United States Patent

[11] 3,600,497

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[33] Great Britain
[31] 1727/66
Continuation-in-part of application Ser. No. 608,148, Jan. 9, 1967, now abandoned.

[54] **ELECTROMECHANICAL TRANSDUCER PICK-UP BRIDGES FOR STRINGED MUSICAL INSTRUMENTS**
4 Claims, 33 Drawing Figs.

[52] U.S. Cl. 84/1.14, 84/DIG. 24
[51] Int. Cl. G10h 3/00
[50] Field of Search 84/1.14-1.16

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Primary Examiner—Milton O. Hirshfield
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ABSTRACT: A piezoelectric pickup bridge for capturing the vibrations of a stringed musical instrument and comprising two parts separated by a resilient pad, the upper part carrying an adjustable screw that transmits vibrations to a transducer. A tone and volume compensating circuit for a sound amplifier connected to said transducer and comprising resistances and capacitances for selectively boosting or attenuating high or low frequencies and simultaneously maintaining substantially constant the overall gain of the system.

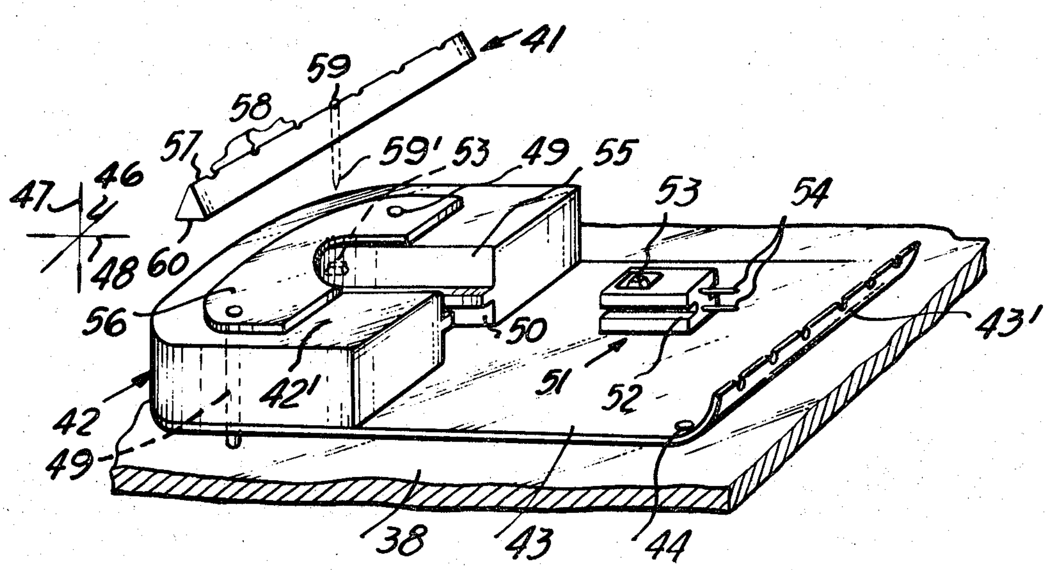


FIG. 1

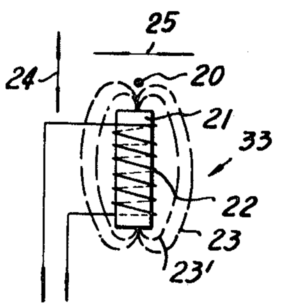
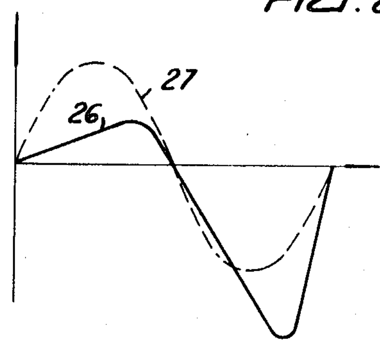


FIG. 2



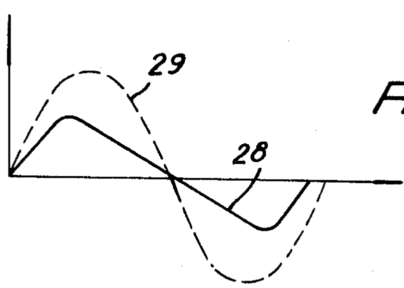


FIG. 3

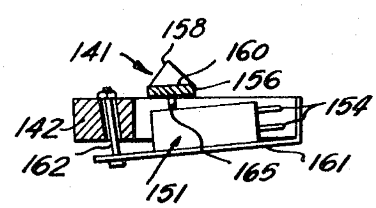


FIG. 7

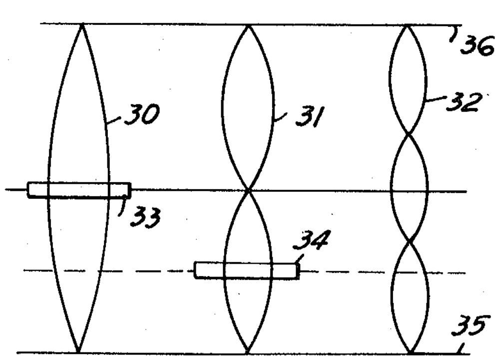


FIG. 4A FIG. 4B FIG. 4C

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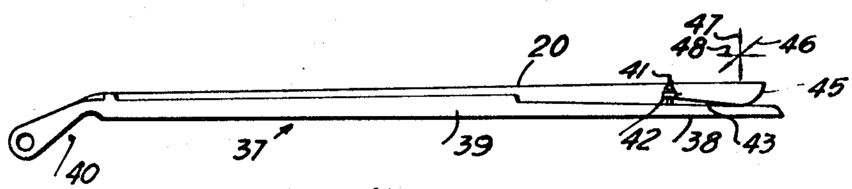


FIG. 5

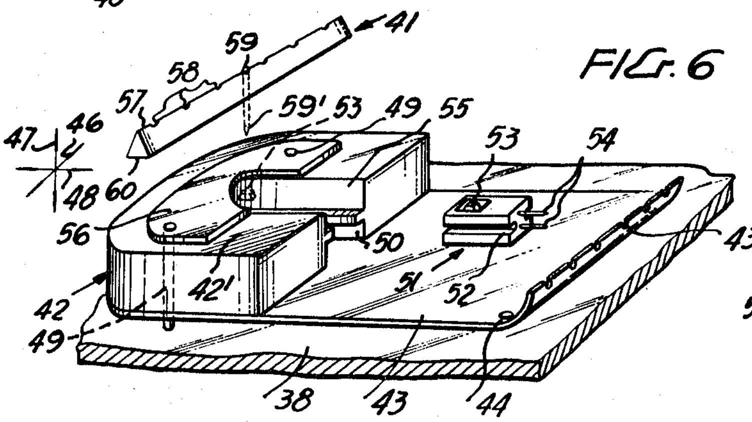


FIG. 6

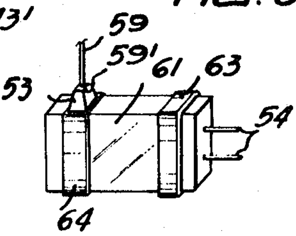
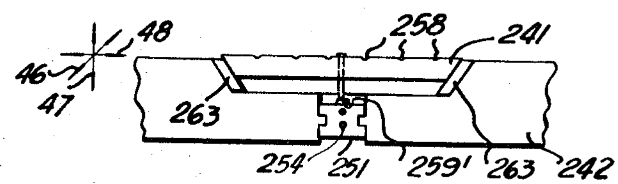


FIG. 6A

FIG. 8



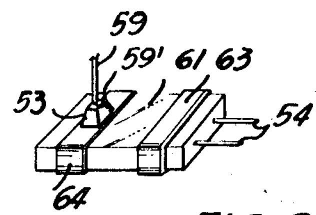
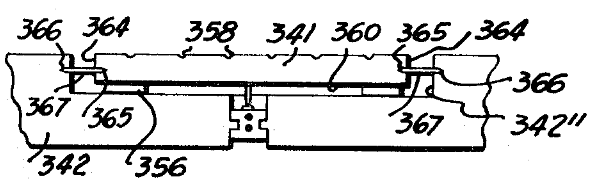


FIG. 6B

FIG. 9



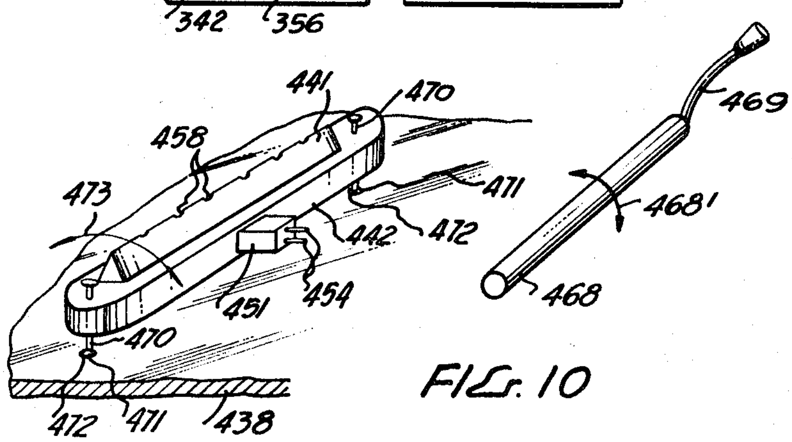


FIG. 10

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FIG. 11

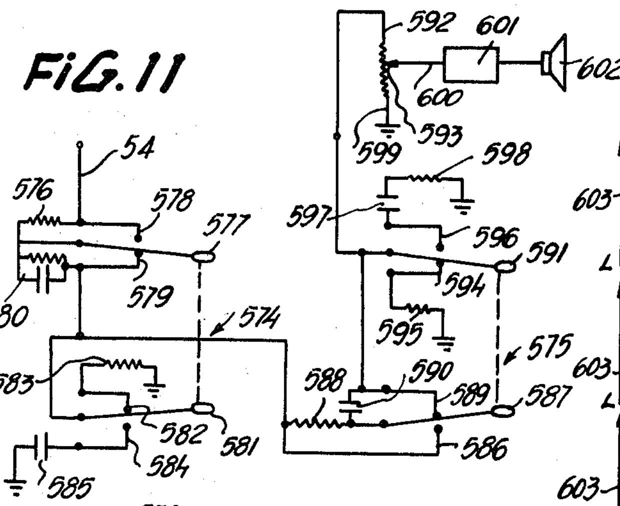


FIG. 13

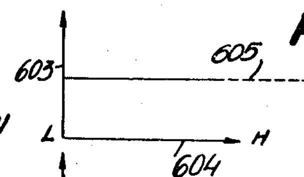


FIG. 12

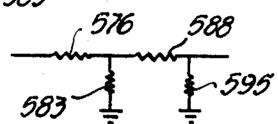


FIG. 15

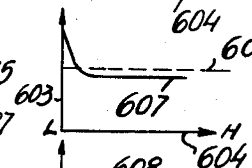


FIG. 17

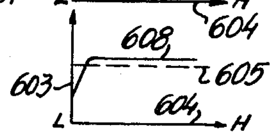


FIG. 14

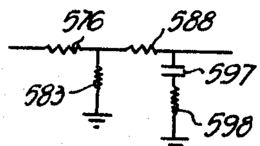


FIG. 19

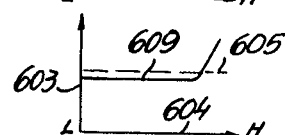


FIG. 21

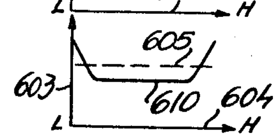


FIG. 16

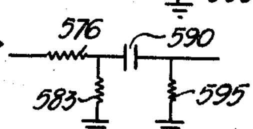


FIG. 23

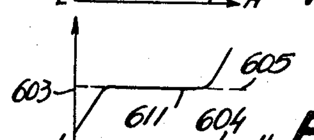


FIG. 18

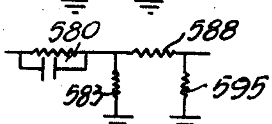


FIG. 25

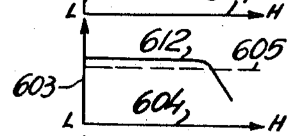


FIG. 20

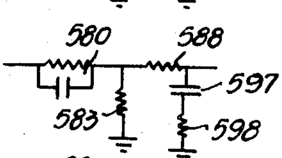


FIG. 27

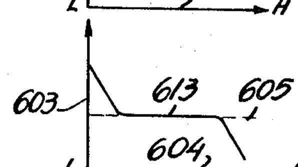


FIG. 22

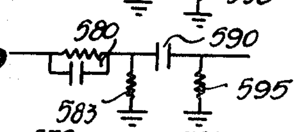


FIG. 29

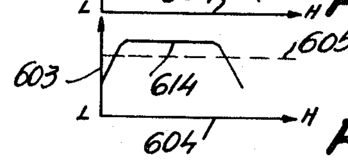


FIG. 24

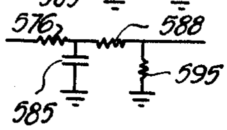


FIG. 26

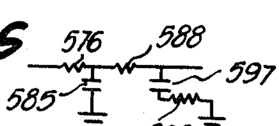
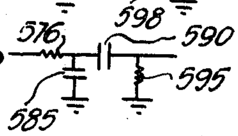


FIG. 28



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ELECTROMECHANICAL TRANSDUCER PICK-UP BRIDGES FOR STRINGED MUSICAL INSTRUMENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Pat. application Ser. No. 608,148 filed Jan. 9, 1967, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to improvements in stringed musical instruments and more particularly it refers to an instrument where in addition to the resonant box, an electromechanical capturing device is provided, for directly capturing the vibrations of the strings from a particular bridge arrangement. If desired said resonant box may be replaced by said electromechanical capturing device.

The expression "stringed musical instrument" intends to cover all kinds of musical instruments, where strings are used to produce the sound, and includes the percussion instruments such as, for instance, the piano where a hammer strikes the steel wires, said hammer being operated from a keyboard, the plucked instruments such as, for instance, a guitar where the strings are plucked to enter in vibrations and finally those stringed instruments where a bow is drawn across the strings to produce the vibrations, such as a violin.

2. Description of the Prior Art

In these last years magnetic pickups for guitars and the like instruments have been widely used and the sound reproduction thereof may immediately be detected as belonging to such an instrument and which sound is not the equivalent of the sound produced by pertinent traditional instruments.

SUMMARY OF THE INVENTION

It is an aim of the present invention to achieve a sound reproduction which is substantially equivalent to that of the traditional instrument.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to provide a better comprehension of the present invention, it is considered advisable to first explain a number of concepts concerning the known electromagnetic pickups, and to facilitate the explanation thereof, reference will be made to the accompanying drawings, wherein besides of the above-mentioned known electromagnetic pickups several embodiments of the present invention are shown by way of example.

FIG. 1 is a schematic layout of a simplified electromagnetic arrangement for a stringed musical instrument of which only one string is shown.

FIGS. 2 and 3 are graphs representing the output of the electromagnetic pickup as a function of the vertical and horizontal vibration, respectively, of the string of FIG. 1.

FIGS. 4A, 4B and 4C are graphs illustrating the vibration of the string in its fundamental, second and third harmonic vibrating moods, respectively.

FIG. 5 is a schematic side elevation of a guitar including the features of the present invention.

FIG. 6 is an exploded perspective view of a first embodiment of a capturing device in accordance with the present invention which embodies the bridge as schematically shown in FIG. 5.

FIG. 6A is a schematic perspective view of the piezoelectric element, mounting and vibration receiving nose of a conventional monoaural cartridge for use with the present invention.

FIG. 6B is a schematic perspective view of the piezoelectric element, mounting and vibration receiving nose of a further possible conventional monoaural cartridge for use with the present invention.

FIG. 7 is a schematic side elevation with certain portions shown in longitudinal section of an alternative embodiment of the bridge arrangement with regard to the one shown in FIG. 6.

FIG. 8 is a schematic end view of still another embodiment of the present invention, as far as the bridge arrangement is concerned.

FIG. 9 is a schematic end view of a further alternative embodiment of the present invention, as far as the bridge arrangement is concerned.

FIG. 10 is a schematic perspective view of a bridge arrangement to be used when the instrument is provided with means for achieving a "wower" effect.

FIG. 11 is a diagram of a preferred circuit arrangement including compensating tone and volume control means with associated selector switch means.

FIG. 12 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11, to obtain a flat attenuated response.

FIG. 13 is a graph of such a flat attenuated response.

FIG. 14 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11, to obtain a frequency response, where low frequencies are boosted.

FIG. 15 is a graph of such a boosted low frequency response.

FIG. 16 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11, to obtain a frequency response, where low frequencies are attenuated.

FIG. 17 is a graph of such an attenuated low frequency response.

FIG. 18 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11 to obtain a frequency response, where high frequencies are boosted.

FIG. 19 is a graph of such a boosted high frequency response.

FIG. 20 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11 to obtain a frequency response, where low and high frequencies are boosted.

FIG. 21 is a graph of such a boosted low and high frequency response.

FIG. 22 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11 to obtain a frequency response, where low frequencies are attenuated and high frequencies are boosted.

FIG. 23 is a graph of such an attenuated low frequency and boosted high frequency response.

FIG. 24 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11, to obtain a frequency response, where high frequencies are attenuated.

FIG. 25 is a graph of such an attenuated high frequency response.

FIG. 26 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11, to obtain a frequency response, where low frequencies are boosted and high frequencies are attenuated.

FIG. 27 is a graph of such a boosted low frequency and attenuated high frequency.

FIG. 28 is a circuit diagram showing a particular connection which may be achieved by the circuit arrangement shown in FIG. 11, to obtain a frequency response, where low and high frequencies are attenuated.

FIG. 29 is a graph of such an attenuated low and high response.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Since the electromagnetic capturing devices are generally used in guitars, reference will now be made to a guitar having, as is well known, a bridge and a neck and usually six strings, and the electromagnetic capturing devices being arranged between the bridge and the neck.

In the embodiment shown in FIG. 1, the cross section of one paramagnetic string 20 is shown, below which an electromagnetic capturing device 33, comprising a magnetic core 21 and a coil 22, is situated. As will be obvious to those skilled in the art, magnetic core 21 will be surrounded by a magnetic field, schematically represented by lines of force 23 and 23'.

Upon actuating paramagnetic string 20, it vibrates substantially according to the vertical direction identified by double arrow 24 and according to a horizontal direction represented by double arrow 25.

Considering one cycle of vertical vibration (arrow 24) of paramagnetic string 20, the electromagnetic force induced in coil 22, represented in FIG. 2 by curve 26, is distorted with regard to the mechanical vibration of the string, represented by dotted curve 27. The distortion represented by curves 26 and 27 in FIG. 2 is due to the nonlinear response of the electromagnetic pickup and more particularly due to the fact that its response is proportional to the square of the gap between string 20 and magnetic core 21.

Considering one cycle of the horizontal vibration (arrow 25) of paramagnetic string 20, the electromagnetic force induced in coil 22, represented in FIG. 3 by a curve 28, is distorted with regard to the mechanical vibration of the string ; represented by dotted curve 29, because also in this case, when string 20 vibrates according to arrow 25, a variation in the gap takes place.

It will be evident that upon plucking string 20 it substantially vibrates simultaneously according to double arrows 24 and 25 and thereby the mechanical vibrations are the geometric sum of dotted curves 27 and 29 and the output will be the geometric sum of curves 26 and 28, which is quite different from the mechanical vibrations and thereby the sound reproduction is not a true reproduction of the mechanical vibrations of the string. This is the reason why an electromagnetic pickup is unable to achieve a true sound reproduction originated from the mechanical vibration.

The electromagnetic sound reproduction arrangements have further drawbacks, as will now be explained in connection with FIGS. 4A, 4B and 4C.

Upon plucking string 20 which is capable of vibrating between lines 35 and 36, representing for instance, the bridge and the neck, respectively, the string will carry out different oscillations and more particularly the fundamental oscillation 30 as shown in FIG. 4A, plus the harmonic contents, more particularly the second harmonic represented by oscillations 31 (FIG. 4B), the third harmonic represented by oscillations 32 (FIG. 4C), and so on. If only one capturing device 33, positioned halfway between bridge line 35 and neck line 36 is used (FIG. 4A), the former will only be able to capture the fundamental oscillation 30 and any odd harmonics, such as third harmonic 32, but will not be able to capture for instance the second harmonic 31 for which an additional capturing device 34 is required, as is already known by those skilled in the art. However, this second capturing device 34 is again unable to capture all the even harmonics and therefore additional capturing devices are necessary if further even harmonics are to be captured. In practice good quality electromagnetic guitars have usually four capturing devices. From the foregoing it is apparent, if only one capturing device is used, a poor reproduction of the sound is achieved and if the number of capturing devices is increased, the quality of reproduction will be better, since more harmonics are detected. However each harmonic is again captured with substantially the same distortions as explained in connection with FIGS. 2 and 3. Furthermore, it is to be borne in mind, that the use of several capturing devices is more expensive and since they are usually connected in series, the inoperativeness of one will render the whole instrument inoperative.

Furthermore, electromagnetic pickups are unable to reproduce wide frequency response, since they are usually high impedance devices and therefore the distributed capacitance of the coil as well as its associated capacitance, tend to attenuate high frequencies.

It is an aim of the manufacturers of stringed musical instruments to capture the mechanical vibrations as truthfully as possible, in order to achieve good sound. I have realized that all the vibrations of the strings can be collected at the bridge by a single capturing device, provided that the bridge is suitably modified to swing or oscillate in accordance with the vibrations of the string(s) which is operated.

The first aspect which had to be studied was the way the type of vibrations are produced when a string is actuated; the second aspect consisted in studying the best way of capturing those vibrations. This second aspect had to be related to the first aspect in such a manner that the means for capturing the vibrations would actually be able to truthfully capture all the vibrations, if desired.

As may be seen in FIG. 5, a guitar 37 is shown having a body portion 38, a finger board 39 including at one end the peg box 40. Since FIG. 5 is a side elevation, only one string, which is again identified by reference number 20, is shown and the explanations will all be made in connection with said string, although a guitar has usually six strings and each string will behave in a similar manner.

The bridge arrangement, which is a particular feature of the present invention, is shown in more detail in FIG. 6, but with regard to FIG. 5, it may be stated that said bridge has a top portion 41 and a bottom portion 42, which is mounted on a plate 43 rigidly connected by means of screws 44 to the body portion 38. The plate 43 has an upstanding end portion 43' to which one end of the string 20 is attached, as indicated by reference number 45, while the other end of the string is attached in the traditional way to the peg box 40. It will be appreciated that upon plucking string 20, if the instrument is for said string a guitar, said string will vibrate in three directions, as identified by double arrows 46, 47 and 48, and the purpose of the present invention is to make it possible that all these vibrations be captured, if it should so be wished.

To this end, as may be better appreciated from FIG. 6, the bottom portion 42 of the bridge is rigidly attached to plate 43, but may be adjusted in height with regard to the body portion 38 by means of a pair of height adjustment screws 49 arranged at the opposite end with regard to screws 44. This adjustability is desirable, because each player may wish to adjust the height existing between the strings 20 and the finger board 39.

The bottom portion 42 is preferably somewhat U-shaped, defining in a recess 55 a pair of guide channels 50, which enables the insertion of an electromechanical transducer, for instance a cartridge 51, having to this end a pair of corresponding guide ribs 52 (only one visible in FIG. 6). Cartridge 51 may be a conventional piezoelectric device of the monoaural or stereo type depending whether all three possible perpendicular vibrations are to be captured or whether one or more may remain undetected, as will be more fully explained further on. Cartridge 51 is a conventional cartridge from which the needle member has been removed whereby it has a projecting nose 53 hereinafter called "input." Furthermore, cartridge 51 has a pair of connecting pins 54, hereinafter called "output."

To better describe the possible cartridges for use in the present invention, it is to be noted that generally three types are commercially available. Two of these three types are for monoaural sound while the third type is for stereo. The first two mentioned types are provided with a piezoelectric element which produces an electric signal when bent or twisted. This piezoelectric element is generally of parallelepipedic shape and can be positioned so that nose 53 rests against one end portion of one of the larger surfaces or against one end portion of one of the longer narrower surfaces.

In this connection, and to more fully understand this, reference will now be made to FIGS. 6A and 6B. In FIGS. 6A and 6B the first two of the three above-mentioned types of commercially available cartridges are schematically represented. Both in FIGS. 6A and 6B only those parts necessary for an understanding of this description have been schematically represented; the remaining components are well known to those skilled in the art so no further description or illustration thereof is believed necessary. Three commercially available cartridges, of the type referred to are Electrovoice Model 103; Ronette Model DC500 and Astatic Model C2A respectively.

The piezoelectric element of a cartridge is generally a parallelepipedic member 61 held stationary at one end by means of a bracket 63 and having its other end freely movable with respect thereto. Nose 53 is generally kept in contact with member 61 by means of a plastic harness 64. In general, two possible positions exist for nose 53. A first position is that illustrated in FIG. 6A while a second possible position has been illustrated in FIG. 6B. If a cartridge having a piezoelectric element 61 with an input 53 in position shown in FIG. 6A is used then, as will be obvious to those skilled in the art, only the component of the vibrations perpendicular to the plane of the larger surfaces and which are applied to input 53 will produce an electric signal at 54. However, if a cartridge having a piezoelectric element 61 with an input 53 in the position shown in FIG. 6B is used, then, the three perpendicular components of the vibrations can produce a signal at output 54. Both the described types of cartridges are known, so that it is merely a question of selecting the appropriate one for the particular use which is desired.

When the cartridge 51 is inserted in the recess 55 of the bottom portion 42, the input 53 will be located in the position as shown in dotted lines in said recess 55. A resilient pad 56 is attached to the top surface 42′ of the bottom portion 42. Depending on the degree of resiliency of said pad, different outputs may be achieved through the cartridge 51, as will be later better understood.

The top portion 41 of the bridge has in this embodiment a substantially triangular cross section, the vertex 57 of which has six slots 58 for the strings (not shown in FIG. 6) and a vibration transmitting and adjustment screw 59 screwed in and passing through the top portion 41, in such a way that the head of the screw 59 is accessible from the upper portion, while the opposite end of said screw is a substantially pointed end, as identified by reference numeral 59′, projecting out of base wall 60.

It is to be understood that when reference is made in this specification and appendant claims to a "pointed end," the scope of these words is to be interpreted as also encompassing a flat end of reduced surface area.

When the top portion 41 is mounted on the bottom portion 42, as shown in FIG. 5, the end portions of the base wall 60 rest on the resilient pad 56, while the middle portion faces the recess 55, whereby the substantially pointed end 59′ positively abuts with more than just frictional contact on the input 53, thereby establishing a link between the cartridge input 53 and the top portion 41 of the bridge capable of transmitting vibrations therethrough. In practice, a pointed contact is preferred although good results are achieved by providing a small flat surface in planar contact with input 53. In both cases, a micrometric study of this vibration transmitting contact will reveal that input 53, due to it being generally of resilient material, is slightly deformed by the end 59′ of screw 59 when in vibration transmitting contact therewith.

In practice, the strings of the guitar are stretched across the top portion 41 with the screw 59 in withdrawn position so that it does not enter in contact with input 53. Thereafter, the strings are tuned and once this has been accomplished, the screw 59 is set to establish the optimum contact with the input 53, so as to be able to transmit in a substantially point or fulcrumlike manner the vibrations in the three directions as identified by double arrows 46, 47 and 48.

Since the end portion of the base wall 60 of the top portion 41 of the bridge are resting on the resilient pad 56, upon playing the guitar, the vibrations of the strings will be transmitted to the resiliently supported top portion 41 and therefrom through the tapered end 59′ of screw 59 to the input 53 of cartridge 51.

If cartridge 51 is of the monoaural type, such as illustrated in FIG. 6A, only the vibrations according to double arrow 46 will be reflected at the output 54, but if cartridge 51 of the type illustrated in FIG. 6B is used, then the vibrations according to double arrows 46, 47 and 48 will be reflected at the output. If the cartridge 51 is of the stereo type, then, only those vibrations according to double arrows 46 and 47 will be reflected at the output. In this case, the vibrations according to double arrow 48 hardly produce any output at 54 and therefore they can be considered as nonexistent.

While in the embodiment just described, the link is a vibration transmitting and adjustment screw 59, it will be evident that in the cheaper embodiment the same effect can be achieved by providing the top portion 41 with an integral tapered projection.

Furthermore, it is not a fundamental requirement that the pointed end 59′ projects out of the base wall 60, but may project out of any other part of the top portion 41 as long as the input 53 is in front of the tapered end.

In the embodiment illustrated in FIG. 7—wherein the same reference numerals have been used but with the prefix "100"—top portion 141 is provided with an integral pointed projection 165 which is functionally equivalent to screw 59, although for height adjustment purposes cartridge 151 is mounted on a supporting plate member 161 fixed at one end to the bottom portion 142 of the bridge, while the other end is provided with a height adjustment screw and nut arrangement 162 to carry out similar adjustments as were provided by the screw 59.

In the instruments so far described, the base wall 60, 160 rests by its end portions on the resilient pad 56, 156 and thereby a certain dampening effect is achieved in the vertical direction, as identified by double arrow 47, which may be desirable in many cases. However, it will be obvious that if the resilient pad 56 is arranged in a different position, that the dampening effect in connection with the two directions as identified by double arrows 46, 47 may be varied. For instance, in the embodiment of FIG. 8,—where the same reference numerals have been used but preceded by the prefix "200"—the bottom portion 242 has a pair of spaced apart pads 263 arranged at 45° with regard to the horizontal and the end portions of top portion 241 are likewise bevelled and rest on these pads 263, whereby an approximately equal resiliency is achieved in the two directions as identified by arrows 46 and 47.

In some cases, it may be desirable to completely bar the capturing of the vibrations according to the direction represented by one of the arrows 46, 47 or 48. For instance, it can be conceived that in a piano, which is a percussion instrument, it may be only desirable to pickup the vibrations according to double arrow 47. In this event, the embodiment of FIG. 9 could be used—wherein the same reference numerals have been employed but preceded by the prefix "300"—. The bottom portion 342 has a recess 342″ with spaced apart resilient pads 356 on which the top portion 341 is mounted. The end walls 364 have each a V-shaped recess 365 and which face opposite V-shaped recesses 366 in the bottom portion 342. A double ridge-shaped blocking member 367 is arranged inbetween each pair of V-shaped recesses 365 and 366, thereby achieving the desired effect. In this case, and in accordance with what has been stated above, a cartridge 51 of the type illustrated in FIG. 6B can be used. If the arrangement of V-shaped recesses 365 and 366 and double ridge-shaped blocking member 367 would be located between the base wall 360 and the top surface 342′, vibrations in the direction as identified by double arrow 46 will only be picked up. In this case, and in accordance with what has been stated above, a cartridge 51 of the type illustrated in FIG. 6A can be used.

In all the embodiments so far described, the bottom portion 42, 142, 242, 342 is always rigidly connected to the body portion 38 of the instrument. There are, however, some plucking instruments, particularly amongst the so-called electric guitars, where the end of the string identified by reference numeral 45 in FIG. 5 is mounted on a "wower" tail piece consisting for instance, as schematically shown in FIG. 10—wherein the same reference numerals have been used but with the prefix "400"—of a cylinder member 468 journaled in pertinent bearings (not shown) which enable, by means of a lever 469, to rotate cylinder member 468 in the two directions as indicated by double arrow 468', to vary the tension of the strings. In order to avoid that there is a sliding movement of the strings, in the slots 458 at the bottom portion 442 is mounted on a pair of rocking screws 470, so that their ball-shaped heads 471 may rock in pertinent recesses 472 of the body portion 438 of the instrument, as schematically illustrated by double arrow 473.

If it is desired to obtain an independent output for each string (or for different groups of strings, such as in a piano), it will be obvious that the top portion 41, 141, 241, 341, 441 can be divided into as many sections as there are slots 58, 158, 258, 358, 458 each facing one pertinent cartridge with the corresponding link.

Considering now the sound reproduction of the vibrations captured by the device of the present invention, the connecting pins 54 defining the output have to be connected to an amplifier and a loudspeaker arrangement. According to tests and marketing researchers carried out, it has proved, that it is highly advisable to provide compensating tone and volume control means in-between the output 54 and the amplifier. (To avoid any possible confusion, the description will be started with reference numeral 574—FIG. 11). The compensating tone and volume control means basically comprises two, two-way three-position selector switches 574, 575, as well as resistor and capacitor elements whose interconnection with the terminals of two-way three-position selector switches 574 and 575 will hereinbelow be described.

One of the connecting pins 54 is connected to ground (not shown in FIG. 11), while the other one (shown in FIG. 11) is connected by a first resistor 576 to a first movable contact 577 of two-way three-position selector switch 574; furthermore, said other connecting pin 54 is also connected to a first stationary contact 578 of two-way three-position selector switch 574. A second stationary contact 579 is connected to first movable contact 577 through a parallel R–C circuit 580. Second stationary contact 579 is also connected to second movable contact 581 of two-way three-position selector switch 574; this second movable contact 581 has a third stationary contact 582 connected to ground through a second resistor 583 and a fourth stationary contact 584 connected to ground through a first capacitor 585.

Furthermore, second movable contact 581 is connected directly to a fifth stationary contact 586 and to a third movable contact 587 through a third resistor 588. Third movable contact 587 is connected to a sixth stationary contact 589 through a second capacitor 590. Sixth stationary contact 589 is connected directly to fourth movable contact 591 and to one terminal 592 of a volume control 593 to which reference will be made later on.

Seventh stationary contact 594 is connected to ground through a fourth resistor 595; while eighth stationary contact 596 is connected to ground through a third capacitor 597 connected in series with a fifth resistor 598.

Referring once again to volume control 593, its free stationary terminal 599 is connected directly to ground, while its sliding contact terminal 600 is connected to the input of an amplifier 601, whose output is connected to a loudspeaker arrangement 602.

While in the traditional tone control systems any variation of frequency response is unavoidably associated with a variation in the gain, the purpose of the arrangement disclosed in FIG. 11 is to overcome this drawback by compensating the gain accordingly with the variation of the frequency response.

With the circuit of FIG. 11, nine preferred possibilities will now be described.

I. When the two-way three-position selector switches 574 and 575 are in the position illustrated in FIG. 11, the resulting circuit is the one illustrated in FIG. 12, wherefrom it may be appreciated that the arrangement includes an interconnection of resistors, thereby producing an attenuated flat response which, according to FIG. 13, is represented by the following system.

The ordinate 603 represents the relative output, while the abscissa 604 represents the range of frequencies between low (L) and high (H) frequencies. The dotted line 605 represents a reference level which in FIG. 13 agrees with the frequency curve response 606.

The hereinbefore explained system of ordinate 603, abscissa 604 and level 605 will also be used in FIGS. 15, 17, 19, 21, 23, 25, 29.

II. Upon moving fourth movable contact 591 towards eighth stationary contact 596, seventh stationary contact 594 becomes disconnected, thereby eliminating fourth resistor 595 from the circuit and interconnecting third capacitor 597 and fifth resistor 598 with fourth movable contact 591, thus establishing the circuit illustrated in FIG. 14. In this event, as shown in FIG. 15, the low frequencies will be boosted, while the medium and high frequencies will be lowered in level with respect to the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 607.

Before making reference to FIGS. 14 to 29, it should be pointed out that each circuit will be described starting again from the position of both two-way three-position selector switches 574, 575, as illustrated in FIG. 11.

III. Upon moving third movable contact 587 towards fifth stationary contact 586, sixth stationary contact 589 becomes disconnected, thereby short-circuiting third resistor 588 and introducing second capacitor 590 into the circuit, thus establishing the circuit illustrated in FIG. 16. In this event, as shown in FIG. 17, the low frequencies will be attenuated, while the medium and high frequencies will be boosted in level with respect to the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 608.

IV. Upon moving first movable contact 577 towards first stationary contact 578, first resistor 576 is short-circuited while R–C circuit 580 is introduced in the circuit, thus establishing the circuit illustrated in FIG. 18. In this event, as shown in FIG. 19, the high frequencies will be boosted, while the medium and low frequencies will be attenuated in level with respect to the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 609.

V. Upon moving first movable contact 577 towards first stationary contact 578 and fourth movable contact 591 towards eighth stationary contact 596, a combination of what has been described in connection with FIGS. 14 and 18 is achieved. In this event, as shown in FIG. 21, the low and high frequencies will be boosted, while the medium frequencies will be attenuated in level with respect to the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 610.

VI. Upon moving first movable contact 577 towards first stationary contact 578 and third movable contact 587 towards fifth stationary contact 586, a combination of what has been described in FIGS. 16 and 18 is achieved. In this event, as shown in FIG. 23, the low frequencies are attenuated and the high frequencies are boosted, while the medium frequencies are maintained at the same level as the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 611.

VII. Upon moving second movable contact 581 towards fourth stationary contact 584, second resistor 583 becomes disconnected, while first capacitor 585 is connected into the circuit, thus establishing the circuit illustrated in FIG. 24. In this event, as shown in FIG. 25, the high frequencies will be attenuated while the medium and low frequencies will be boosted in level with respect to the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 612.

VIII. Upon moving fourth movable contact 591 toward eighth stationary contact 596 and second movable contact

581 towards fourth stationary contact 584, a combination of what has been described in connection with FIGS. 14 and 24 is achieved. In this event, as shown in FIG. 27, the low frequencies are boosted and the high frequencies are attenuated, while the medium frequencies are maintained at the same level as the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 613.

IX. Upon moving third movable contact 587 towards fifth stationary contact 586 and second movable contact 581 towards fourth stationary contact 584, a combination of what has been described in connection with FIGS. 16 and 24 is achieved. In this event, as shown in FIG. 29, the low and high frequencies will be attenuated, while the medium frequencies will be boosted in level with respect to the reference level 605, in such a way that the overall gain of the system will be maintained substantially constant, as is apparent from curve 614.

Obviously, if only certain of the hereinbefore described changes are desired, the unrequired part of the circuit of FIG. 11 may be eliminated.

From the foregoing it is evident that when using the present invention, the strings need not to be paramagnetic strings since no electromagnetic field is required for capturing the vibrations of the strings; diamagnetic strings provide better sound qualities.

Although several embodiments of the invention have been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the design and arrangement of the parts without departing from the spirit and scope of the invention, as the same will now be understood by those skilled in the art.

I claim:

1. A bridge for a stringed musical instrument, said bridge comprising a bottom portion and a top portion, resilient means supporting said top portion upon said bottom portion for vibratory movement of the former in at least one of three perpendicular directions, said bottom portion including an electromechanical transducing cartridge having an input and an output, and means defining a pointed end on said top portion, said pointed end establishing a point contact with said cartridge input, said point contact transmitting to said cartridge input any vibratory movement provided by said top portion.

2. A bridge according to claim 1, wherein said means defining a pointed end is rigidly connected to said top portion.

3. A bridge for a stringed musical instrument, said bridge comprising a U-shaped bottom portion defining a free space, an electromechanical transducing cartridge housed within said free space, a resilient pad secured to said bottom portion, and a top portion of triangular cross section, the base of which rests upon said resilient pad for vibratory movement of the former in at least one of three perpendicular directions, said top portion including a vibration transmitting and adjusting screw having a pointed free end extending into said free space and establishing a point contact with said cartridge to transmit any vibratory movement thereto provided by said top portion and the vertex of said top portion having slots defined therealong for receiving the strings of the instrument.

4. A bridge for a stringed musical instrument, said bridge comprising a bottom portion and a top portion resilient means supporting said top portion upon said bottom portion for vibratory movement of the former, at least one blocking member arranged between said bottom portion and said top portion to dampen the vibrations in at least one of the three possible perpendicular directions of the vibratory movement, said bottom portion including an electromechanical transducing cartridge having an input and an output, and a projection rigidly connected to said top portion and defining a pointed end establishing a point contact with said cartridge input for transmitting thereto any vibratory movement provided by said top portion.