Sept. 9, 1958 C. ANDERSEN 2,850,933

PIANO ACTION

Filed March 24, 1954 2 Sheets-Sheet 1

Fig. 1.

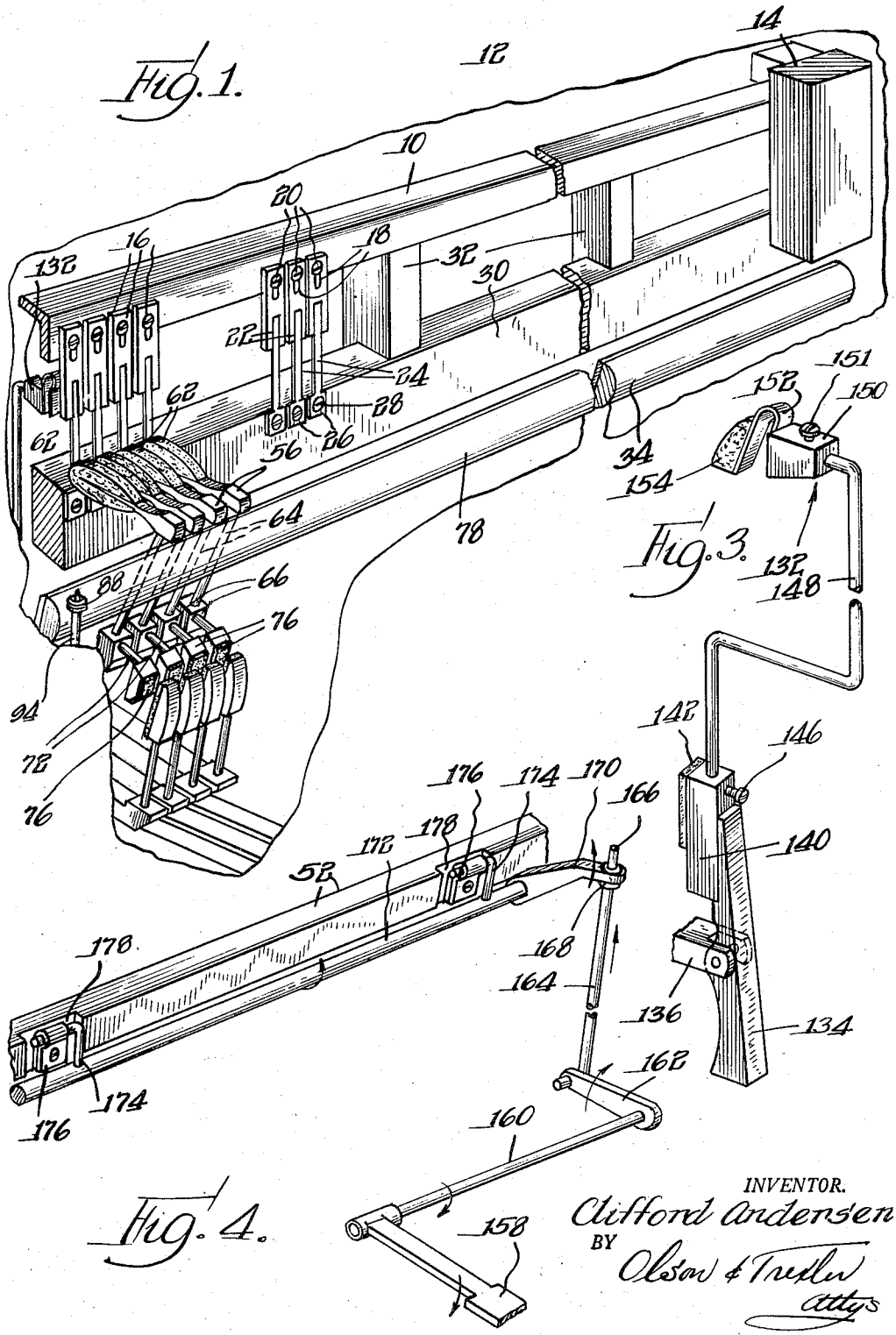


Fig. 3.

Fig. 4.

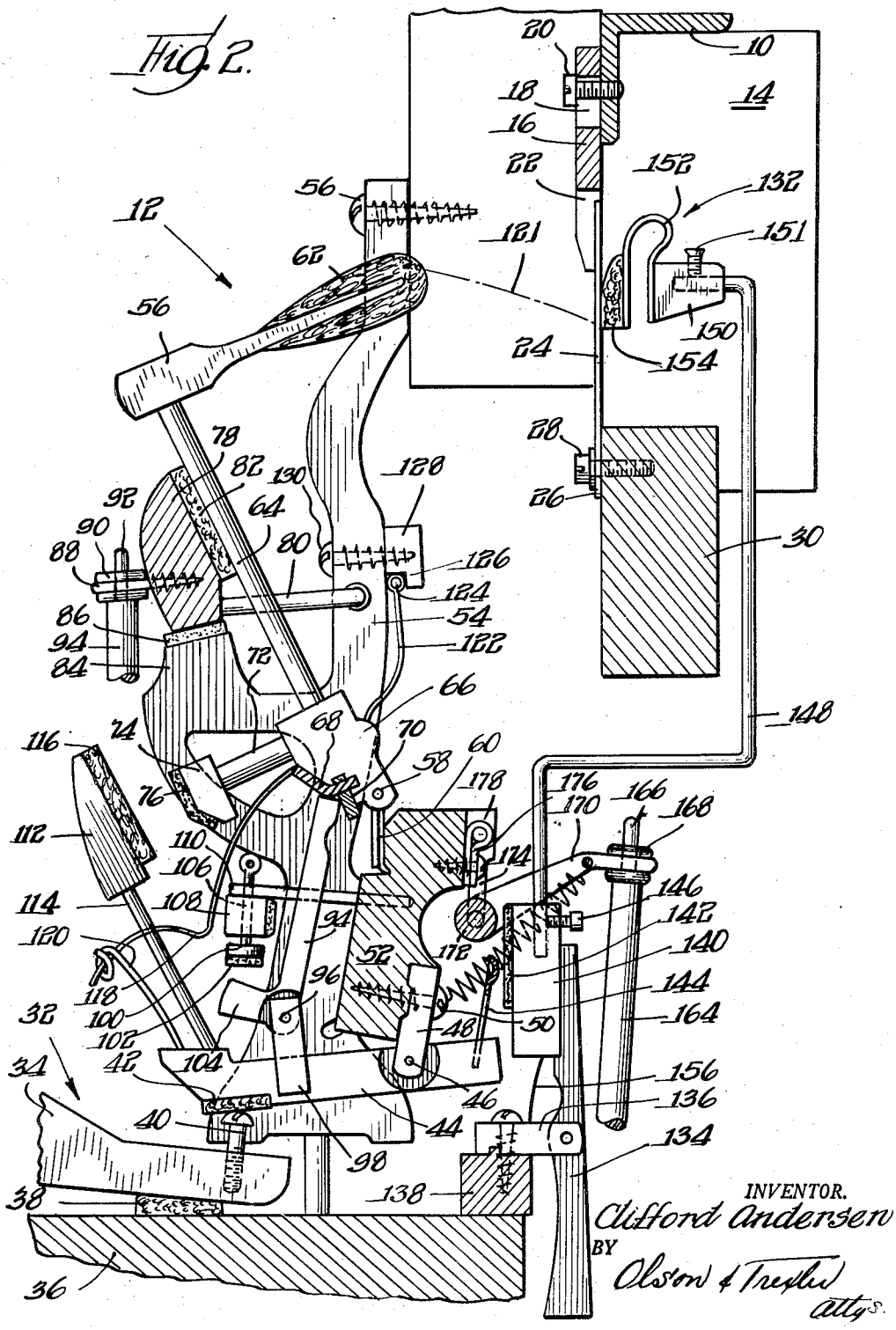
INVENTOR.
Clifford Andersen
BY
Olson & Trudell
Attys

Sept. 9, 1958 C. ANDERSEN 2,850,933

PIANO ACTION

Filed March 24, 1954 2 Sheets-Sheet 2

Fig. 2.



INVENTOR.
Clifford Andersen
BY
Olson & Trestler
attys.

United States Patent Office

2,850,933

Patented Sept. 9, 1958

2,850,933

PIANO ACTION

Clifford Andersen, De Kalb, Ill., assignor to The Rudolph Wurlitzer Company, North Tonawanda, N. Y., a corporation of Ohio

Application March 24, 1954, Serial No. 418,273

1 Claim. (Cl. 84—404)

This invention is concerned generally with an electronic piano, and more particularly with a piano action therefor.

For countless years pianos and similar instruments have been constructed with tensioned strings which have been vibrated by striking or plucking in order to produce musical tones. In the specific case of pianofortes, commonly termed pianos, and so named hereinafter, the stringes are struck by hammers. The various strings of a piano are of different dimensions, weight, and construction, and consequently have different vibrational characteristics giving rise to the distinctive piano tones. One undesirable characteristic is that the different strings have different vibrational decay characteristics. If the strings were allowed to vibrate naturally, the vibrations of some of them would decay in as little as a half second, while others would take progressively longer to decay, up to as much as thirty seconds.

In order to impart substantially uniform decay time to the strings, it long has been common practice to employ dampers. The dampers generally employ felt pads which are engageable with the strings mechanically to damp vibrations thereof. When a note is played, the damper corresponding to that note is withdrawn to allow the string to vibrate as long as the corresponding key is held down. When the key is released, the damper reengages the string to damp the vibrations thereof. Further mechanism generally is provided which is operable by the pianist's foot to withdraw all of the dampers simultaneously to allow loud playing and to achieve certain resonance effects.

Conventional piano actions including the dampers thereof occupy a considerable amount of space. In particular, the dampers and the hammers percussively actuating the strings occupy a considerable space longitudinally of the strings and operate on the strings at rather widely spaced points. The space taken by the actions including the dampers in conventional pianos is of little consequence, as such pianos are necessarily large anyway. The string length necessitates that one dimension (the horizontal dimension in grand pianos, and the vertical dimension in uprights) be several feet in length, ranging from about 3½ feet in an inexpensive piano up to 9 feet for a high quality piano. The aggregate string tension characteristically will be on the order of 18 tons, and strong frames are necessary to resist this tension. Cast iron conventionally is used for such frames, and conventional pianos may weigh from as little as 500 pounds for an inexpensive piano up to about 1,500 pounds for a high quality piano.

For many purposes the imposing size of a conventional piano is desirable due to the psychological effect created thereby. In other cases the large size and weight are decided drawbacks. For instance, student practice rooms often must be uneconomically large, and it may be extremely expensive or impossible to move a conventional piano into an upstairs apartment. Furthermore, the upper floors of some buildings could not safely withstand

the weight of a conventional piano, particularly a grand piano.

It has been proposed heretofore to produce a comparatively small piano by using impulsively actuated vibratory reeds as tone generators, and by electronically amplifying the vibrations so produced, and then transducing the amplified electrical vibrations into piano-like sounds. An additional benefit to be derived from such a piano is that the pianist may use earphones as transducers, thereby rendering the piano tones clearly audible to him, while allowing others in the vicinity to pursue their own activities without distraction. Various difficulties have been encountered in attempting to obtain pure piano tones in this manner, many of which have not heretofore been solved successfully. Substantial mechanical problems also have been presented. All of the vibratile reeds are rather small, and the treble reeds are extremely small. There has not been enough room for the dampers of conventional piano actions to engage the reeds without either getting in the way of the hammers or reacting in an unsatisfactory manner. In connection with the latter, it will be understood that the reed vibrates with considerable intensity at the location where it is impulsed or struck by a hammer, and engagement of the reed by a damper at this point is prone to cause the damper to bounce away from the reed, thereby achieving imperfect damping and tending to change the pitch of the tone generated.

It is accordingly an object of this invention to provide an improved action for electronic pianos of the type utilizing percussively actuated vibratile reeds as tone generators.

It is a further object of this invention to provide an improved damper for an electronic piano of the foregoing character.

Yet another object of this invention is to provide, in an electronic piano utilizing vibratile reeds as tone generators, a damper which will not rebound or change the tone of a reed when engaging the back of a reed adjacent the area where the reed is impulsed or struck by a hammer.

Other and further objects and advantages of the present invention will be apparent from the following description when taken in connection with the accompanying drawings wherein:

Fig. 1 is a fragmentary perspective view of a plurality of vibratile reeds and corresponding piano actions;

Fig. 2 is a vertical sectional view on an enlarged scale showing one of the reeds and actions;

Fig. 3 is a perspective view of one of the dampers; and

Fig. 4 is a fragmentary perspective view of the mechanism for rendering all of the dampers inoperative in order to achieve resonant effects and to play with louder volume.

Referring first to Figs. 1 and 2, there may be seen a frame member 10 of an electronic piano 12. The frame member preferably is in the form of an aluminum angle bar and is mounted between a pair of end blocks 14. A plurality of pick-ups 16 is spaced along the front flange of the frame member or bar 10. The pick-ups are generally in the form of rectangular metal blocks having slots 18 near one end thereof through which screws 20 are passed and threaded into the bar 10. The opposite ends of the pick-ups are provided with slots 22 opening at the ends of the pick-ups, and within which the tone generating reeds 24 vibrate.

The reeds 24 comprise metal tongues having attaching lugs 26 at one end thereof for receiving mounting screws 28 which are threaded into an insulating reed mounting bar 30 which is supported beneath and from the frame member 10 by means of spacer supports 32. It will be understood that the dimensions and weight of the reeds

vary from one reed to another to determine their frequency and vibrational modes. The reeds may be provided at their tips with weights for aiding in the determination of the frequency and vibrational modes.

Beneath, and slightly in front of the reeds and pick-ups, there is located a piano keyboard **32** comprising a plurality of keys **34** pivoted on a board **36** in any known or suitable manner, the board being conventionally mounted on the piano case or frame. The inner end of each key is limited in its lowermost position by a felt pad or stop **38**, and the top inner end of each key is provided with a capstan screw **40**. Directly above the capstan screw there is a felt pad **42** on a whip **44** which is pivotally mounted at **46** on a whip flange **48** which is secured by means such as screw **50** on a main rail **52** extending between the action brackets **54** which are mounted at opposite ends of the keyboard by means such as screws **56** threaded into the end block, and by any other suitable or conventional means. A plurality of hammers **56** corresponding to the reeds **24** is pivotally mounted as shown at **58** on a metal bracket **60** mounted along the top outer edge of the main rail **52**. Each hammer comprises a head having a felt striker **62**, the head being conventionally mounted on a shank **64**. Each hammer further includes a butt **66** on which the pivotal connection **58** is made, and each butt is provided along its lower edge with a leather abutment or wear strip **68** and felt bumper **70**. A catcher stem or shank **72** extends rearwardly from the butt and carries a catcher **74** having its outer face covered with a suitable buffer **76** such as leather.

The rest position of the hammers as shown in Figs. 1 and 2 is determined by a hammer rail **78** which is pivotally supported at opposite ends from the action brackets **54** by means of a pair of hammer rail hooks or swings **80**. The face of the hammer rail **78** is provided with a felt pad **82** engageable with the hammer shanks **64** for arresting them quietly and without physical shock. Bracket portions **84** extend up beneath the hammer rail **78** and are provided with felt pads **86** for limiting the lowermost position of the hammer rail. Means is provided for raising the hammer rail including an eyelet **88** screwed into the rail and carrying a grommet **90** through which a pin **92** on a push rod **94** extends. The push rod **94** is connected by means of any suitable linkage to a pedal corresponding to the conventional "soft" pedal on a conventional piano. It will be understood that when the pedal is depressed, the push rod **94** is raised. This pivots the hammer rail **78** and the hammer rail hooks or swings **80** about the pivotal mounting of the latter on action brackets **54** to push the hammers **56** closer to the reeds **24** and thereby to shorten the stroke of the hammer. The shortened stroke causes the hammers to have less inertia when they strike the reeds whereby the reeds are vibrated with less intensity, and consequently generate tones of lower volume.

Each hammer is actuated by an L-shaped fly or jack **94** pivotally mounted at **96** on a fly flange **98**, the fly flange being fixed on the whip **44**. A regulating rail button **100** having a felt pad **102** along the bottom thereof is mounted above the heel **104** of each fly **94**. The buttons **100** are mounted by screws **106** threaded through a regulating rail **108** extending between brackets **110** which are screwed into the main rail **52** or otherwise mounted from the action brackets **54**. The buttons are suitably mounted on the screws **106**, and the screws are conveniently provided at their upper ends with eyelets for ready finger adjustment.

A backcheck **112** is mounted by means of a backcheck wire **114** near the outer end of the whip **44** and is provided with a felt pad **116** engageable with the felt pad **76** on the catcher **74** when the whip is pivoted by the depression of the key **34**. The usual bridle tape **118** extends between the butt **66** and a bridle wire **120** on the whip.

It will be understood that when the key **34** is depressed, the capstan screw **40** pivots the whip **44** about the pivot **46** to force the fly **94** up against the butt **66**. When the foot **104** of the fly engages the pad of the regulating rail button, the fly is pivoted from beneath the butt **56**, and the hammer continues under its own inertia and strikes the reed **24** as indicated along the dashed line **121**. Each hammer is returned by a butt spring **122** fixed in the butt and having an end **124** thereof trapped behind a flange **126** on a spring rail **128** mounted on the action brackets **54** by means such as screws **130**. Pivoting of the whip **44** raises the backcheck into position for its felt to engage the felt pad **76** of the catcher whereby to arrest the hammer before it returns completely to its rest position against the pad **82** on the hammer rail **78**. When the key is released, the whip and backcheck return to their normal positions and the hammer shanks rest against the padded hammer rail.

In order to prevent unwanted resonant effects and to limit decay times, each reed is provided with a damper indicated generally at **132** (Figs. 1, 2, and 3). Each damper comprises a damper lever **134** pivotally mounted on a damper lever flange **136**. All of the damper lever flanges **136** are mounted on a damper lever rail **138** extending transversely across the keyboard. Each damper lever **134** has fixed to it a block **140** having a felt pad **142** engageable by a spoon **144** mounted in the tail end of the whip **44**. A set screw **146** secures a damper lever rod or wire **148** in a socket in the block **140** for pivotal movement with the lever **134**. The damper rod or wire **148** is offset to clear the reed mounting block or rail **30** and has a damper block **150** secured to its upper end by means such as a set screw **151**. The damper block **150** carries a spring **152** which is illustrated as being a substantially U-shaped leaf spring, and the end of this spring carries a damper pad **154** of resilient material which conveniently can be felt. When the whip **44** is pivoted by depression of the key **34**, the spoon **144** engages the felt pad **142** on the block **140** to pivot the damper lever **134** about its mounting in the bracket **136**. This causes the damper pad to be retracted from the corresponding reed **24** so that the same is free to vibrate when struck by the hammer **56**. When the key is released, the damper returns to its damping position under the action of a spring **156** which is illustrated as a leaf spring extending between the damper lever block **140** and the damper lever bracket **136**, but which could take other forms.

When the damper pad **154** reengages the reed **24**, the reed is vibrating. The spring **152** takes up the vibration and rapidly silences the reed, while maintaining the pad **154** in firm engagement with the reed. The spring **152** keeps the pad **154** from bouncing off of the reed **24** which would cause the reed to be imperfectly damped and would tend to raise the pitch of the reed as the vibrations decay. The spring **152** thus will be seen to be of utmost importance.

Mechanism is provided for simultaneously rendering all of the dampers inoperative in order to play at greater volume and to achieve certain resonant effects. This mechanism includes a foot pedal **158** (Fig. 4) to be operated by the pianist's right foot. This pedal is fixed on a rock shaft **160** pivotally mounted in any suitable bearings (not shown) on a fixed part of the piano. A lever **162** is fixed on the other end of the rock shaft **160** and has a pivotal connection with a push rod **164**. The push rod **164** has a reduced upper end **166** (Figs. 2 and 4) which fits through a grommet **168** in an aperture in a lever **170**. The lever **170** is fixed on a damper operating rod or bar **172**. The damper operating bar or rod **172** is provided with a pair of L-shaped arms **174** pivotally received in brackets **176** mounted in recesses **178** in the main rail **52** whereby pivotally to support the damper actuator rod or bar **172**. When the pedal **158** is depressed, the rock shaft **160** is rocked in a clockwise direction as indicated in Fig. 4 and raises the lever **162** thereby to elevate the push rod **164**. This raises the lever **170** and pivots the damper actuating rod or bar about the arms **174** outwardly away from the main rail **52** and into

engagement with the felt pads **142** (Fig. 2) on all of the damper lever blocks **140** whereby to retract the dampers from the reeds. The dampers remain retracted as long as the pedal is depressed, and are returned by their aforementioned springs when the pedal is released.

It will be apparent that I have herein presented an improved piano action having particular applicability to vibrating reed electronic pianos. The damper pad engages each reed on the back thereof substantially opposite to the point where it is struck by the associated hammer, thereby rendering it possible to damp the reed. Conventional dampers in string pianos are displaced longitudinally of the springs too great a distance from the hammers and therefore could not be used with vibrating reed electronic pianos. The vibrations of the reed are particularly strong directly opposite where the reed is struck by the hammer, and in particular they are substantially stronger than the vibrations of a piano string where the damper of a conventional piano engages a string. These strong vibrations tend to make the damper rebound from the reed, and rebounding would result in improper damping action and in "upping" or raising the tone of the reed. The spring **152** causes the damper pad to comply with the vibrations of the reed while damping the same, thereby completely avoiding rebounding of the damper.

The specific structural details herein shown and described will be understood as being by way of illustration only. Various changes in structure are possible and form a part of this invention insofar as they fall within the spirit and scope of the appended claim.

I claim:

Piano tone producing mechanism comprising a vibratory reed tone generator of substantially flat configuration and having oppositely disposed substantially flat faces, means for mounting one end of said reed with the other end thereof free for vibration, a piano key, a hammer including a butt and a head carried therefrom, means pivotally mounting said butt for movement of said head toward and away from one flat face of said reed, means interconnecting said key and said hammer for pivotally moving said butt upon movement of said key to carry

said head into percussive engagement with said one flat face of said reed at a predetermined striking position thereon, a rod-like damper lever, means pivotally mounting said lever at a greater distance from said reed striking position than the pivotal mounting of the hammer and on the same side of the striking position as the hammer pivotal mounting, said damper lever extending throughout a substantial portion of its length parallel to the reed and on the opposite side thereof from the hammer, said damper lever terminating adjacent said striking position, a damper block secured on the end of said damper lever, a damper pad engaging the opposite flat face of said reed at said striking position, and a generally U-shaped flat blade type spring mounting said damper pad from said damper block, said spring having a pair of parallel flat arms both parallel to said reed flat faces and respectively secured to said block and to said pad and having an interconnecting bight, said bight projecting beyond said block and said pad and bulging outwardly beyond at least one of said arms to impart flexibility to said spring, said spring maintaining said damper pad free from rebound and free from lateral wobble against said opposite flat face of said reed at said striking position to damp vibrations of said reed, and means operatively connected to said key and to said damper lever for pivoting said lever upon movement of said key, whereby to retract said damper pad from said opposite flat face of said reed to free said reed for vibration.

References Cited in the file of this patent

UNITED STATES PATENTS

293,855	Doyle	Feb. 19, 1884
395,543	Caldera	Jan. 1, 1889
579,031	Zintzsch	Mar. 16, 1897
967,015	Gilmore	Aug. 9, 1910
2,456,321	Rhodes	Dec. 14, 1948
2,484,745	Rowe	Oct. 11, 1949
2,502,861	Linderoth	Apr. 4, 1951

FOREIGN PATENTS

142,178	Germany	July 4, 1903