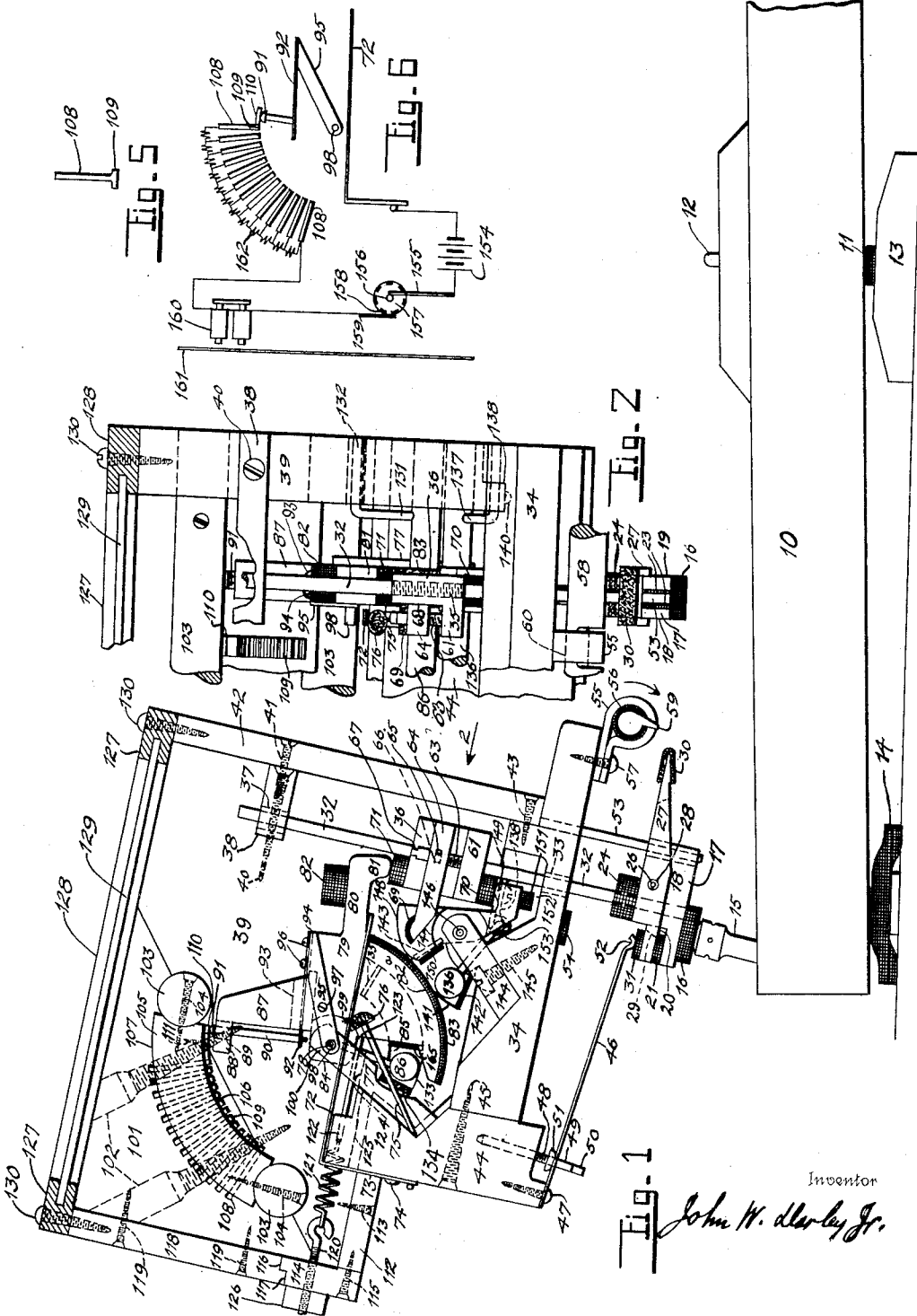


J. W. DARLEY, JR.
SOSTENUTO MUSICAL INSTRUMENT.
APPLICATION FILED OCT. 4, 1915.

1,318,977.

Patented Oct. 14, 1919.
2 SHEETS—SHEET 1.

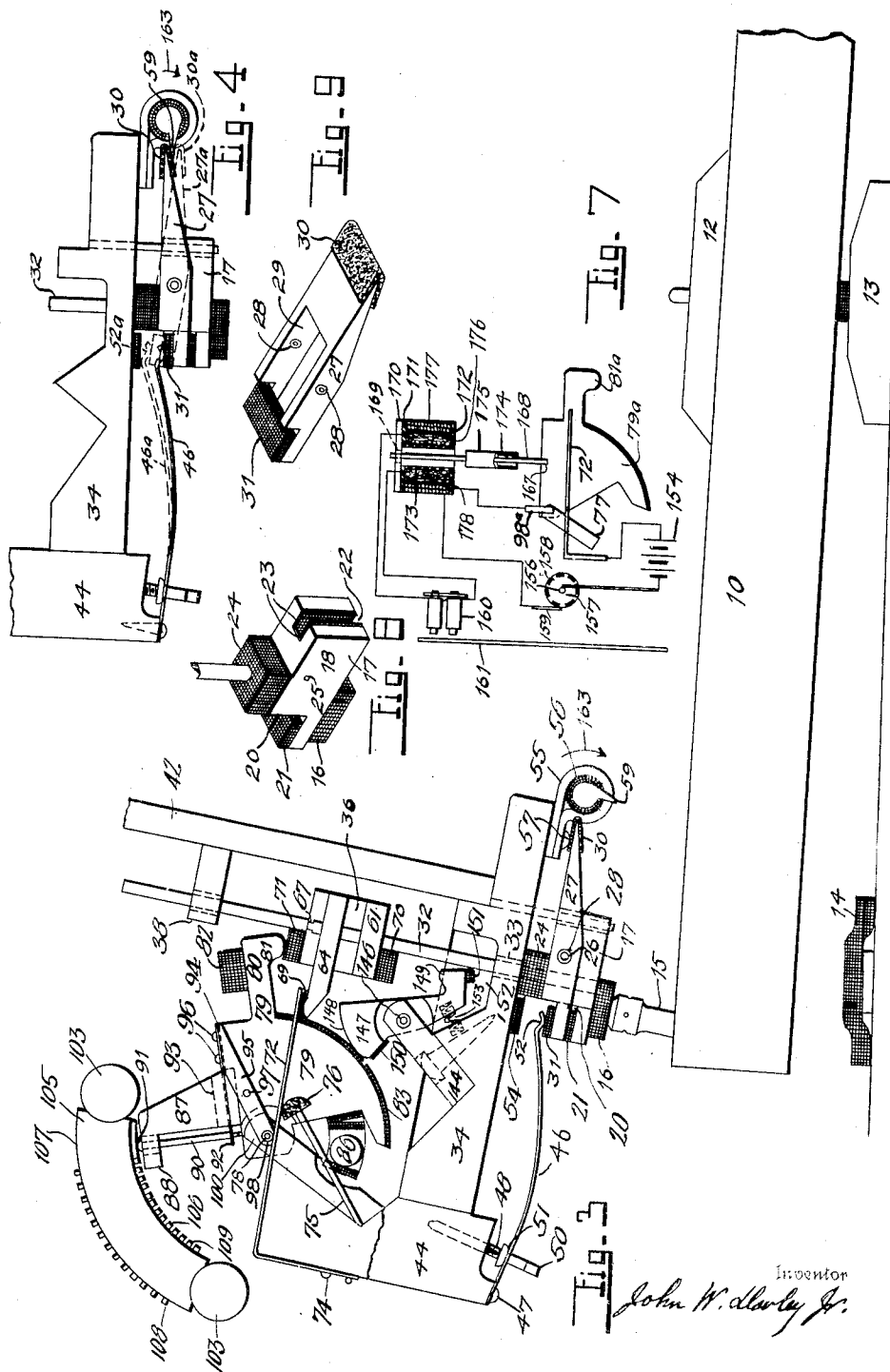


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UNITED STATES PATENT OFFICE.

JOHN W. DARLEY, JR., OF BALTIMORE, MARYLAND.

SOSTENUTO MUSICAL INSTRUMENT.

1,318,977.

Specification of Letters Patent.

Patented Oct. 14, 1919.

Application filed October 4, 1915. Serial No. 54,086.

To all whom it may concern:

Be it known that I, JOHN W. DARLEY, JR., a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Sostenuito Musical Instruments, of which the following is a specification.

My invention relates to stringed musical instruments, and especially to instruments of the type in which a string is continuously vibrated at the will of the performer.

The object of my invention is to produce a stringed key board musical instrument, in which the strings shall be continuously vibrated by magnetic forces developed in the field of an electro-magnet, through the coil of which a pulsating current of electricity is caused to flow by the depression of the corresponding key.

A further object of my invention is to cause said current of electricity to be of a strength proportional to the speed with which said key is depressed, whereby the performer can sound any tone, either loudly or softly at will.

A further object of my invention is to provide means for increasing or decreasing the strength of said current of electricity after said key is depressed, whereby crescendo or diminuendo of the tone is obtained.

In carrying out my invention I make use of the well known fact that if the strings of a musical instrument are formed of paramagnetic material and an electro-magnet is placed with its pole or poles in proximity thereto, and a current of electricity, that is pulsated with a frequency that is either the same as or a sub-multiple of the number of vibrations of said string per second, flows through the coil of said electro-magnet, then said string will sound its fundamental tone accompanied by certain upper partials, the latter depending in number and strength upon the structural features supporting said strings, the peculiarities of said string, and the location of said magnet with reference to the points of support of said strings.

In combination with the above mentioned well known combination of strings with an electro-magnet having a coil through which a pulsating coil of electricity flows, I provide means for varying the strength of said current in accordance with the speed with which a key is depressed, and for varying said current after said key is depressed.

In the drawings:—

Figure 1, is a side view of the mechanism for one key for controlling the flow of electricity through the coil of the magnet for vibrating the corresponding string;

Fig. 2, is a view of the mechanism shown in Fig. 1, looking in the direction of the arrow 2, the key being omitted;

Fig. 3, is a side view of the working parts shown in Fig. 2 in the position they assume when the front end of the key is depressed;

Fig. 4, is a side view of some of the parts shown in Fig. 1 in the position which they assume when the front end of the key is depressed and the sostenuto pedal is operated;

Fig. 5, is a detail view of one of the contact points used in carrying out my invention;

Fig. 6, is a diagram of the connections of my improved device;

Fig. 7, is a diagrammatic view of an alternative construction;

Fig. 8, is a detail view of part of my improved mechanism; and

Fig. 9, is a detail of a part which cooperates with the block shown in Fig. 8.

In the drawings:—

10 represents a key such as is ordinarily used in a piano. This key is mounted to rock on a felt washer 11 which is placed around the balance pin 12 and rests against the balance rail 13. The front end of the key is provided with a guiding pin and a stop washer as is customary with piano keys. When the front end of the key is in its normal position, the rear end of the key is resting upon the cushion 14 shown in Fig. 1.

The new mechanism hereinafter described is carried by a box whose sides are 34, 44, 112, 118, 127, 42, 39 and another side similar to 39, (not shown), said box being fixed in the casing of the instrument.

The key 10 carries near its rear end a capstan screw 15 upon which rests a felt cushion 16. The cushion 16 is secured upon the wood block 17, which is shaped as shown in Fig. 8.

The wood block 17 is formed with two parallel sides 18 and 19, (see Figs. 1, 2 and 8), with a notch 20 on the rear end, in which is mounted the felt strip 21. The front end of the block 17 is provided with a slot 22, the sides of which are provided with cloth pads 23—23. A felt pad 24 is secured to the top of the block 17 for a purpose hereinafter referred to. The block 17 is provided with a transverse hole 25 in which fits tightly

the pin 26. 27 is a lever provided with bushed holes 28—28 through which passes the pin 26 and thus the lever 27 is revolvably mounted upon the pin 26. A slot 29 of sufficient width and length to clear the block 17 is provided in the lever 27 and belt pads such as 30 and 31 are provided at the extremities of said lever for purposes hereinafter referred to. A vertical wire such as 32 has its lower threaded end screwed into the block 17; said wire passes through the pad 24 and slides freely in a bushing 33 provided in a hole in the rail 34.

A thread such as 35 is provided near the middle of the wire 32 upon which is threaded the block 36, and the upper end of the wire 32 slides freely in a felt bushing 37 provided in a hole in the rail 38.

The rail 38 fits in a notch provided in the cheek 39 and is secured to said cheek by screws such as 40. There may be as many cheeks similar to 39 as it is desirable to use. The rail 38 is further supported by screws such as 41 which pass through the front casing 42 and screw into the rail 38. The front casing 42 is secured at the bottom to the rail 34 by screws such as 43, and is further secured at its ends by screws, not shown, which thread into the cheek 39.

A rail 44 is secured to the rear of the rail 34 by screws such as 45. Springs such as 46 are secured to the rail 44 by screws such as 47 and a second screw 48 threads into the rail 44. The screw 48 has a lower portion 49 provided with a flat end 50 for the application of the turning tool. The portion 49 passes through a hole provided in the spring 46 and an enlarged portion 51 is provided on the screw 48 for said spring to bear against. The front end of the spring 46 is curved as at 52 and said curved portion rests against the pad 31 and serves to keep the rear end of the lever 27 against the pad 21. It is evident that by turning the screw 48 in either direction, the pressure of the curved portion 52 against the pad 31 can be increased or diminished as desired.

A pin such as 53 is secured in the rail 34 and slides freely between the cloth pads 23 in the slot 22 of the block 17. A pad such as 54 secured to the rail 34 prevents the curved portion 52 of the spring 46 from striking said rail when the front end of the key is rapidly depressed. Bearings such as 55 provided with cloth bushings 56 are secured by the screws 57 to the rail 34.

A sostenuto bar 58 is provided and said bar has a rib such as 59 formed integrally therewith. At any desired number of points the rib 59 is removed to provide a plurality of circular portions such as 60 to be revolvably mounted in the bearings 55, so that said sostenuto bar 58 will lie substantially parallel with the felt pads 30 on the lever 27.

The block 36 is provided with an offset

portion 61 in which is screwed the lower portion of the screw 63. The upper portion of the screw 63 is not threaded, and the arm 64 is revolvably mounted thereon. The arm 64 is prevented from moving longitudinally on the screw 63 by the pin 65 which fits tightly in said arm and extends into a slot 66 turned in the screw 63. The upper part of the screw 63 is flattened as at 67 for the application of a turning tool. The arm 64 is made of such a width that it fits snugly against the side 68 of the block 36 in order to prevent said arm from turning. The arm 64 is provided with a curved nose at its rear end which is covered by the felt pad 69. Felt pads such as 70 and 71 are provided, respectively, on the bottom and top of the block 36 to the rear of the vertical wire 32.

A flat spring such as 72 having a downwardly extending portion 73 is secured to the rail 44 by screws such as 74 and the front end of the spring 72 is located to be struck by the pad 69 as hereinafter explained.

A wire such as 75 is secured in the rail 44 and extends upwardly and toward the right, the upper end of said wire being provided with a soft leather button 76. The spring 72 normally rests against the button 76.

A flange such as 77 is secured to the rail 44 in any approved manner and said flange is provided at its upper end with a slot in the usual manner and with holes in which are mounted cloth bushings.

A pin such as 78 is revolvably mounted in said bushings and said pin fits tightly in a hole provided in the lever 79. The lever 79 is the movable part of the rheostat by which I control the flow of electricity.

The lever 79 is provided with a forwardly extending arm 80 having a downward extension provided with a rounded nose 81, which normally rests against the pad 71. The upper side of the arm 80 is provided with a felt pad 82 secured thereto. The lever 79 is further provided with a curved portion 82^a, upon which is secured the buckskin pad 83, and with a rearward extension 84 in which the pin 78 is mounted. A recess such as 85 is provided between the curved portion 82^a and the rearward extension 84 in order to provide clearance around the horizontal metallic rod 86. The lever 79 is further provided with an arm 87 which extends upwardly and terminates in a rearward extension 88. The extension 88 is provided with a hole in which is mounted a cloth bushing 89 and a pin 90 slides freely in the bushing 89.

The pin 90 is provided with a head 91 for a purpose hereinafter explained and the lower end of said pin is reduced in size, passes through a hole provided in the inner end of the spring 92, and is secured thereto by soldering. The arm 87 is provided with

a hole 93 through which the spring 92 extends toward the front.

The lever 79 is provided with a flat portion over which extends the bent portion 94 of the connector 95. The front end of the spring 92 extends over the bent portion 94 of the connector 95 and screws such as 96—96 serve to secure the spring 92 and the bent portion 94 to the lever 79. A screw such as 97 further secures the connector 95 to the lever 79. The connector 95 is provided in its rear end with a hole which fits over the pin 78 and a metallic bushing 98 fits over the pin 78. The pin 78, connector 95 and bushing 98 are secured together by solder. The lever 79 is counterbored as at 99 so that the prong 100 of the flange 77 will not touch the inside surface of the connector 95. A block 101 is secured by screws 102—102 to the cheek 39.

Metallic bars 103—103 are secured in holes provided in the cheek 39 and the block 101, and an insulating rail 105 having curved depressions on its sides adapted to fit against the cylindrical bars 103—103 is secured to said bars by screws such as 104—104. The inner surface 106 and the outer surface 107 are cylindrical in shape and concentric with the center of the pin 78.

In line with the movement of the head 91 of each pin 90, when the same swings around as hereinafter described, the rail 105 is drilled with a plurality of radially disposed holes, thirteen in number, and in each of said holes a contact pin, (see Fig. 5), consisting of a body portion 108 and a head 109 is mounted. The body portion 108 is adapted to fit in the holes drilled in the rail 105 and the head 109 is adapted to rest against the inner curved surface 106 of said rail so as to present contact surfaces to the head 91 of the pin 90.

An additional contact piece 110 is secured to the rail 105 by a screw 111, with one end in contact with the head 109 of the first contact pin. The juncture between said head 109 and the additional contact piece 110 is rendered a good conductor by soldering, so that when the head 91 is in the position shown in Fig. 1, the first contact pin will be in electrical connection with said head 91.

The bottom casing 112 is secured to the cheek 39 by screws such as 113 and a strip 114 is secured to the bottom casing 112 by screws such as 115. The strip 114 is provided with an offset 116 which is overlaid by a rabbet 117 formed on the bottom edge of the rear casing 118 and the latter is secured to the block 101 by screws such as 119—119.

The strip 114 is provided with a plurality of holes, one opposite the center of each flange 77, and in each of said holes a screw eye such as 120 is mounted. One end of the spring 121 is attached to the eye of the

screw eye 120 and the other end of said spring is attached to a piece of silk cord 122, the front end of which is attached as at 123 to the lever 79. The bottom 124 of the slot in the flange 77 is so placed that the silk cord 122 can have free movement, and slots, the bottom of one of which is shown at 125, are cut through the top of the rail 44 in order to provide clearance around the spring 121. On the rear end of the screw eye 120, a nut 126 is threaded to provide means for adjusting the tension of the spring 121.

A cover is provided consisting of the side pieces 127—127 and end pieces, one of which is shown at 128, and the glass plate 129 mounted in grooves provided in said side and end pieces. The cover is secured to the cheeks 39, the front casing 42 and the rear casing 118 by screws such as 130—130—130.

The horizontal metallic rod 86 is provided with a plurality of metallic hooks such as 131; the lower ends of said hooks are rigidly secured in said bars 86 and the upper ends of said hooks are revolvably mounted in bushed holes such as 132, (see Fig. 2), provided in the cheeks 39.

Curved slots such as 133 are provided in the cheeks 39 to provide clearance for the bar 86 and felt pads such as 134 and 135 are provided in the ends of the slots 133 to limit the motion of said bar.

A second horizontal metallic bar 136 is rigidly secured to hooks such as 137 and the free ends of said hooks are mounted in bushed holes provided in bearings such as 138 which are secured to the cheeks 39 by screws such as 140. Curved slots such as 141 are formed in the cheeks 39 and provide clearance for the bar 136, and felt pads 142 and 143 are provided at the ends of said slots to limit the motion of said bar.

Flanges such as 144 are secured to the rail 34 by screws such as 145. The upper ends of said flanges are provided with slots in the usual manner and with bushed holes in which are revolvably mounted pins such as 146. Rigidly mounted on the pin 146 is a detent 147 which has a surface 148 eccentric to the center of the pin 146, a nose adapted to make contact with the pad 70, and two felt pads 150 and 151. The rail 34 has a longitudinal recess as at 152 to provide clearance around the lower end of the detent 147. Oppositely disposed holes are provided in the rail 34 and the lower arm of the detent 147, and in said holes there is mounted the compression spring 153.

The electrical connections of my improved device are as follows; reference being had to Fig. 6.

The battery, or other source of electricity 154, has one terminal connected to the spring 72; the other terminal of said battery is connected to a spring such as 155

which bears against the axle 156 of the metallic cylinder such as 157. The cylinder 157 is provided with a plurality of slots in which are mounted pieces of insulation 158 so that the exterior surface of the cylinder 157 shall present to the spring 159 a surface which is alternately conducting and insulating. The spring 159 is connected to one terminal of the magnet 160; the poles of the magnet 160 are disposed in proximity to the string 161, and the other terminal of said magnet is connected to the body 108 of the last contact pin. A resistance coil 162 is provided which has one end connected to the body 108 of the last contact pin, the other end connected to the body 108 of the first contact pin and intermediate connections to the bodies of intermediate pins as shown diagrammatically in Fig. 6. The string 161 is to be made of the proper length to sound a note of the chromatic scale and is to be secured over a bridge and bearing bar in proximity to a sounding board in any approved manner. The cylinder 157 is to be revolved in any approved manner at such a speed that pulsations of electric current through the coils of the electro-magnet 160 shall be either the same as or a sub-multiple of the note of the chromatic scale which the string 161 sounds.

The operation of my improved device is as follows:

When the key 10 and horizontal metallic bars 86 and 136 are in the position shown in Fig. 1, it is evident by reference to Fig. 6 that no electricity flows through the coils of the electro-magnet 160 because the circuit is open between the spring 72 and bushing 98, hence the string 161 will not sound.

If now, the front end of the key 10 is gently depressed the lever 79 will be moved into the position shown in Fig. 3, the nose 81 resting upon the pad 71. During the movement of the key 10 the vertical wire 32 is moved upward, carrying with it the block 36 and the arm 64, and the pad 69 on the rear end of said arm strikes the spring 72 and moves it upwardly so that it makes contact with the bushing 98. When this happens, a current of electricity flows from the battery 154, through the spring 72, the bushing 98, the connector 95, the spring 92, the pin 90 and head 91 to the additional contact piece 110 to the head 109 of the first contact pin and through the body 108 thereof to one end of the resistance coil 162, through all of said resistance coil to the coils of the electro-magnet 160, to the spring 159, through the cylinder 157 to the axle 156 to the spring 155 and thence to the battery 154.

Hence, it is evident that a weak current of electricity will flow through the coils of the electro-magnet 160 and the string 161 will be sounded with a soft tone.

If the front end of the key 10 is struck with a somewhat harder blow the vertical wire 32 will be moved more swiftly upward and the lever 79 will acquire so much kinetic energy during its initial movement by the pad 71 that it will move in a counter-clockwise position from the position shown in Fig. 3 to a position which will bring the head 91 in contact with the head 109 of either the last contact pin or an intermediate contact pin, so that there will be less of the resistance coil 162 included in the electric circuit than when the front end of the key 10 is softly depressed. Consequently a stronger current of electricity will flow through the coils of the electro-magnet 160 and the spring 161 will sound with a louder tone. Hence, it is evident that the amount of resistance in the electric circuit depends upon the speed with which the front end of the key 10 is depressed; consequently, the strength of the electric current flowing through the coils of the electro-magnet 160 also depends upon said speed, and furthermore, the amplitude of vibration of the string 161 also depends upon said speed.

When the lever 79 is moved around as just described, it is prevented from returning by the action of the eccentric surface 148 of the detent 147 upon the buckskin pad 83, said eccentric surface being held in contact with said buckskin pad by the pressure of the spring 153. Hence, it is evident since the lever 79 cannot return toward its initial position, that the spring 161 will continue to sound at a loudness determined by the speed by which the front end of the key was depressed.

When the front end of the key is permitted to rise, the vertical wire 32 and block 36 will move downwardly; this will bring the pad 70 into contact with the nose 149 of the detent 147 and bring the eccentric surface 148 out of contact with the pad 83. Then the pull of the spring 121 will bring the lever 79 to the position shown in Fig. 1. Furthermore, it is evident that if the front end of the key 10 is allowed to rise but slightly that the pad 69 on the arm 64 will move downwardly slightly, and allow the spring 72 to move out of contact with the bushing 98. Hence the circuit will be open and the string 161 will cease sounding, but the pad 70 will not move downward sufficiently to strike the nose 149. Consequently, the lever 79 will remain in the position to which it was moved by the first movement of the key 10; hence, if the key be again depressed, after it has been slightly released as just described, it is evident that the string 161 will again be sounded at the loudness determined by the speed of the first movement of said key. From this it follows that the speed of the first movement of the key determines the

loudness with which the string 161 sounds and that repetition notes can be rapidly sounded by allowing the front end of the key 10 to rise slightly and depressing same in rapid succession.

When the front end of the key is depressed, the block 17 and attached lever 27 will move upwardly to the position shown in Fig. 3, and by the full lines in Fig. 4. If now the front end of the key is released, said block and lever 27 will return to the position shown in Fig. 1, which return is occasioned by the pressure of the portion 52 of the spring 46 upon the pad 31 attached to the rear end of the lever 27. Said pressure normally keeps said rear end against the pad 21 on the rear end of the block 17.

However, it is sometimes desirable to sustain a note after the front end of the corresponding key is released, and this is accomplished as follows:

After the front end of the key is depressed, a pedal, (not shown), is depressed in order to move the rib 59 in direction of the arrow 163 in Figs. 3 and 4. This brings the end of said rib under the pad 30 on the front end of the lever 27; consequently, when the front end of the key is released, the lever 27 and block 17 cannot move downwardly, hence said note will continue to sound as long as said pedal is depressed, but the front end of the key will rise and the rear end of the key will drop to the position shown in Fig. 1, owing to the weight of the rear end of said key.

Other keys being depressed after the rib 59 is moved into the position shown in Fig. 4, the pads 30^a on the front ends of the levers 27^a corresponding to said keys will strike the rib 59, and the upward movement of the blocks similar to 17 corresponding to the levers 27^a will move said levers into the position shown dotted in Fig. 4, and the corresponding springs 46^a will be moved into the position also shown dotted in said figures. Hence, any note can be sustained even though the front end of its corresponding key is released and this action does not interfere with the movement of the remaining keys.

In order to provide for a crescendo of a note that is sounding, a pedal is provided which is connected to the horizontal metallic bar 86 so that the depression of said pedal will swing said bar in a counter clockwise position, so that it will strike the pad 165 attached to the lever 79 and move said lever in a counter clockwise direction, thus decreasing the amount of resistance in circuit with the coils of the electro-magnet 160 and increasing the amplitude of vibration of the string 161.

In order to provide for a diminuendo of a note that is sounding, a pedal is provided which is connected to the horizontal metallic

bar 136 so that the depression of said pedal will swing said bar in a clockwise direction and cause it to strike the pad 150 attached to the detent 147 and move said detent in a clockwise direction so as to bring the eccentric surface 148 out of contact with the pad 83 attached to the lever 79, and then said lever 79 will move in a clockwise direction and increase the amount of the resistance 162 in circuit with the coils of the electro-magnet 160 and thus decrease the amplitude of vibration of the string 161.

The pedals and connection between the pedals for operating the rib 59 and the horizontal metallic bars 86 and 136 being old and well known in the art are not illustrated or described. The pedals connected, respectively, to the rib 59, the metallic bars 86 and 136, have analogous functions to the functions of the sostenuto, loud and soft pedals in the ordinary piano.

The pad 24 comes in contact with the lower surface of the rail 34 when the front end of the key is depressed and thus at all times limits the upward movement of the block 17. The pad 82 comes in contact with the top horizontal metallic bar 103 and limits the swing of the lever 79, whenever the front end of the key is very swiftly depressed. The pad 150 comes in contact with the horizontal metallic bar 126 and thus limits the clockwise movement of the detent 147.

Another method of operating my improved device is as follows:

If the pedal attached to the horizontal metallic bar 86 is depressed different distances, it is evident that the bar 86 will be moved through different arcs in a counter-clockwise direction, hence, the lever 79 and head 91 will be moved to different positions; if then, the front ends of the keys are struck, whether slowly or swiftly, the strings 161 will not vibrate to an amplitude depending upon the speed with which the key has been struck, but will vibrate to an amplitude depending upon the position to which the loud pedal has been moved, and as long as the loud pedal is held in said position, the depression of said keys will vibrate said strings to said amplitude.

In the variation shown in Fig. 7, the electrical features shown in Fig. 1 are omitted and the spring 72, flange 77, battery 154, shaft 156, cylinder 157, insulation 158, spring 159, magnet 160 and string 161 are similar to the structures above described, but the lever 79 is replaced by a lever 79^a which is the same as the lever 79 excepting that the arm 87, rearward extension 88, pin 90, spring 92, connector 95 and bushing 98 are omitted. The function of the bushing 98 is performed by a stationary contact 98^a. To the lever 79^a there is pivotally connected as at 167 a soft steel or iron wire 168; the

upper end of said wire passes loosely through and is guided by a bushing 169 provided in a cross piece 170 which is supported on the upper head 171 of a solenoid spool.

5 The solenoid spool consists of the upper head 171 and the lower head 172 both formed of insulating material and joined together by the insulating tube 173. Surrounding the wire 168, there are a plurality of short
10 lengths of soft iron or steel wire such as 174 confined within the insulating tube 175. The upper ends of said wires 174 being so located that when the nose 81^a and lever 79^a are moved upwardly to a position corresponding
15 to the position of the lever 79 and nose 81 in Fig. 3, then said upper ends will be in line with the bottom surface of the lower head 172. The outside diameter of the tube 175 is such that said tube does not touch
20 the inner surface of the tube 173.

Two superimposed coils 176 and 177 are wound upon the solenoid spool, insulation such as 178 being placed between said coils. The terminals of the inner coil 176 are connected
25 with the terminals of the electro-magnet 160 and the terminals of the outer coil 177 are connected respectively, to the contact 98^a and the spring 159.

The operation of this form of my device
30 is as follows:

When the nose 81^a is moved upwardly by a slow depression of the front end of the key, the spring 72 will be moved upwardly to touch the contact 98^a. When this happens
35 a pulsating current of electricity flows through the outer coil 177, this will induce a feeble pulsating current of electricity in the coil, 176 and the circulation of said current in the coils of the electro-magnet 160
40 will feebly vibrate the string 161. Said vibrations will be of small amplitude because of the small mutual inductance of the coils 176 and 177.

When the front end of the key is more
45 swiftly depressed the nose 81^a will move farther around in a counter clockwise direction and this will move the soft iron or steel wires 174 up within the tube 173 and thus increase the mutual inductance of the
50 coils 176 and 177, and increase the strength of the induced current flowing through the coils of the electro-magnet 160.

Hence, the string 161 will be vibrated with an amplitude depending upon the speed
55 with which the front end of the key is depressed. The rib 59 and metallic rods 86 and 136, and all other parts used in connection with the parts shown in Fig. 7, are the same as those shown in Fig. 2. In addition
60 to the parts already noted as being omitted from the lever 79, there are also omitted the metallic bars 103, the rail 105, the contact pin shown in Fig. 5 and the resistance 162.

I claim:—

65 1. The combination of selecting means, a

vibrating body, electrically excited means for vibrating said body, a source of electricity, an electric circuit including said electrically excited means and said source, and means for determining the strength of the current of electricity in said circuit, said strength depending upon the speed of said selecting means.

2. The combination of selecting means, a vibrating body, electrically excited means
75 for vibrating said body, a source of electricity, an electric circuit including said electrically excited means and said source, means for determining the strength of the current of electricity in said circuit, said
80 strength depending upon the speed of said selecting means, and means for afterward varying said strength.

3. The combination of keys, strings, a source of electricity for vibrating said
85 strings, and means for varying the force derived from said source and applied to said strings, the force depending upon the speed of said keys, and continuing uniform at will during the time said keys are held down.

4. The combination of keys, strings, a source of electricity for vibrating said
90 strings, means for varying the force derived from said source and applied to said strings, the force depending upon the speed of said
95 keys, and continuing uniform at will during any part of the time said keys are held down, and means for varying said force while said keys are held down.

5. The combination of keys, sounding
100 bodies, a source of electric power, means energized thereby for continuously vibrating said sounding bodies, and means for varying the force of said means to vary the amplitude of vibration of said sounding bodies depending upon the speed of said keys.

6. The combination of keys, sounding
105 bodies, a source of electric power, means energized thereby for continuously vibrating said sounding bodies, means for varying the force of said means to vary the amplitude of vibration of said sounding bodies depending upon the speed of said keys, and means for afterward varying said amplitude at the will of the operator.

7. The combination of a vibrating body, a source of electricity, a magnet for actuating said vibrating body energized by said source, a key and means operated by said key to vary the amount of energy applied to said
115 vibrating body, the amount depending upon the speed of said key.

8. The combination of a key, a source of electricity, an electric circuit, means moved by said key for varying the strength of the current in said circuit, the strength depending upon the speed of said key and a vibrating body, and means activated by said current for vibrating said body.

9. The combination of a key, a source of 118

electricity, an electric circuit, means moved by said key for varying the strength of the electric current in said circuit, the strength depending upon the speed of said key, and a contact maker operated by said key for closing said circuit, near the end of the movement of said key, whereby said contact maker can be moved by said key to open said circuit without varying the position of said means.

10 10. The combination of a key, a circuit closer, contacts, a contact maker moved by said key and adapted to engage any one of said contacts, the one depending upon the speed of said key, and an electric circuit

including said contacts and contact maker and terminating at the contact surfaces of said circuit closer, said circuit closer being moved by said key near the limit of the movement of said key.

11. The combination with a key, a vibrating body, and means for producing vibrations therein varying in amplitude with the speed of movement of said key, of means acting in combination with said first named means for continuing said vibrations at said amplitude after said key has been released and returned to its normal position.

In testimony whereof I affix my signature.
JOHN W. DARLEY, JR.