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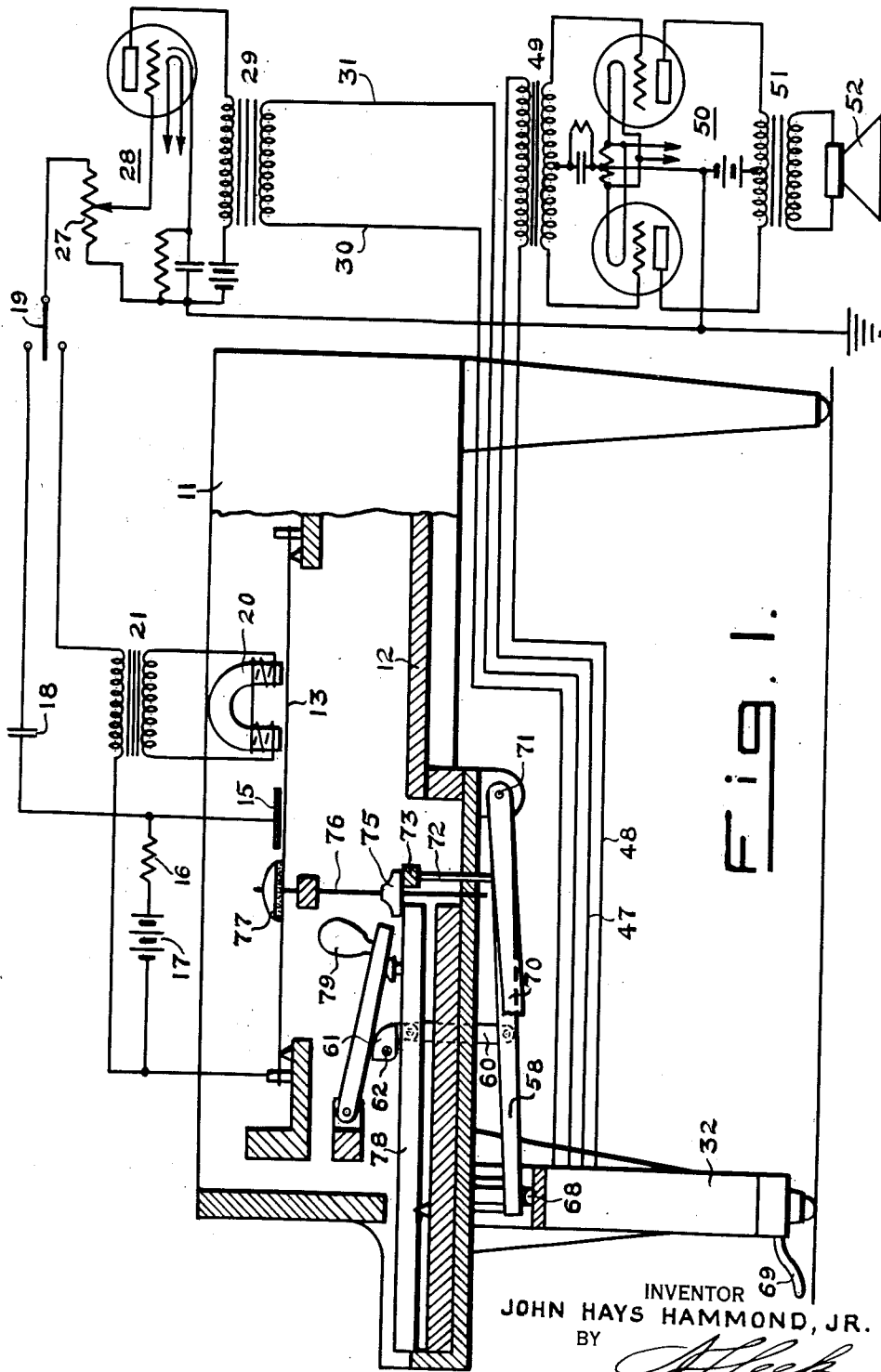
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2,297,829

ELECTRIC PIANO WITH PEDAL CONTROL

Filed May 12, 1940

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

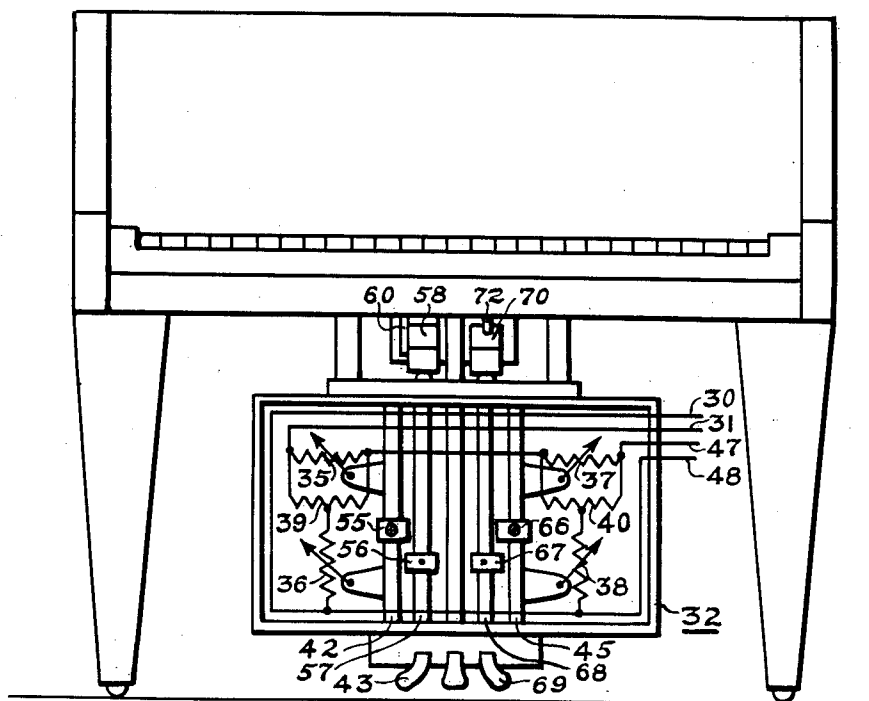


Fig. 2.

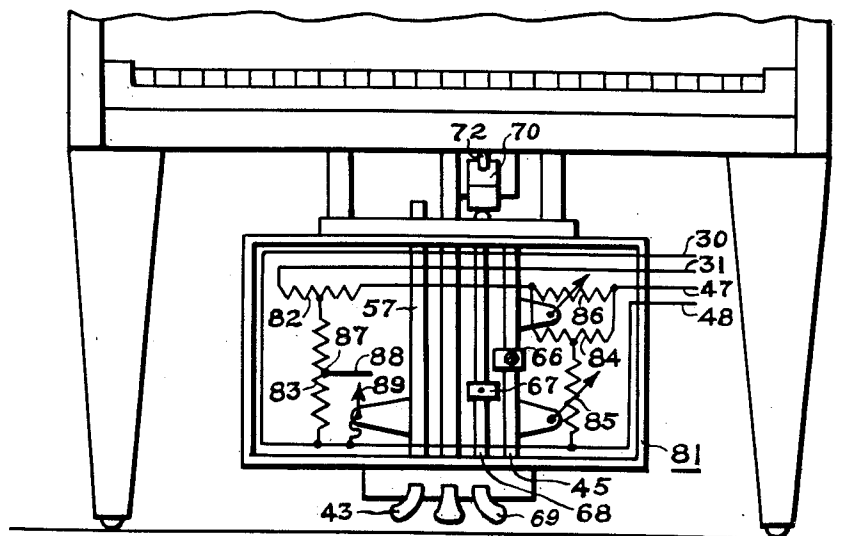


Fig. 3.

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3 Sheets-Sheet 3

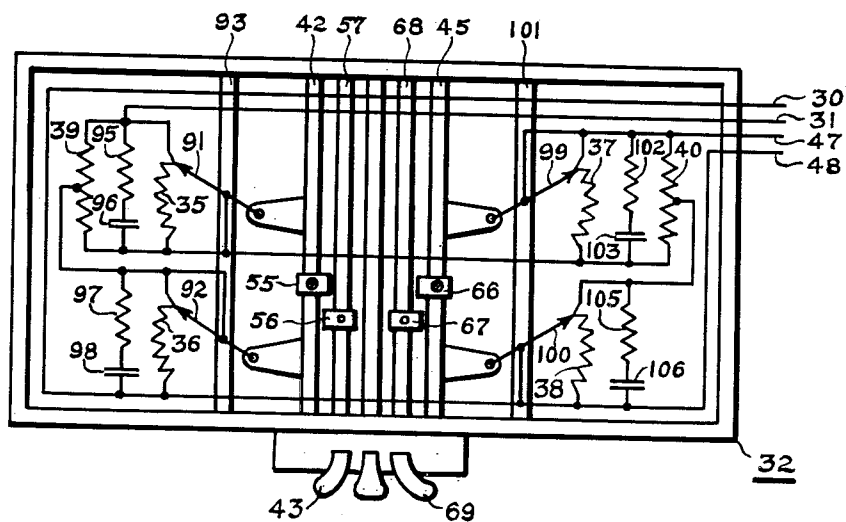


Fig. 4.

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ELECTRIC PIANO WITH PEDAL CONTROL

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9 Claims. (Cl. 84-1.27)

This invention relates to musical instruments and more particularly to a pedal operated volume control for an electronic piano. This application is a continuation in part of my co-pending application, Serial Number 199,792, filed April 4, 1938, for Electronic piano with pedal control.

The invention provides means for picking up energy from vibrating portions of the instrument, amplifying this energy, increasing the amount of amplification by the operation of a pedal or decreasing the amount of amplification by the operation of a second pedal and reproducing this energy as audible sound.

The vibratory energy may be picked up either electrostatically, or electromagnetically from the strings of the piano or other vibrating portion thereof. The loud-speaker for reproducing the sound may be mounted entirely independent of the piano or it may be mounted in the piano, either separately or attached to the sound board to produce regeneration as may be desired.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description, taken in connection with the accompanying drawings forming a part thereof, in which:

Figure 1 is a side elevation of a standard grand piano illustrating one embodiment of the invention, with parts broken away to show the construction;

Figure 2 shows an end elevation of the piano illustrated in Figure 1;

Figure 3 is a view similar to Figure 2 illustrating a modified form of pedal operated volume control; and

Figure 4 illustrates a modified form of the attenuation circuits.

Referring to the embodiment of the invention shown in Figures 1 and 2, a piano 11 is shown as provided with the usual sound board 12 and electrically grounded metallic strings 13. Mounted adjacent to the strings 13 is a capacity pick-up, which in the form shown comprises a plate 15 which is connected through a resistor 16 and a battery 17 to the grounded strings and thru a condenser 18 to one point of a two position switch 19. The plate 15 may extend across all

the strings or a separate plate or other metallic device may be used for each note, or for any selected group of notes and may be made adjustable if desired. The energizing circuit may be varied in accordance with standard practice. A representative circuit has been shown by way of illustration only.

Mounted adjacent to each string 13 or each group of strings is an electromagnetic pick-up 20. All of these pick-ups 20 may be connected either in series or in parallel to the primary of a transformer 21, the secondary of which is connected between the second point of the switch 19 and ground. The switch 19 permits the capacity pick-ups 15 or the electro-magnetic string pick-ups 20 to be utilized according to the effect desired.

The blade of the switch 19 is connected thru a potentiometer 27 to the input circuit of a pre-amplifier 28 of standard construction. While only one stage of amplification is shown in the pre-amplifier 28 it is to be understood that several stages may be used if found desirable, especially in connection with the capacity pick-up 15.

The pre-amplifier 28 is connected thru a transformer 29 to two conductors 30 and 31 which are connected to an attenuator 32, see Figure 2. In the embodiment shown this attenuator is formed in two sections of the bridged T type comprising four variable resistances 35, 36, 37 and 38 and two fixed center tapped resistances 39 and 40. The controls of the variable resistances 35 and 36 are connected to a rod 42, and the controls of the variable resistances 37 and 38 are connected to a rod 45.

The output side of the attenuator 32 is connected by two conductors 47 and 48 to the primary of a transformer 49 (Figure 1) the secondary of which is connected to the input circuit of a power amplifier 50 of standard construction. The output circuit of this amplifier 50 is connected thru a transformer 51 to a loud-speaker 52.

The rod 42, which is slidably mounted in the frame work of the piano 11, is provided with an adjustable lug 55 (Figure 2) which at suitable times is engaged by a second lug 56 attached to a rod 57, which is operated by the usual soft pedal 43.

The soft pedal action may be of standard type. In the embodiment shown, the upper end of the rod 57 engages a lever 58 which is pivoted for rotation at 71 (Figure 1). The lever 58 is connected to one end of a link 60, the other end of

which is connected to one of a series of cam shaped members 61 which fit between the keys 78 and which are rigidly mounted on a rod 62. The rod 62 is rotatably mounted in the frame work of the piano 11.

It is to be understood that the invention is also applicable to pianos having other types of soft pedal action such as means to shift the hammers laterally with respect to the strings or groups of strings.

The rod 45 which is slidably mounted in the framework of the piano is provided with an adjustable lug 66 (Figure 2) which cooperates with a second lug 67 attached to a rod 68 which is operated by the usual loud pedal 69. The loud pedal action may also be of any standard type. As shown, the upper end of the rod 68 engages a lever 70 which is pivoted for rotation at 71 (Figure 1). The lever 70 engages a rod 72 to the upper end of which is attached a bar 73 extending across the full width of the piano. The bar 73 engages a plurality of collars 75 which are attached to rods 76 to the upper ends of which are attached dampers 77, which normally rest upon the strings 13. The piano action, including the keys 78 and hammers 79, is of any standard construction and is not set forth in detail herein. The pedal 69 may constitute the usual loud pedal or sustenuto pedal and is not restricted to the specific embodiment shown. In the operation of this system either of the two pick-ups 13 and 15 may be used by moving the switch 19 into the first, or second position, thus connecting the pre-amplifier 28 to the electrostatic pick-ups 15, or the electromagnetic pick-ups 20. It will be understood that certain pick-ups may be used for a selected range of piano notes and others for other notes and that they may be combined, amplified and mixed in any well known manner.

When the piano is played, energy from the selected pick-up is fed thru the potentiometer 27 to the pre-amplifier 28 where it is amplified and fed thru the attenuator 32 to the power amplifier 50. From the power amplifier 50 the energy is fed to the loud-speaker 52 where it is reproduced as audible sound in the usual manner.

With the pedals 43 and 69 in their normal positions, the potentiometer 27 may be adjusted to provide an average normal amplification corresponding to the normal playing volume of the piano without the use of any of the pedals. If it is desired to decrease the volume of sound below the normal level, the soft pedal 43 is depressed which, by means of the rod 57, raises the lever 58. This raises the link 60 which causes the cam shaped members 61 to be rotated in a counterclockwise direction, thus lifting all the hammers 79 an amount dependent upon this rotation. In this way the travel of the hammers 79 is decreased thus producing the well known pianissimo effect. The cam shaped members 61 are so formed that during the first part of their motion the hammers will be lifted, after which any further rotation will not affect the position of the hammers.

If the pedal 43 is further depressed beyond the position of maximum hammer control the lug 56 will engage the lug 55 thus lifting the rod 42 which operates the variable resistances 35 and 36 in a direction to increase the former and decrease the latter. This will decrease the amount of energy passing from the transformer 29 to the transformer 49 thereby causing a decrease in the volume of sound produced by the loud speaker 52. The nature of the attenuator is such, how-

ever, as to maintain a constant impedance between these transformers as the attenuation is varied. In this way the volume of sound produced by the loud speaker 52 may be diminished in proportion to the amount the soft pedal 43 is depressed.

In the embodiment of the invention shown in Figures 1 and 2, the standard soft pedal action of the piano and the electrical sound reproducing system act successively so as to decrease the total volume of sound produced by the instrument below the sound intensity level which is normally obtained by the soft pedal action.

If it is desired to increase the volume of sound above the normal level, the loud pedal 69 is depressed thereby elevating the rod 68 which in turn rotates the lever 70 in a clockwise direction about the point 71. This action, by means of the rod 72, elevates the bar 73 which engages all of the collars 75 thereby lifting all of the dampers 77 from the strings 13 to produce the well known fortissimo effect.

This effect is obtained prior to contact between the lugs 66 and 67. If the pedal 69 is further depressed the lug 67 will engage the lug 66, thereby elevating the rod 45 which operates the variable resistances 37 and 38 to decrease the former and increase the latter. This allows more energy to pass from the transformer 29 to the transformer 49, but maintains a constant impedance between these transformers.

In this way the volume of sound produced by the loudspeaker may be increased in proportion to the amount the loud pedal is depressed, the electrical control acting subsequently to the loud pedal action of the piano to increase the total volume of sound produced by the instrument above the sound intensity level which could be attained by the usual loud pedal action.

Referring to the modified form of the invention shown in Figure 3 the conductors 30 and 31 are connected to an attenuator 81 which comprises three fixed resistances 82, 83 and 84 and two variable resistances 85 and 86. The output side of the attenuator 81 is connected to the two conductors 47 and 48.

The fixed resistance 83 is provided with a tap 87 which is connected to a fixed contact 88, which cooperates with a movable contact 89 carried by the rod 57, which in turn is operated by the soft pedal 43. The controls of the variable resistances 85 and 86 are connected to the rod 45, which is operated by the loud pedal 69 as described in connection with Figure 2. In this form of the invention the standard soft pedal action is eliminated.

In the operation of the modified form of the invention shown in Figure 3, when it is desired to decrease the volume of sound below the normal level the soft pedal 43 is depressed, thereby causing the movable contact 89 to engage the fixed contact 88 thus short circuiting part of the resistance 83. This decreases the amount of energy passing from the transformer 29 to the transformer 49. In this way the volume of sound produced by the loud-speaker 52 may be diminished a predetermined amount when the soft pedal 43 is depressed.

If it is desired to increase the volume of sound above the normal level, the loud pedal 69 is depressed to actuate the loud pedal action and variable resistances 85 and 86 in a manner similar to that described in connection with Figures 1 and 2. The attenuators may be of any standard type for decreasing and increasing the amount of en-

ergy transferred from the transformer 29 to the transformer 49.

While in the form of the invention shown the mechanical operation is produced first followed by the electrical operation, it is to be understood that this order of procedure may be varied as desired by changing the positions of the adjustable lugs 55 and 56 the length of the rod 72 and the shape of the cam members 61. In this way, the mechanical and electrical operations may occur simultaneously or the electrical operation may precede the mechanical operation if desired.

In certain instances it may be desirable to change the frequency transmission characteristics of the line so as to produce different effects on the different frequencies in a manner well known in the art. For example, the ratio of the high to the low frequencies may be varied with volume to accentuate the base notes at high volume and to accentuate the treble notes at low volume or vice versa as may be desired.

These results may be accomplished by the use of the modified attenuator circuits shown in Figure 4. In these circuits the rod 42 operates the variable resistances 35 and 36 the movable contact arms 91 and 92 of which are pivotally mounted on a vertical member 93. Bridged across the variable resistance 35 and the fixed resistance 39 is a resistance 95 and a condenser 96 in series and bridged across the variable resistance 36 is a resistance 97 and a condenser 98 in series. The rod 45 operates the variable resistances 37 and 38 the movable contact arms 99 and 100 of which are pivotally mounted on a vertical member 101. Bridged across the variable resistance 37 and the fixed resistance 40 is a resistance 102 and a condenser 103 in series and bridged across the variable resistance 38 is a resistance 105 and a condenser 106 in series.

In the operation of the attenuator shown in Figure 4 when the rod 42 is elevated by the depression of the soft pedal 43 the contact arms 91 and 92 are rotated in a counter-clockwise direction thus increasing the resistance of the variable resistance 35 and decreasing the resistance of the variable resistance 36 which increases the attenuation of the attenuator 32. As the attenuation is increased a greater proportion of the high frequencies is allowed to pass thru the filter net work thus changing the frequency characteristics with the attenuation.

When the rod 45 is elevated by the operation of the loud pedal 69 the contact arms 99 and 100 are rotated in a clockwise direction thus decreasing the resistance of the variable resistance 37 and increasing the resistance of the variable resistance 38 which decreases the attenuation of the attenuator 32. As the attenuation is decreased a greater proportion of the low frequencies is allowed to pass thru the filter net work producing the opposite effect to that produced when the soft pedal 43 is depressed.

Although only a few of the various forms in which this invention may be embodied have been shown herein, it is to be understood that the invention is not limited to any specific construction but may be embodied in various forms without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a piano, a vibrating element, an electrical pick-up device connected to receive energy therefrom, a sound reproducing device, a transmission channel interconnecting said pick-up device and said sound reproducing device, and at-

tenuation control means comprising a variable impedance network interposed in said transmission channel, said network being variable to control the attenuation of said channel and including means to maintain a substantially constant total impedance in said transmission channel, and manual control means to actuate said attenuation control means.

2. In a piano, a vibrating element, an electrical pick-up device connected to receive energy therefrom, a sound reproducing device, a transmission channel interconnecting said pick-up device and said sound reproducing device, and attenuation control means comprising a variable impedance network interposed in said transmission channel, said network being variable to control the attenuation of said channel and having means to vary the frequency transmission characteristics of said channel in accordance with the attenuation.

3. In a piano, a vibrating element, an electrical pick-up device connected to receive energy therefrom, a sound reproducing device, a transmission channel interconnecting said pick-up device and said sound reproducing device, and attenuation control means comprising a variable impedance network interposed in said transmission channel, said network being variable to control the attenuation of said channel and having means to vary the frequency transmission characteristics of said channel in accordance with the attenuation in a manner to discriminate against the low frequencies when the attenuation is high and to discriminate against high frequencies when the attenuation is low.

4. In a piano having a vibrating element, an electrical pick-up device connected to receive energy therefrom, a sound reproducing device, a transmission channel interconnecting said pick-up device and said sound reproducing device, and variable volume control means adapted to vary the transmission characteristics of said channel, separate loud and soft pedals connected respectively to actuate said volume control means from an intermediate position corresponding to normal piano volume to increase and decrease respectively the volume of the reproduced sound.

5. The invention set forth in claim 6 in which the piano action includes hammers adapted to actuate said strings and the soft pedal action includes means for decreasing the throw of said hammers when said soft pedal is depressed.

6. In a piano having a piano action including vibrating strings, a soft pedal action, a soft pedal actuating the same, a loud pedal action, a loud pedal actuating the same, an electrical pick-up device connected to receive vibratory energy from said piano, a sound reproducing device, a transmission channel interconnecting said pick-up device and said sound reproducing device, said transmission channel normally having transmission characteristics suited to the normal playing of the piano without actuation of either the loud or the soft pedal, independent volume control means associated with said transmission channel to increase and decrease respectively the transmission characteristics thereof and means associated with the loud and soft pedal actions respectively to actuate said volume control means whereby depression of the loud and soft pedals increases or decreases respectively both the mechanical and the electrical sound propagating characteristics of the piano.

7. In the invention set forth in claim 6, means associated with said loud and soft pedal actions

to cause mechanical actuation of said actions prior to the electrical control of said transmission channel, whereby the transmission characteristics of said channel are altered only after the standard soft and loud pedal mechanical action of the piano has taken effect.

8. In the invention set forth in claim 6, means associated with said loud and soft pedal actions respectively to actuate said electrical control means prior to the actuation of the mechanical loud and soft pedal actions, whereby the trans-

mission characteristics of said channel are altered prior to the change in the mechanical action of said piano.

9. In the invention set forth in claim 6, means to control the frequency transmission characteristics of said channel and means actuating said last means in accordance with said transmission control means, whereby the frequency and the volume are varied in a predetermined related manner.

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