Dec. 10, 1963 A. ZANESSI 3,113,990

STRINGED MUSICAL INSTRUMENT

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Fig. 1

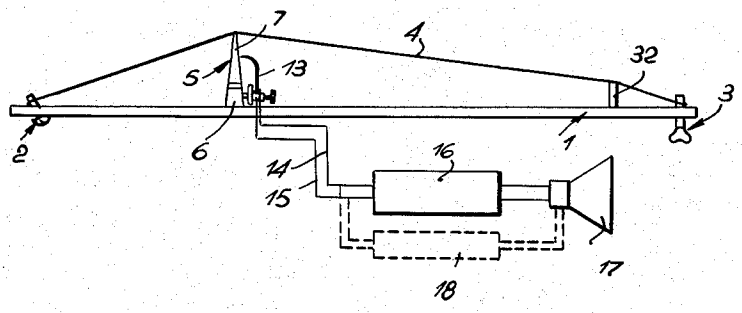


Fig. 2

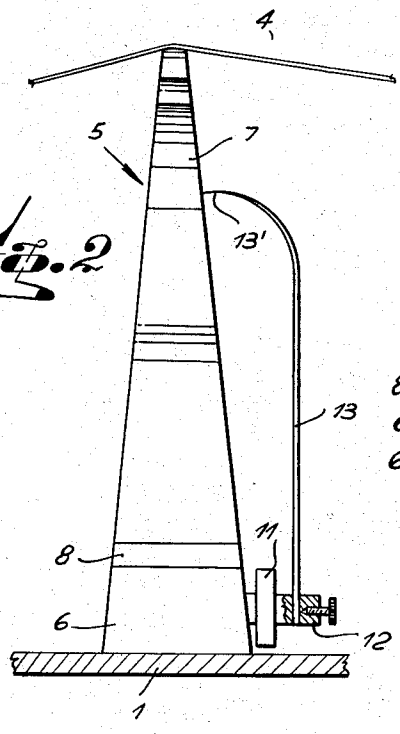


Fig. 3

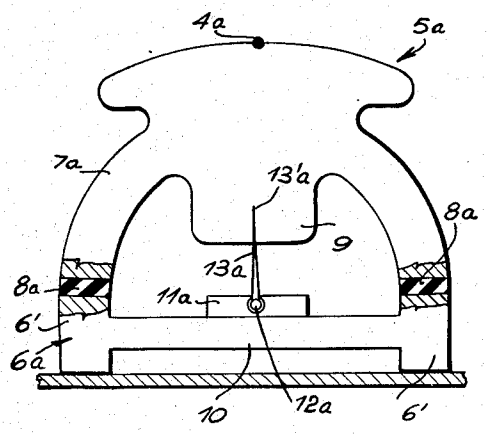
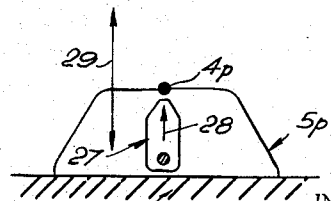


Fig. 6



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Fig. 4

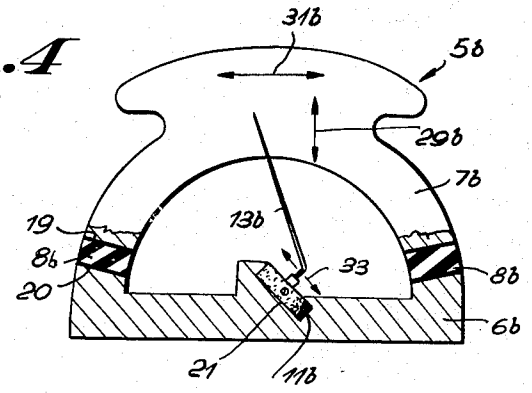
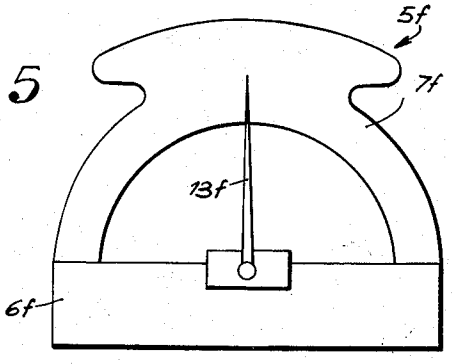


Fig. 5



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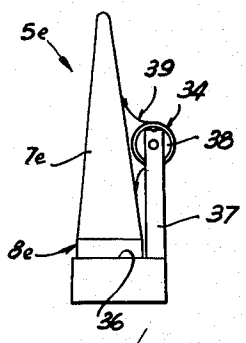


Fig. 9

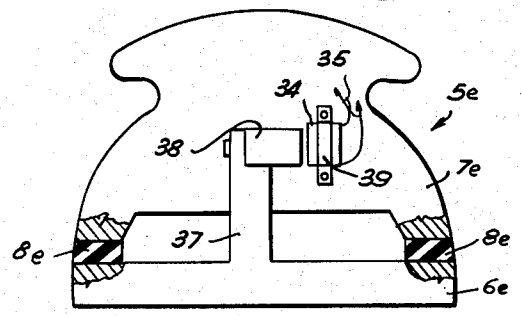


Fig. 8



Fig. 7

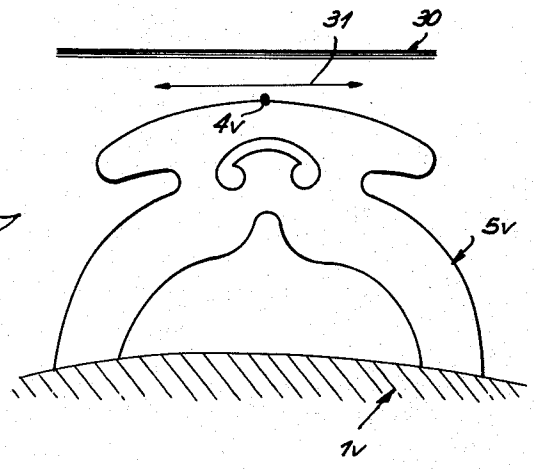
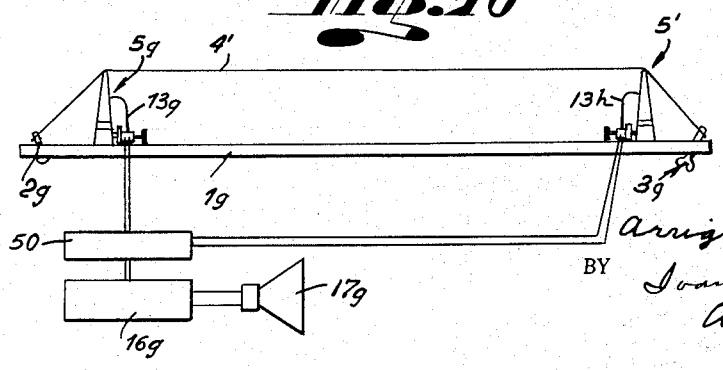


Fig. 10



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3,113,990

STRINGED MUSICAL INSTRUMENT

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Filed Jan. 13, 1959, Ser. No. 786,507
23 Claims. (Cl. 84—1.16)

The present invention relates to a stringed musical instrument and more particularly it refers to an instrument where the resonant box has been replaced by an electronic capturing device for directly capturing the vibrations of the string and transmitting them through an amplifier arrangement, optionally having a filter, to a loudspeaker arrangement.

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.

The art of building the different types of resonant boxes is well known to be one of the most difficult arts in order to achieve a good sound effect. The capture of the vibrations and the translation thereof into sound without distortion, and/or attenuation, require, for many instruments, that the resonant box be of peculiar and often large size, particularly in connection with low pitched stringed musical instruments such as, for instance, a contrabass.

A careful study of this art has shown that, with modern concepts, it is possible to replace this resonant box by an electronical arrangement and yet to reproduce exactly the same sound. The instrument may even have a larger field of applications if by means of filters certain captured vibrations are altered so that, for example, a contrabass can produce the music for a violincello.

To achieve such a result, the present invention comprises a stringed musical instrument having a support with at least one pair of spaced apart pegs, at least one bridge in between said pair of pegs, a string attached to said pair of pegs and stretched across said bridge, said bridge comprising of a base portion rigidly connected to said support and a top portion over which passes said string and which top portion resiliently rests on said base portion. For example, a rubber plug or the like can be inserted between the portions so that said top portion may carry out certain movements with regard to said base portion which are precisely the vibrations the string will perform. A feeler contacts said top portion for capturing mechanical vibrations porduced by said string, when operated; said mechanical vibrations are transmitted by said feeler to transducer means for converting said mechanical vibrations into electrical vibrations; an amplifying stage and optionally a filter stage and/or an altering stage connect said transducer means with loudspeaker means for converting said electrical vibrations into sound.

In order to facilitate the comprehension of the present invention, reference will now be made to several specific embodiments by way of example in relationship to the accompanying drawings, wherein:

FIG. 1 is a schematic side elevation of a stringed musical instrument, in accordance with the present invention.

FIG. 2 is a side view in larger scale of the bridge.

FIG. 3 is a front view of a modified form of the bridge.

FIG. 4 is a similar view as FIG. 3 of a slightly modified embodiment of the bridge.

FIG. 5 is a front view of still another embodiment of a bridge.

FIG. 6 is a schematic front view of a known piano arrangement which will facilitate the explanation of the theory of the invention.

FIG. 7 is a schematic front view of a known violin arrangement which may likewise be applied to a guitar arrangement, which will facilitate the explanation of the theory of the invention.

FIG. 8 is a front view of a bridge according to the present invention, wherein the feeler is not of the needle type.

FIG. 9 is an end view of FIG. 8.

FIG. 10 is a schematical side elevation similar to FIG. 1, but showing an instrument with two bridges.

The first aspect which had to be studied was the way the type of vibrations are produced when a string is operated; the second aspect consisted in studying the way of best 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 had to be applied in such a way to the instrument that when the vibrations are captured it would be assured that all the vibrations are captured.

More particularly a string when operated produces usually three types of vibrations of which a first one is perpendicular to the longitudinal axis of the string itself. The second type of vibration is parallel to the longitudinal axis of the string and the third type of vibrations is the relative lengthening and shortening of the string itself during the vibration.

This concept may however be analyzed, as far as the first two vibrations are concerned, from a different angle, as shown in FIGS. 6 and 7.

In FIG. 6 the case of a percussion insurment, such as a piano is shown, having a support **1***p*, a bridge **5***p* over which a string **4***p* passes and a hammer **27** will strike on the string **4***p* moving it upwardly in the direction shown by arrow **28**, whereby the string will carry out the principal vibration as indicated by double arrow **29**, which vibration is perpendicular to the axis of the string **4***p*.

In FIG. 7 the case of a violin is illustrated wherein again the support **1***v* is shown which forms part of the resonant box supporting a bridge **5***v* having a string **4***v* passing thereover. When a bow **30** (only schematically shown) is drawn across the string **4***v* the latter will carry out a principal vibration as shown by double arrow **31**, which vibration is again perpendicular to the longitudinal axis of the string **4***v*, but parallel to the support **1***v*, whilst in the case of the piano (FIG. 6) the vibration is likewise perpendicular to the support **1***v*.

The principal vibration as analyzed in connection with the violin in relationship with FIG. 7 also applies to a plucked string such as in the case of a guitar.

To capture all these vibrations it is best that this is done at the bridge of the instrument and therefore according to the present invention such a bridge is divided into two portions, namely a top portion and a base portion. The base portion is rigidly connected to a support while the top portion rests resiliently on the base portion to be able to vibrate with the string. There is then used a kind of a feeler which captures from the top portion those vibrations in the same way as does the needle of a pick-up of a phonograph.

The expression "feeler" is to be understood as referring to means for capturing vibrations and need not necessarily be a needle. Although in the preferred embodiments it will be seen that the feeler is a needle, in the embodiment as shown in FIG. 8 and which will be described later on, the capturing of the vibrations is carried out without such a needle.

Referring now to FIG. 1 an instrument is there shown consisting of a support **1**, which may be, for instance, a small board and which may have any suitable shape in

accordance with what is required by aesthetics and commodity. On this board **1** a stationary peg **2**, a bridge **5**, a stay **32** and a revolvable peg **3** are mounted and a string **4** is stretched across said bridge **5** and said stay **32**, as already known in the art, linked to the stationary peg **2** and the revolvable peg **3**, which latter enables the adjustment of the tension of the string **4**.

The portion between the bridge **5** and the stay **32** may, if the instrument is, for instance, an instrument to replace a violin, be the finger board.

As to the bridge itself, reference will now be made to FIG. 2, wherefrom it can be appreciated that the bridge **5** consists of a base portion **6** rigidly connected to the support **1** and a top portion **7** over the upper end of which passes the string **4**. Obviously, in practice the instrument will usuually have more than one string.

A pair of rubber plugs **8** is arranged between the top portion **7** and the base portion **6** which plugs resiliently support the top portion **7** on the base portion **6**, which top portion **7** remains in position due to the tension of the string **4**.

FIG. 3 shows a plan view of a bridge **5***a* similar to that of FIG. 2, the essential difference being that the needle which picks up the vibrations of the top portion **7** is longer in FIG. 3 than in FIG. 2. Referring to FIG. 3, the top portion **7***a* is an arc and has in its needle portion a downwardly depending tongue member **9**, the tongue member being spaced apart from cross member **10** which connects the outer legs **6'** of the base portion **6***a*. Rubber plugs **8***a* are interposed between the upper ends of legs **6'** and the lower ends of the arc of the top portion **7***a* and comprise in its middle portion a tongue member **9** which is spaced apart form a cross member **10** which links the outer blocks. On this cross member **10** a crystal **11***a* is mounted, such as those used in pick-ups, i.e. made of Rochelle salt, a ceramic component or quartz, which is related to a fastening means **12***a* for a needle **13***a* the free end **13***a'* of which bears against the top portion **7***a*. This needle **13***a* operates as a feeler to capture the vibrations to which the top portion **7***a* is subject to. A crystal **11** is mounted on the cross bar (not shown) of the bridge **5** of FIG. 2 and a needle **13** is secured to the crystal **11** by means of fastening means **12**, the free end **13'** of the needle contacting the top portion **7**.

It is evident that the shorter the feeler is in length, the larger the output signal will be and therefore the purity of the sound is low and the distortion is large. Therefore, whilst in FIG. 3 the free end **13***a'* contacts the tongue **9** and the needle **13***a* is a short feeler as contrasted to the needle **13** of FIG. 2 which is of larger length and therefore the latter will transmit a better sound.

The mechanical vibration which is captured by feeler **13** is transformed into an electrical vibration and transmitted through conductors **14**, **15** to an amplifier stage **16** to be finally transformed into sound by means of loudspeaker **17**. It will thus be understood that feeler **13** captures a mechanical vibration which through the crystal **11** or any other equivalent means, as will be later explained, is converted into an electrical vibration and therefore the crystal **11** is generically called a transducer means. The electrical vibration necessarily has to pass through an amplifier stage **16** in order to be passed to the loudspeaker **17**.

If it is desired to alter the qualities of the instruments as far as the sound reproduction is concerned, it is possible to locate, for instance, a filter stage **18** at the input of an amplifier stage **16**, such as indicated in dotted lines in FIG. 1, which enables by boosting or the attenuation of certain vibrations or transforming them into another type of vibration (by producing a certain amount of harmonics of subharmonics). It is evident to anybody skilled in the art, that instead of connecting the filter stage **18** at the input of the amplifier stage **16**, a similar result could be achieved by connecting said filter stage in between stages of the amplifier and since such a connection as such does not form part of the invention it is not necessary to illustrate it.

With regard to the capturing of the mechanical vibrations which are converted into electrical vibrations, it is pointed out that the whole spectrum of frequencies is captured which may be classified into three types of frequencies, namely, the principal frequencies, the subharmonic frequencies and the harmonic frequencies, as is well known by those skilled in the art and obviously the filter **18** may cut out or increase some of those three classes. In addition, the volume as well as the tone may likewise be modified at will.

It has been noticed that a better result is achieved if the bridge is built in accordance with FIG. 4, wherein the top portion **7***b* of the bridge **5***b* rests on the base portion **6***b*, by slightly towards the centre, inclined resting means such as defined by cuts **19** and **20** in between of which are fit the rubber plugs **8***b*. In this event, the crystal **11***b* is mounted on an inclined portion **21** of the base portion **6***b* and is further provided with the feeler **13***b*, so that all the vibrations are captured, more particularly the vibrations corresponding to double arrows **29***b* and **31***b* (compare FIGS. 6 and 7) which will produce a displacement in the direction of double arrow **33** in the pick-up system inasmuch as the direction **33** is obviously the resultant of the directions **29***b* and **31***b*. Thus, certain distortions are avoided.

Since the invention does not reside in the transducer means itself, it is considered unnecessary to refer in detail to more types of transducer means. However, it will be evident to anybody skilled in the art that the transducer means, for example, could be of the electromagnetic type such as by using a movable coil, a movable iron or the like.

For instance, in FIGS. 8 and 9, a bridge **5***e* is shown consisting of a top portion **7***e* supporting a coil **34**, the cables **35** of which are connected to an amplifying stage (not shown) as already described and a base portion **6***e* having a platform **36** on which rubber plugs **8***e* are mounted and an upwardly projecting arm **37** supporting a magnet **38** which is in functional relationship with the coil **34** and thus the vibrations are detected without a needle. It can, however, be considered that the coil **34** mounted by means of the bracket **39** on the top portion **7***e* of bridge **5***e* and the magnet **38** supported by the upwardly projecting arm **37** are likewise a feeler arrangement.

It will also be evident to those skilled in the art that it is not necessary that the bridge uses rubber plugs for resiliently supporting the top portion in the base **6***f* since it could be conceived, such as shown in FIG. 5, that the entire top portion **7***f* of the bridge **5***f* is made of a resilient material such as a suitable plastic or the rubber plugs could be replaced by any other suitable mechanical means which behave in a similar way. The top portion **7***f* is mounted on bottom portion **6***f*.

It is also possible, such as shown in FIG. 10 to provide an instrument having a support **1***g*, a stationary peg **2***g*, a revolvable peg **3***g*, a first bridge **5***g* and a second bridge **5'** instead of the stay **32** as shown in FIG. 1. In this case the string **4'** is stretched across bridges **5***g* and **5'**. The feeler and transducer **13***g* and **13***h* associated with bridges **5***g* and **5'**, respectively, are connected by their respective conductors to means **50** which in turn is connected to amplifier **16***g* to which is connected loudspeaker **17***g*. Means **50** connects both bridges **5***g* and **5'** together in phase or out of phase and also constitutes the means for selectively connecting either bridge to the amplifier. With this embodiment rather very special effects can be achieved by connecting both bridges **5***g* and **5'** together in phase or out of phase. The moment string **4'** is operated, its vibrations are transmitted to the two bridges **5***g* and **5'** at different instances and ampli-

tudes, so that it will be possible to obtain four different kinds of sound effects by connecting:

(*a*) Only bridge 5*g* through its stages to the amplifier 16*g* (see FIG. 1);

(*b*) Only bridge 5' through its stages to the amplifier 16*g*;

(*c*) Bridges 5*g* and 5' in phase through its stages to the amplifier 16*g*;

(*d*) Both bridges 5*g* and 5' out of phase through its stages to the amplifier 16*g*.

I claim:

1. A stringed musical instrument having a support with at least one pair of spaced apart pegs, at least one bridge in between said pair of pegs, a string attached to said pair of pegs and stretched across said bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string, means resiliently connecting said top portion to said base portion for vibratory movement in at least two directions substantially perpendicular to each other, a feeler contacting said top portion for capturing mechanical vibrations transmitted by said string, when operated, to said top portion and transducer means connected to said base portion for converting the mechanical vibrations of said feeler into electrical vibrations, and loudspeaker means connected to said transducer means for converting said electrical vibrations into sound.

2. A stringed musical instrument having a support with at least one pair of spaced apart pegs, a stay in between said pair of pegs, a bridge in between said stay and one of said pegs, a string attached to said pair of pegs and stretched across said bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string, means resiliently connecting said top portion to said base portion for vibratory movement in at least two directions substantially perpendicular to each other, a feeler contacting said top portion for capturing mechanical vibrations transmitted by said string, when operated, to said top portion and transducer means connected to said base portion for converting the mechanical vibrations of said feeler into electrical vibrations, and loudspeaker means connected to said transducer means for converting said electrical vibrations into sound.

3. A stringed musical instrument having a support with at least one pair of spaced apart pegs, at least one bridge in between said pair of pegs, a string attached to said pair of pegs and stretched across said bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string and means resiliently connecting said top portion to said base portion for vibratory movement in at least two directions substantially perpendicular to each other, a feeler contacting said top portion for capturing mechanical vibrations transmitted by said string when operated, to said top portion and transducer means connected to said base portion for converting the mechanical vibrations of said feeler into electrical vibrations, an amplifier stage connected to said transducer means, and a loudspeaker connected to said amplifier stage for converting said electrical vibrations into sound.

4. A stringed musical instrument as claimed in claim 3, wherein a filter stage is inserted between said transducer means and said loud speaker to alter the vibrations to be transmitted to the loudspeaker.

5. A stringed musical instrument comprising a support, at least one string mounted on said support, a bridge having a vibratory body portion contacting said string and receiving the vibrations therefrom, said body portion including spaced apart legs each resiliently supported by said support so that said body portion may vibrate in all directions, and coil mounted on said body portion and movable therewith, a transducer means including a magnet adjacent said coil, said transducer means converting

the mechanical movement of said coil into electrical vibrations.

6. A stringed musical instrument having a support with at least one pair of spaced apart pegs of which one peg is a revolvable peg, a bridge in between said pair of pegs, a string attached to said pair of pegs and stretched across bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string, a resilient plug mounted in between said top portion and said base portion for resiliently supporting said top portion for vibratory movement in at least two directions substantially perpendicular to each other, a pick-up arrangement mounted on said base portion and including a needle abutting against said top portion for capturing mechanical vibrations transmitted by said string, when operated, to said top portion, transducer means connected to said needle and said base portion for converting said mechanical vibrations into electrical vibrations, and loudspeaker means connected to said transforming means for converting said electrical vibrations into sound.

7. A stringed musical instrument having a support with at least one pair of spaced apart pegs of which one peg is a revolvable peg, at least one bridge in between said pair of pegs, a string attached to said pair of pegs and stretched across bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string, a resilient plug mounted in between said top portion and said base portion for resiliently supporting said top portion for vibratory movement in at least two directions substantially perpendicular to each other, a combined feeler and transducer arrangement including a magnet mounted on said base portion and a coil mounted on said top portion adjacent to said magnet for capturing mechanical vibrations transmitted by said string, when operated, to said top portion and transforming said mechancal vibrations into electrical vibrations and loudspeaker means connected to said transducer arrangement for converting said electrical vibrations into sound.

8. A stringed musical instrument having a support with at least one pair of spaced apart pegs, a pair of bridges in between said pair of pegs, a string attached to said pair of pegs and stretched across said pair of bridges, said bridges each comprising a base portion rigidly connected to said support and a top portion over which passes said string, means resiliently connecting said top portion to said base portion for vibratory movement in at least two directions substantially perpendicular to each other, a feeler contacting said top portion for capturing mechanical vibrations transmitted by said string, when operated, to said top portion and transducer means connected to said base portions for converting said mechanical vibrations into electrical vibrations, loudspeaker means for converting said electrical vibrations into sound and means for selectively connecting said transducer means to said loudspeaker means.

9. A stringed musical instrument as claimed in claim 8, wherein said means selectively connecting said transducer means to said loudspeaker means selectively connects either or both said transducer means to said loudspeaker means.

10. A stringed musical instrument as claimed in claim 8, wherein said means selectively connecting said transducer means to said loudspeaker means connects both transducer means in phase to said loudspeaker means.

11. A stringed musical instrument as claimed in claim 8, wherein said means selectively connecting said transducer means to said loudspeaker means connects both transducer means out of phase to said loudspeaker means.

12. A stringed musical instrument having a support with at least one pair of spaced apart pegs, a bridge in between said pair of pegs, a string attached to said pair of pegs, and stretched across said bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string, inclined

resting means on said base portion, said resting means being slightly inclined toward the center of the bridge, means resiliently supporting said top portion on said inclined resting means for vibratory movement in at least two directions substantially perpendicular to each other, a feeler contacting said top portion capturing mechanical vibrations transmitted by said string, when operated, to said top portion and transducer means connected to said base portion for transforming the mechanical vibrations of said feeler into eletcrical vibrations and loudspeaker means connected to said transducer means for converting said electrical vibrations into sound.

13. A stringed musical instrument having a support with at least one pair of spaced apart pegs, a bridge in between said pair of pegs, a string attached to said pair of pegs, and stretched across said bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string, inclined resting means on said base portion, said resting means being slightly inclined toward the center of the bridge and comprising rubber plugs fit in between said top and base portion for resiliently supporting said top portion for vibratory movement in at least two directions substantially perpendicular to each other, a feeler contacting said top portion for capturing mechanical vibrations transmitted by said string, when operated, to said top portion and transducer means connected to said base portion for converting the mechanical vibrations of said feeler into electrical vibrations, and loudspeaker means connected to said transducer means for converting said electrical vibrations into sound.

14. A stringed musical instrument having a support with at least one pair of spaced apart pegs, at least one bridge in between said pair of pegs, a string attached to said pair of pegs and stretched across said bridge, said bridge comprising a base portion rigidly connected to said support and a top portion over which passes said string inclined resting means on said base portion, said resting means being slightly inclined toward the center of said bridge and comprising rubber plugs in between said top and said base portion for resiliently supporting said top portion for vibratory movement in at least two directions substantially perpendicular to each other, said base portion including an inclined portion, a crystal mounted on said inclined portion, a feeler connected to said crystal and contacting said top portion for capturing mechanical vibrations transmitted by said string, when operated, to said top portion and loud speaker means, and electrical means interconnecting said crystal and said loud speaker.

15. A bridge for a stringed instrument having at least one string, comprising a base portion adapted to be mounted on said instrument, a vibratory top portion for contacting said string and receiving the mechanical vibrations therefrom, said top portion having spaced apart legs each resiliently supported on said base portion for vibratory movement in at least two directions substantially perpendicular to each other and means associated with said bridge for capturing the mechanical vibrations of said top portion and converting said mechanical vibrations into electrical vibrations.

16. A bridge as claimed in claim 15 wherein said means for capturing the mechanical vibrations and converting them into electrical vibrations includes feeler means contacting said top portion for capturing the mechanical vibrations therefrom and transducer means mounted on said base portion cooperating with said feeler means for converting the mechanical vibrations thereof into electrical vibrations.

17. A bridge as claimed in claim 16 wherein said feeler means comprises a coil mounted on said top portion and movable therewith and said transducer means includes a magnet mounted on said base portion adjacent said coil.

18. A bridge as claimed in claim 16 wherein said transducer means includes a crystal and said feeler means includes a feeler connected to said crystal for transmitting the vibrations of said top portion to said crystal.

19. A bridge as claimed in claim 18 wherein said spaced apart legs are supported on resting means on said base portion, said resting means being slightly inclined toward the center of the bridge.

20. A bridge as claimed in claim 19 wherein said base portion includes an inclined portion and said crystal is mounted on said inclined portion.

21. A stringed musical instrument comprising a support, at least one string mounted on said support, a bridge comprising a vibratory top portion and a base portion, said vibratory portion contacting said string and receiving mechanical vibrations therefrom, said base portion being rigidly connected to said support, said top portion having spaced apart legs each resiliently supported on said base portion for vibratory movement in at least two directions substantially perpendicular to each other, means associated with said bridge for capturing the mechanical vibrations of said top portion and converting said mechanical vibrations into electrical vibrations, and loud speaker means connected to said means for converting said electrical vibrations into sound.

22. A stringed musical instrument comprising a support, at least one string mounted on said support, a bridge having a vibratory body portion contacting said string and receiving the vibrations therefrom, said body portion including spaced apart legs each resiliently supported by said support so that said body portion may vibrate in all directions, feeler means resiliently contacting said body portion substantially perpendicularly to the main plane of said body portion for capturing the mechanical vibrations in all directions of said body portion, and transducer means cooperating with said feeler means for transforming the mechanical vibrations thereof into electrical vibrations.

23. A stringed musical instrument as claimed in claim 22 wherein said feeler means comprises a bent needle, said transducer means includes a crystal, said needle being connected to said crystal.

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