is provided whereby tension may be balanced on each side of the piano frame so that any desired amount of down bearing may be retained for a longer period of time than was heretofore possible.

The provision of a tensionally balanced frame has other advantages. As heretofore provided, many piano frames are frequently warped before the piano leaves the factory and string varying tension will result in a changed pitch to the piano which must be corrected by tuning and eventual stabilization of the frame. In a piano frame balanced in accordance with the present invention, this problem is eliminated.

It is an object of the present invention, therefore, to provide a piano with a frame having strings bridged on each side thereof and including a sounding board with a suitable aperture to permit access to the strings on one side of the sounding board by the hammers of some of the piano actions.

Another object of the present invention is to provide a piano having an unusually compact arrangement of component elements while permitting the employment of maximum full length strings and a full conventional keyboard.

A further object of the present invention is to provide a structure for a stringed instrument whereby the skeletal elements of the frame will be subjected to fully compensated tensioning forces.

Yet another object of the present invention is to provide a construction for a stringed instrument, such as a piano, which will readily lend itself to enclosure in various types of cabinet casings supported on legs in the manner of a table.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the annexed sheets of drawings in which a preferred embodiment of a piano

constructed in accordance with the principles of this invention is shown.

On the drawings:

Figure 1 is a plan view, with parts removed, of a piano according to the present invention;

Figure 2 is an elevational view, with parts removed for the sake of clarity, taken on line II—II of Figure 1;

Figure 3 is a cross-sectional view, with parts removed for the sake of clarity, taken on line III—III of Figure 1;

Figure 4 is a cross-sectional view taken on line IV—IV of Figure 2;

Figure 5 is a cross-sectional view taken on line V—V of Figure 3;

Figure 6 is a broken, cross-sectional view taken on line VI—VI of Figure 1, this view being fragmentary in part and being greatly enlarged in order to show additional details of construction of the mechanism incorporated in the piano of this invention;

Figure 7 is an enlarged fragmentary elevational view, with parts shown in cross-section, showing the details of construction of an action provided in the piano of the present invention;

Figure 8 is a fragmentary cross-sectional view somewhat similar to the view shown in Figure 6, but showing a portion of the action mechanism employed at one end of the sounding board of the piano according to the present invention; and

Figure 9 is an alternative embodiment showing a hydraulic actuating mechanism for a piano.

As shown on the drawings:

The piano of the present invention is indicated generally by the reference numeral 20 and includes a cabinet which may be supported in a conventional manner by a plurality of legs selected of such dimension as to position the working elements of the piano at a proper height from a support surface such as a floor.

The cabinet of the piano includes a keybed 21 upon which is carried a key frame front rail 22 situated generally subjacent a plurality of keys 23 and sharps 47, there being one key or sharp for each musical note on the chromatic scale. The cabinet further includes an outer rim 24 including a back rim 24*a* and a pair of side rims 24*b* and 24*c*, respectively, extending along the sides of the piano, all of which serve to encase the working mechanism of the piano 20.

A side rail 26 is fixed to the side rim 24*c* and a side rail 27 is affixed to the side rim 24*b*, the side rails 26 and 27 abutting the ends of a sounding board structure or frame indicated generally by the reference numeral 28. A pin block 29 and a pin block 30 are situated on opposite ends of the sounding board structure 28 and mount a plurality of tuning pins, the tuning pins in the pin block 29 being indicated generally by the reference numeral 31 and the tuning pins in the pin block 30 being indicated by the reference numeral 32.

As will be noted on the drawings, the sounding board structure or frame 28 is of general rectangular configuration—having a unitary skeletal box-like frame which, for the sake of clarity, has been shown on the drawings as including an upper section 28*a* and a lower section 28*b* and between which is located the sounding board per se indicated at 28*c* (Figure 6). The sounding board structure is disposed in substantial parallel disposition to the keyboard.

Each of the tuning pins 31 in the pin block 29 at one end of the sounding board 28 carries a string 33, all the successive strings 33 passing over a bearing bar 34 (Figure 4) and being threaded between successive related pairs of bridge pins 36 arranged in predisposed array on a two-piece bridge 37. The other ends of the strings are firmly secured to a plurality of hitch pins 38 carried by a string rest 39.

Each of the tuning pins 32 carries a string 40 which passes over a bearing bar 41 situated adjacent the pin block 30 after which the strings 40 are threaded between successive pairs of spaced-apart bridge pins 42 carried on a bridge 43, the free ends of the strings 40 being firmly secured to a plurality of hitch pins 44 carried by a string rest 46.

It will be noted that the arrangement of the strings on opposite sides of the frame 28 and in the disposition described permits the use of maximum full length strings.

As is well known to persons skilled in the art, the strings of a conventional piano are subjected to tensional forces which, if unrestrained, tend to flatten the "bulge" or "crown" of the sounding board with a resultant loss of pitch and tonal efficiency. The arrangement of the present invention, therefore, is particularly advantageous since the arrangement of the strings 40 on one side of the frame 28 and the strings 33 on the other side of the frame 28 forms a balanced structure in which the tensional forces established by tightening the strings 33 and 40 tend to balance each other. Consequently, the bearing bar and bridge structure may be provided to afford any amount of down bearing, and the piano will retain its tone a much greater period of time than was heretofore possible.

Moreover, in view of such an arrangement, lighter materials may be employed in the construction of the piano components and unnecessary cumbersome reinforcement supports are eliminated, thereby promoting an unusual compact assemblage which characterizes the piano of the present invention over similar stringed instruments heretofore provided.

In order to produce musical tones, the strings 33 and 40 are struck with hammers successively actuated upon digital manipulation of the keys 23 and the sharps 47 provided on the keyboard of the piano 20. According to the present invention, separate groups of actions are provided, there being a first group of actions on the left-hand side of the piano adapted to strike the strings 33 and a second group of actions on the right-hand side of the piano adapted to strike the strings 40.

The strings 40, being situated on what in the present embodiment appears to be the upper side of the sounding board 28, lie in registry with an aperture 48 formed in the sounding board 28 adjacent the string rest 39. Thus, both the right-hand actions and the left-hand actions may be located on one side of the sounding board 28c, the hammers of the right-hand actions passing through the aperture 38 in striking the strings 40.

Before describing the detailed structure of the actions employed in the piano construction of the present invention, the structure provided to transmit motion from the keys 23 and sharps 47 to the actions may be explained. A preliminary reference may be had to Figure 5 showing the key frame front rail 22 on the keybed 21 and a plurality of symmetrically arranged supplementary members which may be identified as key levers 49. Keeping the structure shown in Figures 2 and 3 in mind in viewing Figure 5, it will be evident that the left-hand group of actions is disposed transversely to the keyboard and in substantial parallel registry with the side rim 24c of the outer rim 24, whereas the right-hand group of actions is arranged transversely to the keyboard in substantial parallel registry with the side rim 24b of the outer rim 24.

The end portion of each of the key levers 49 nearest the keyboard is provided with a key capstan screw 50, all of the screws 50 lying in coaxial alignment in spaced relationship to the key frame front rail 22.

The opposite end of each of the key levers 49 is slightly curved and is provided with a key capstan screw 51, there being two respective rows of screws 51, each row lying in coaxial alignment in spaced relation to side rims 24c and 24b of the outer rim 24, respectively, and in actuating registry with the respective actions of the

left-hand actions and the right-hand actions of the piano 20.

A balance rail 52L and a balance rail 52R are firmly supported on the keybed 21 to receive a plurality of balance rail pins 53 which are grounded in the balance rails 52L and 52R and received by recesses 54 having tapered walls and being located at the mid-point of each of the key levers 49, whereby the key levers 49 are pivotally supported on the balance rails 52L and 52R, respectively. The usual balance rail punchings 56 may be provided between the key levers 49 and the balance rail 52, such punchings being made of felt or other suitable sound-deadening material.

Directly adjacent the keyboard ends of each of the key levers 49 is situated a recess 57, each recess 57 adapted to receive one of a plurality of guide pins 58 firmly mounted on the keybed 21, thereby precluding misalignment and shifting of the key levers 49. A small helical coil spring 59 may be interposed between each of the key levers 49 and the keybed 21 in surrounding relationship to the guide pins 58 so as to normally bias the keyboard end of the key levers 49 upwardly.

Referring now more particularly to Figures 6, 7 and 8, a hinge pin, or hinge wire, 60 is shown which extends substantially across the keyboard of the piano 20 and which may be passed through a plurality of aligned slotted recesses 61, there being one slotted recess 61 for each key 23 and each sharp 47 in order to pivotally mount the keys 23 and the sharps 47 relative to a keyboard support 62 firmly assembled to the keybed 21 by a plurality of fasteners 63.

The key frame front rail 22 carries a plurality of front rail key pins 64, each surrounded by the usual front rail punching 66. Each of the front rail key pins 64 is adapted to lie in guiding registry with a recess 67 formed in each of the keys 23, thereby precluding sideway misalignment of the keys 23 on the keyboard of the piano 20.

The keys 23 and the sharps 47 are each paired to a corresponding key lever 49, there being provided a plurality of capstan screw punchings 68 to provide cushioned engagement with the key capstan screw 50 so that the key lever 49 may be pivoted around the balance rail 52 against the bias of the spring 59.

In Figure 9 an alternative embodiment is shown in which a hydraulic structure is employed to transmit motion from the keys and sharps of the keyboard to the actions.

The structure includes a key bellows 69 and an action bellows 70 placed in hydraulic communication with one another by a tubular conduit 71. It will be understood that the actual detailed structure of the bellows 69 and 70 may be conventional. However, it is desirable that the bellows be highly flexible so as to offer a minimum of resistance to operating action of the keys and sharps.

One end of the bellows 69 is closed by a boss 72 suitably apertured to receive the tubular conduit 71 and having a threaded recess therein to receive a fastener 73 securing the bellows 69 to the keybed 21.

The other end of the bellows 69 is provided with a bushing 74 having a threaded recess to receive a key capstan screw 76 in adjustable threaded assembly therein, the key capstan screw 76 lying in registry for engagement with the capstan screw punching 68 on the corresponding key 23.

The bellows 70 is also provided with a boss 77 suitably apertured to receive the tubular conduit 71 and having a threaded recess to receive a fastener 78 securing the bellows 70 in firm assembly with the keybed 21.

The other end of the bellows is closed by a bushing 79 having a threaded recess to receive the key capstan screw 80 to engage a portion of action 81 indicated in dotted outline associated with the particular key coupled to the bellows 69 and the bellows 70.

It will be appreciated that each of the actions provided for actuation by one of the key levers 49 and the keys 23 and sharps 47 is of similar construction; hence, a description of the action which appears in enlarged form in Figure 7, being one of the actions on the left-hand side of the piano 20, it will be sufficient with respect to all of the actions employed in connection with the piano of the present invention.

An action bracket 82 having a flanged pedestal portion firmly secured to the keybed 21 by a plurality of action bracket screws 83 carries an action rail 84 to which each hammer shank flange 86 is fastened by means of a hammer shank flange screw 87. A hammer shank center pin 88 carried by the hammer shank flange 86 pivotally mounts the hammer butt 89 which in turn carries the hammer shank 90 upon the end of which is supported a hammer 91 having a hammer felt 92.

The action rail 84 also carries a wippen flange 93 for each action secured thereto by a wippen flange screw 94, the wippen flange 93 having a wippen center pin 96 pivotally mounting a wippen 97 lying in registry for abutting engagement with a key capstan screw 51 on the end of one of the key levers 49.

A wippen cloth 98 may be provided on the underside of the wippen 97 to cushion the impact of the wippen with the key capstan screw.

The wippen 97 carries a jack flange 99 having a jack center pin 100 which, in turn, pivotally carries a jack 101, the end of the jack 101 engaging the hammer butt 89 through the hammer butt pin 102. A hammer butt bumper felt 103 is also provided on the lowermost portion of the hammer butt 89 to engagingly abut the side portions of the jack 101. A jack spring 104, preferably of a helical coil type, is positioned in the usual manner between the wippen 97 and a seating recess 105 formed in a portion of the jack 101.

A regulating rail bracket 107 threaded at one end for assembly with the action rail 84 carries a regulating rail 108, there being provided a plurality of regulating screws 109 which pass through the regulating rail 108 and apertures formed in the end of the regulating rail bracket 107, each of the regulating screws 109 carrying a regulating button 110 and a regulating button punching 111 on the end thereof adapted for engagement with the spur portion of each of the jacks 101.

The wippen 97 also carries the back check wire 112 which protrudes from the end of the wippen 97, the back check wire 112 having an upwardly turned portion supporting a back check 113 cushioned by a back check felt 114.

A catcher skin 116 is provided on the back underside of the hammer 91 to engage the back check felt 114.

A hammer rail hook 117 is pivotally mounted on the action bracket 82 and carries on the end thereof a hammer rail 118 having a hammer rail cushion 119 on one side thereof and a hammer rail felt 120 on the other side thereof engageable with the hammer shank 90. It will be understood, of course, that the hammer rail 118 may be actuated in the usual manner by a soft pedal mechanism (not shown).

A damper lever flange 121 secured to the action rail 84 by a damper flange screw 122 carries a damper flange center pin 123 pivotally mounting a damper lever 124, the damper lever 124, in turn, carrying a damper wire 126 having a damper head 127 adjustably fastened thereto by a damper block screw 128. The damper head is provided with a damper felt 119 which, for a double string, takes the form of a wedge-shaped point insertable between the strings and, in the case of a single string, takes the form of a pad having a V-shaped recess to surround the string, or, in the case of a double thin string, takes the form of a pad having two recesses therein.

The other end of the damper lever 124 is recessed to receive a damper lever felt 130 with a spoon 131 attached to the wippen 97. The damper felt 129 is normally retained in dampening position relative to a string 33 or 40 through a spring bias provided by a damper spring 132 retained by a damper spring pin 133 carried by the damper lever flange 121, the other end of the damper spring 132 engaging a portion of the damper lever 124.

The damper rod structure, which is usually provided to effect loud pedaling action in the playing of the piano, is not shown. However, it may be noted that the action rail 84 is provided with a recess 134 to seat a damper rod felt which cushions a damper rod against the action rail 84.

It will be understood that operation of the action will proceed in a well known manner, the key levers 49 being selectively actuated upon manipulation of the keys 23 and the sharps 47 to move corresponding wippens 97 of each of the actions paired with each of the keys 23 and the sharps 47, whereby the respective hammers 91 will strike the string 33 or 40 associated therewith to produce a musical tone or tones.

The actions provided on the left-hand side of the piano 20 are of a construction similar to that of the actions provided on the right-hand side of the piano 20. However, because the actions on the right-hand side of the piano 20 must pass through the aperture 48 of the sounding board structure 28, special provision must be made to position the right-hand action rail 84 in the same spaced relationship to the strings 40 as the action rail on the left-hand side of the piano is with respect to the strings 33.

Such disposition is readily effected by interposing an elevator rail 136 between the right-hand action bracket 82 and the keybed 21.

In order to accommodate the extra height provided by the elevator rail 136, a portion of the key levers 49 on the right-hand side of the piano 20 may be bent as indicated in Figures 3 and 8 so that the key capstan screws 51 carried on the ends of the key levers 49 will lie in proper registrated alignment relative to the respective actions with which they are associated.

It may be noted that a key lever cloth 137 may be extended along the elevator rail 136 and on the keybed 21 directly subjacent to the ends of the key levers 49 to provide a cushion therefor.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. In a piano, a frame, a generally horizontally disposed rectangular sounding board in said frame having a pair of opposed faces, a plurality of keys and sharps arranged to form a keyboard, the keyboard lying in spaced parallel relationship to the sounding board, a first set of musical strings stretched across said frame and bridged on one face of said sounding board, a second set of musical strings stretched across the frame and bridged on the opposite face of said sounding board, both sets of strings being disposed lengthwise with respect to said sounding board, a plurality of coaxially aligned actions to selectively strike said strings of both sets of strings and extending transversely across each end of said sounding board, and actuating means between each of said actions and a corresponding one of said keys and said sharps of said keyboard.

2. The combination defined by claim 1 in which said actuating means comprise a pivotally mounted lever arm.

3. The combination defined by claim 1 in which said actuating means include a pair of hydraulically displaceable elements which are hydraulically coupled to one another for interrelated movement.

4. The combination defined by claim 1 in which said actuating means include a bellows connected to each sharp and each key, a bellows connected to each corresponding action, and a coupling conduit between said bellows, said

bellows and said conduit being hydraulically charged to form a hydraulic transmission link.

5. In a piano, a piano frame, a sounding board in said frame and having opposed parallel faces, musical strings stretched across said frame and bridged on each face on opposite sides of said sounding board, a plurality of aligned actions extending transversely across the sounding board and on one side thereof, each of said actions including hammer means to strike the corresponding strings, said sounding board having aperture means aligned with the hammer means provided to strike the strings on the other side of the sounding board, a keyboard including a plurality of key-actuating elements, there being one actuating element for each action, and connection means between each of said actions and each of said actuating elements to operate said actions upon manipulation of the keyboard actuating element.

6. The combination defined by claim 5 in which the connection means comprise a plurality of pivoted lever arms, there being one lever arm between each key actuating element and a corresponding action.

7. The combination defined by claim 5 in which the connection means comprise a hydraulic linkage including movable members to be engaged by said actuating element and said action, and a fluid coupling line between said movable members locking said members for simultaneous related movements.

8. The combination defined by claim 5 in which the connection means include an actuating element bellows, an action bellows, a conduit interconnecting both of said bellows, and a charge of substantially incompressible fluid filling both the bellows and the conduit, said key-actuating element adapted to operate said actuating element bellows whereupon said action bellows will move said action through a related substantially simultaneous movement.

9. In a piano, a keybed, a keyboard support on said keybed, a hinge pin carried by said keyboard support, a plurality of keys pivotally carried by said hinge pin, a balance rail on said keybed, a plurality of key levers pivotally mounted on said balance rail, one end of each of the key levers having a key capstan screw to engage one of said keys, a plurality of actions including hammers to strike the piano strings and extending in coaxial alignment transversely of said hinge pin, there being one row of actions at each side of said keybed, a piano frame superjacent said keybed, a sounding board in said piano frame, strings stretched across said frame on opposite parallel sides of said sounding board, said sounding board having an aperture formed therein at one end thereof and in registry with the row of actions at one side of said keybed whereby the hammers of said row of actions at one side of said keybed will strike the strings on the far side of the keyboard through said apertures, and a key capstan screw at the other end of each of said key levers to engage one of said actions.

10. The combination defined by claim 9 in which the piano frame is provided with hitch pin means on opposite sides of the sounding board and tuning pin means spaced from the hitch pin means whereby the strings on opposite sides of the sounding board may be separately tensioned and the arrangement of said strings will tensionally balance the frame.

11. In a stringed instrument, a sounding board, a plurality of musical strings on opposite parallel sides of said sounding board, separate connecting means on opposite sides of said sounding board to mount opposite ends of each respective string on a corresponding side of said sounding board, and action means mounted on one side of said sounding board and selectively striking all of the strings, said strings being of varying lengths and weights with respect to one another and being progressively serially sized within a predetermined chromatically scaled audible frequency pitch range to provide strings on one side of said sounding board within a first portion of said predetermined audible frequency range and a second group of strings on the opposite side of said sounding board within a second portion of said predetermined audible frequency range, said sounding board having aperture means in registry with some of said action means, said some of said action means selectively striking the strings of one of said groups of strings on the opposite side of said sounding board through said aperture means.

12. A musical instrument comprising a frame, a sounding board in said frame, musical strings stretched over said frame on opposite parallel sides of said sounding board, each having opposite ends connected to said frame on a corresponding side of said sounding board, said strings being of varying lengths and weights with respect to one another and being progressively serially sized within a predetermined chromatically scaled audible frequency pitch range to provide one group of strings on one side of said sounding board within a first portion of said predetermined audible frequency range and a second group of strings on the opposite side of said sounding board within a second portion of said predetermined audible frequency range, and action means mounted on one side of said sounding board and selectively striking all of said strings on both sides of said sounding board, said sounding board having aperture means formed therein in registry with some of said action means, said some of said action means striking the strings of one of said groups of strings on the other side of said sounding board through said aperture means.

13. In a piano, the improvement of a piano frame having a sounding board with musical strings bridged on opposite parallel sides thereof, each of said strings having opposite ends thereof connected to said frame on a corresponding side of said sounding board, said strings being of varying lengths and weights with respect to one another and being progressively serially sized within a predetermined chromatically scaled audible frequency pitch range to provide strings on one side of said sounding board forming a first group of strings within a first portion of said predetermined audible frequency range and providing strings on the opposite side of said sounding board forming a second group of strings within a second portion of said predetermined audible frequency range, and action means mounted on one side of said sounding board having hammers striking all of the strings on both sides of said sounding board, said sounding board having aperture means aligned in the path of movement of the hammers striking the strings on the other side of said sounding board.

14. In a musical instrument, a frame, a sounding board in said frame, musical strings stretched across said frame on opposite parallel sides of said sounding board on opposite sides of said frame, means connected to opposite ends of each respective string variably tensioning said strings on each side of said sounding board separately and substantially tensionally balancing said frame, said strings being of varying lengths and weights with respect to one another and being progressively serially sized within a predetermined chromatically scaled audible frequency pitch range to provide one group of strings on one side of said sounding board within a first portion of said predetermined audible frequency range and a second group of strings on the opposite side of said sounding board within a second portion of said predetermined audible frequency range, and action means mounted on one side of said board having hammers selectively striking all of the strings, said sounding board having aperture means aligned in the path of movement of the hammer striking the strings on the other side of said sounding board.

15. In a piano, the improvement of a piano frame having a sounding board with musical strings bridged on opposite parallel sides thereof, hinge pin means on said frame on opposite sides of said sounding board, tuning pin means spaced from said hinge pin means and together therewith hitching and variably tensioning said

strings on each corresponding side of said sounding board separately and substantially tensionally balancing said frame, said strings being of varying lengths and weights with respect to one another and being progressively serially sized within a predetermined chromatically scaled audible frequency pitch range to provide a first group of strings on one side of said sounding board within the first portion of said predetermined audible frequency range and a second group of strings on the opposite side of said sounding board within a second portion of said predetermined audible frequency range, and action means mounted on only one side of said sounding board but having hammers selectively striking all of the strings, said sounding board having aperture means aligned in the path of movement of the hammer striking the strings on the other side of said sounding board.

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157,487	Germany	Feb. 25, 1905
20,495	Great Britain	Sept. 16, 1911
273,741	Great Britain	Sept. 27, 1928
137,398	Austria	Apr. 25, 1934