United States Patent

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[54] **PITCH-VARYING APPARATUS FOR STRING INSTRUMENTS**
11 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **84/312**
[51] **Int. Cl.** **G10d 3/14**
[50] **Field of Search** 84/312, 313, 267

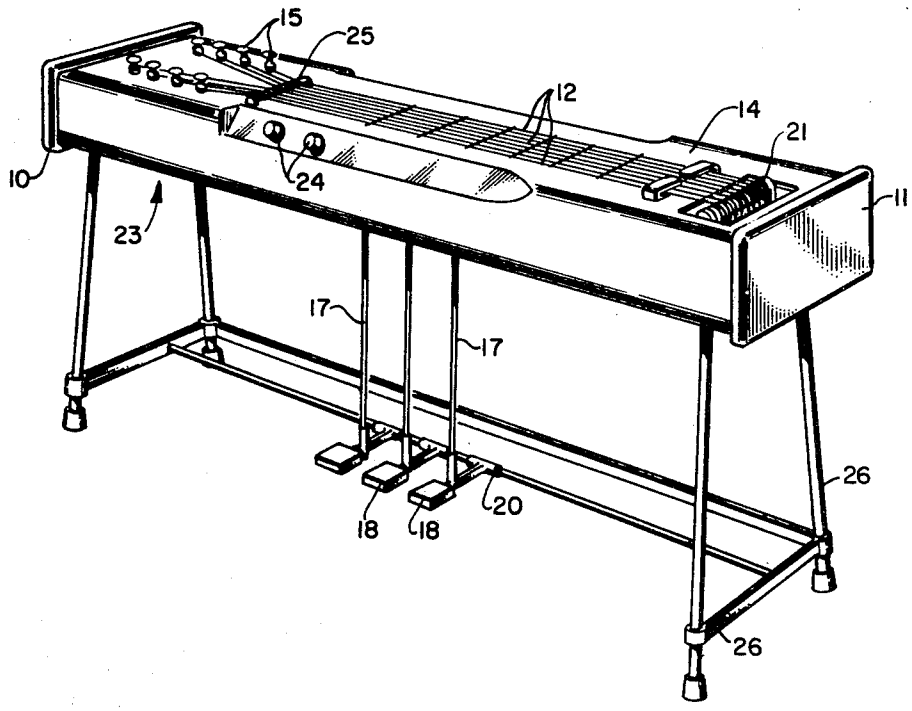
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ABSTRACT: A tension-varying system and a mechanical linkage system therefor for varying the normal tones of guitar strings while the instrument is being played. The tension-varying system include for each guitar string two parallel, juxtaposed wires stretched between the end walls of and within the guitar body. One of the wires is connected at one end to the guitar body and at the other to a lever arm which by means of a spring is connected to the opposing wall of the guitar body. The other wire is likewise connected to one end to the same lever arm and at its other end to a second lever arm to which the guitar string is attached. When the former wire is depressed or further stretched it lowers the tone of the string while depressing or stretching the other wire raises the tone. In one embodiment (FIGS. 2—5) the second lever arm is straight and unitary while in a second, preferred embodiment (FIGS. 6—8) the lever arm is pivoted and two-piece and can break inwardly or outwardly. The mechanical linkage system (FIG. 9) for actuating the tension-varying system by depressing one or the other of the wires includes uniform elements which have flexibility and adjustability.



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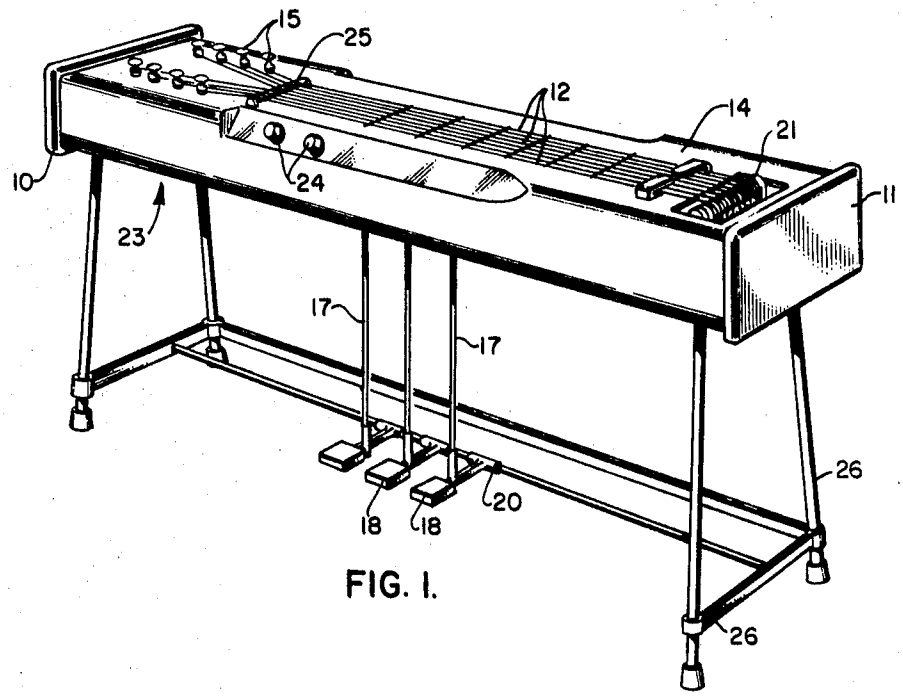


FIG. 1.

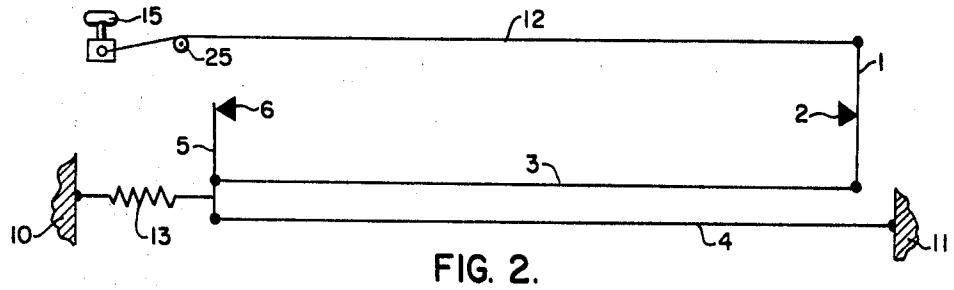


FIG. 2.

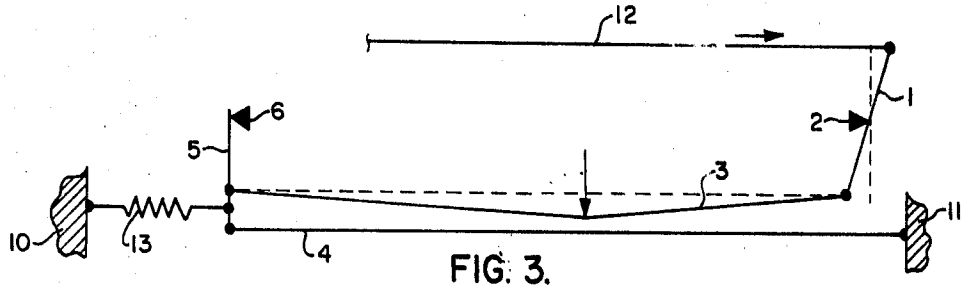


FIG. 3.

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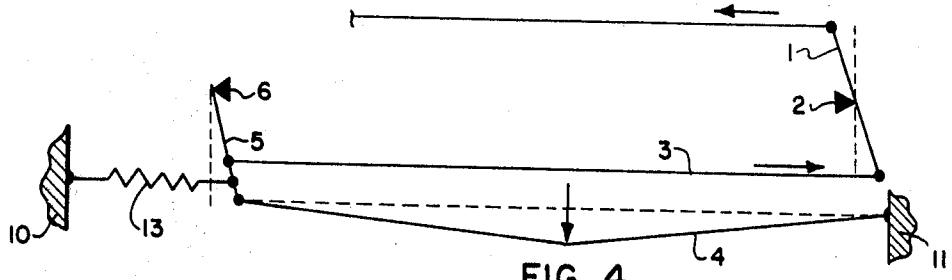


FIG. 4.

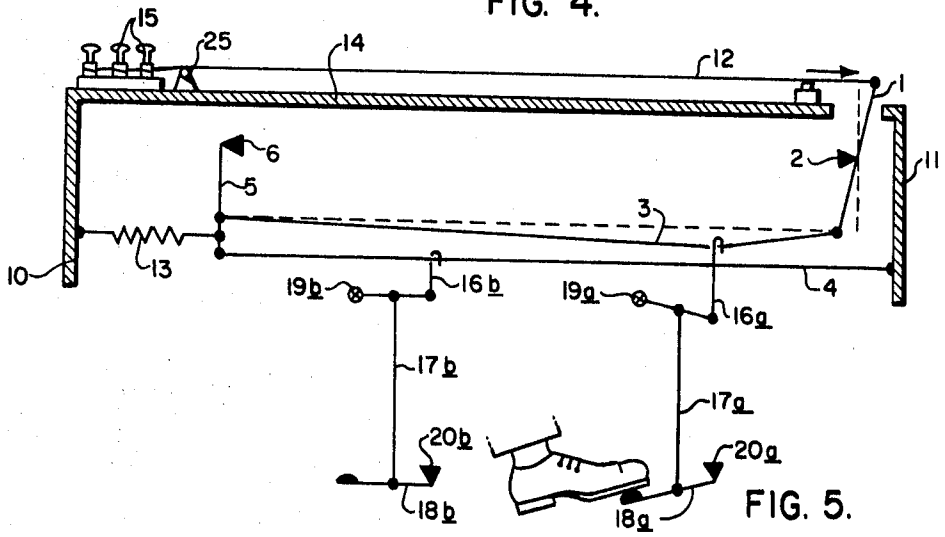


FIG. 5.

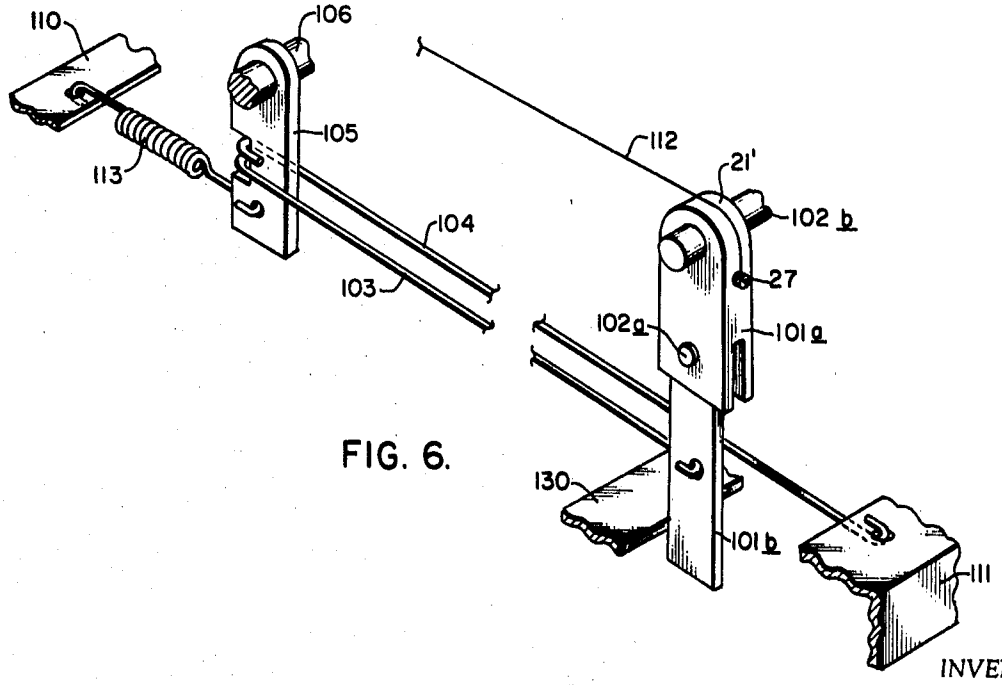


FIG. 6.

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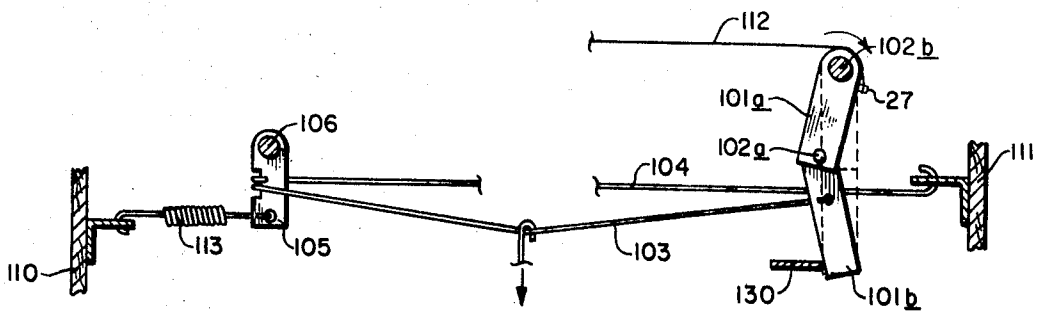


FIG. 7.

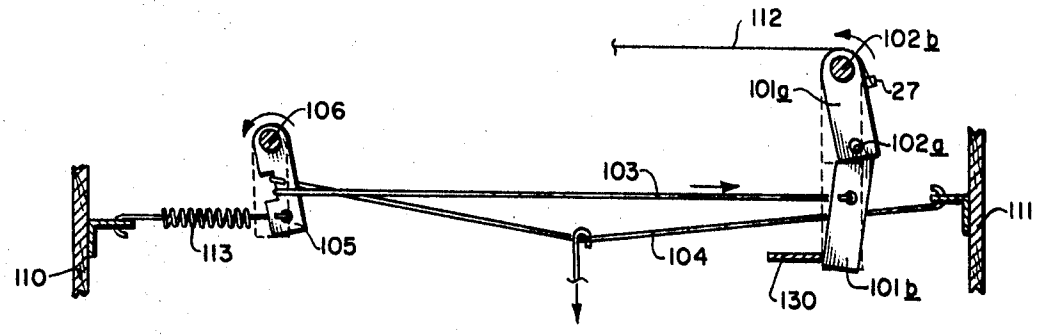


FIG. 8.

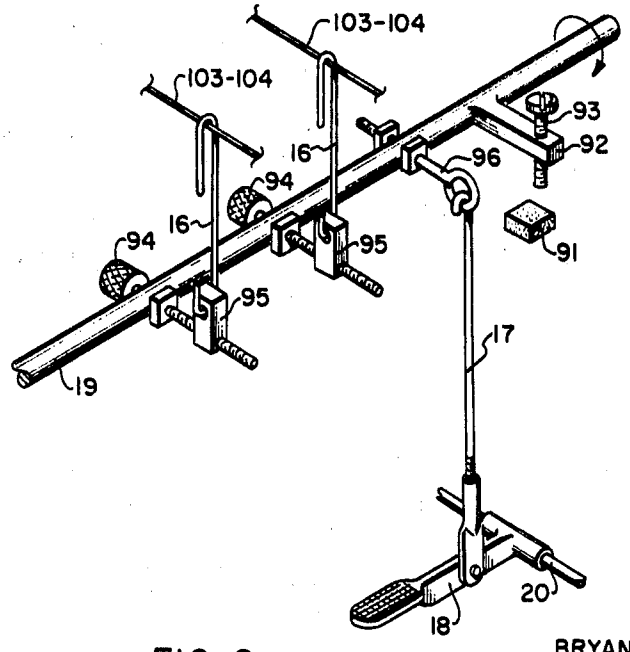


FIG. 9.

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PITCH-VARYING APPARATUS FOR STRING INSTRUMENTS

BACKGROUND OF THE INVENTION

Present-day modern steel guitars use the principle of changing the pitch of various strings while the instrument is being played, much like an organ is played, with the hands and feet. Like the organ, most of this action is performed with the feet operating pedals near the floor, although recently levers have been added which are operated also by the legs, or knees, and are referred to as "knee levers."

To accomplish the pitch change, the foot pedals or knee levers are connected to a series of levers, rods or cables underneath the instrument which, when actuated, tighten or loosen the string or strings to which they are attached. Numerous arrangements of these levers and linkages are used on the various guitars manufactured today.

A serious problem has developed, however, in recent years in manufacturing this type of instrument. There has been a great demand by the musicians purchasing these guitars for more foot pedals and knee levers, with as many as 10 and 12 being used, and more flexibility on the part of the mechanism in order for it to meet their specific physical requirements. Due to the different requirements of individual players, most of the instruments today have to be literally "handmade" or custom designed to suit the customer. This takes an extremely long time, is relatively expensive and makes mass production difficult if not impossible. Consequently the price of each instrument has risen to an unreasonably high amount. To overcome all these problems, the present invention provides a "universal" mechanism that is flexible enough to satisfy the demands of the consumer, yet is relatively inexpensive to manufacture and assemble, and lends itself to mass production techniques.

SUMMARY OF THE INVENTION

The present invention involves two basic aspects, the first being a unique system for varying the tension on the guitar strings and the second being a particularly useful and flexible mechanical linkage system for actuating the tension-varying system.

The tension-varying system utilizes the following principle. A piece of wire, when stretched tight between two points will have a particular length. If only one of the points is fixed and the wire is depressed out of its line of tension at any point, and in any direction, the distance between the two ends will shorten. The amount of movement is of course dependent on the amount of depression. By changing which point is fixed and which can be moved, the direction of movement can be reversed. In the invention this change in lengthening or shortening and this reverse in direction is used to achieve the raising and lowering of the string pitch, and is accomplished by using two tension wires (or any flexible material) in combination with two levers.

The mechanical linkage system causes by means of one or more foot pedals the depression of the tension wires. The mechanical system of the invention offers almost unlimited flexibility and variation, but utilizes parts which can be mass produced and which individually are simple and easily replaced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates in a plan, perspective view an exemplary guitar which has incorporated therein the present invention;

FIGS. 2—4 are schematic illustrations of the basic elements of the tension-varying system of the present invention;

FIG. 5 schematically shows the basic combination of the guitar, the tension-varying system and the mechanical linkage system of the present invention;

FIGS. 6—8 show a specific, detailed embodiment of the tension-varying system, the first being a plan, perspective view and the latter two being side views; and

FIG. 9 illustrates a specific, detailed embodiment of the mechanical linkage system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As is shown in FIG. 1, the present invention is particularly applicable (although of course not exclusively so) to the modern-type steel guitar wherein a horizontally disposed boxlike chamber 23 with end walls 10 and 11 is supported on the floor by upright legs and crossmembers 26. A plurality of guitars strings 12 are suspended in laterally spaced, parallel relation, the strings being tensioned between spaced bridges 21 and 25. The strings are anchored at one end to tuning keys 15 and at the other to the bridge 21. Appropriate electrical controls 24 are provided on the guitar body.

To actuate the tension-varying system of the present invention which is contained within the chamber 23, appropriate foot pedals 18 are rotatably connected to cross rod 20 and attached to mechanical linkage rods 17.

To illustrate the principle of the tension-varying system its elements and their relative workings are schematically illustrated in FIGS. 2—4.

Referring to FIG. 2, the guitar string 12 is attached to a standard tuning key 15 in the usual manner. The other end is attached to a lever 1 which is pivoted about a fulcrum 2. As illustrated schematically, the lever 1 can be a first order or Class A-type lever. Wire 3 is attached to the bottom of lever 1 and lever 5 at its other end. Lever 5 is also pivoted about a fulcrum 6, and has attached to it a second wire 4 and a spring 13. Wire 4 has its opposite end attached to a point 11 which is fixed relative to the guitar body. When the guitar string 12 is tightened to the desired pitch by the tuning key 15, it is held in equilibrium by the spring 13 acting through wire 3 and lever 1. The spring 13 also places wire 4 in tension. All parts then are situated in their "neutral" or normal position.

To raise the pitch of the guitar string 12 it is necessary to apply more tension to it. Referring to FIG. 3, this is done by depressing wire 3 at any point. Since spring 13 is designed to exert a relatively large force, it will not allow lever 5 to move. The depression of wire 3 instead moves lever 1 which adds the necessary tension to the guitar string 12, thereby raising the pitch. An exemplary depression is indicated by the arrow.

To lower the pitch (note FIG. 4) wire 4 is depressed at any point. Since one end of wire 4 is fixed at point 11, it has to overcome the tension of spring 13. In doing so, lever 5 is caused to move to the right and thus allows wire 3 through lever 1 to relax or reduce tension on the guitar string 12, thereby lowering the pitch.

The amount of pitch change is determined simply by the amount of depression applied to either wire 3 or 4. Of course the same results could be obtained by raising, rather than depressing, wires 3 and 4.

Although the illustrations in FIGS. 2—4 showed only one string, all other strings on the instrument could each have the mechanism shown, arranged in parallel array side by side with the others. A guitar with eight strings, for example, would have 16 wires all side by side and parallel. It only becomes necessary then to "play" on these wires by appropriate mechanical means to create the desired effect on the guitar strings as described above.

FIG. 5 shows a schematic representation of a simplified cross section of the entire assembly of the guitar, tension system and mechanical linkage system. As shown in FIG. 5, each foot pedal 18*a*, 18*b* when depressed rotates a lever arm about a shaft 19*a*, 19*b*, respectively running across laterally the underside of the instrument. The foot pedals 18*a*, 18*b* rotate about fulcrums 20*a* and 20*b*, respectively, and are connected to the lever arms by means of connecting rods 17*a* and 17*b*, respectively. Attached to the lever arms are hook members 16*a*, 16*b* which depress wires 3 and 4, respectively, when the lever arms are individually rotated. Thus to raise the normal tone of guitar string 3, foot pedal 18*a* is depressed (as illustrated), while to lower the normal tone foot pedal 18*b* is depressed.

The preferred embodiment of the tension-varying system of the present invention is illustrated in FIGS. 6—8. The preferred embodiment works on the same basic principles and in substantially the same manner as the embodiment of FIGS. 2—5. Accordingly corresponding elements are numbered in similar fashion. For example, spring 113 of the preferred embodiment performs the same function as the corresponding spring 13 of the schematic embodiment. Hence detailed description of the various elements of the preferred embodiment is not considered necessary.

The basic departure lies in the design of the lever arm to which the guitar string is attached. Rather than a straight, one-piece lever arm 1 as schematically illustrated in FIGS. 2—5, the preferred embodiment illustrated in FIGS. 6—8 includes a two-piece lever arm 101*a*, 101*b* rotatably connected together by pin 102*a*. The upper portion 101*a* of the lever arm rotates about shaft 102*b* and has the guitar string 112 tied to it at peg 27. The lower end 101*b* of the lever arm is constrained from inward movement at its lower extremity by fixed stop bar 130.

As is shown in FIG. 7, when wire 103 is depressed, it pulls the upper extremity of the lower section 101*b* of the lever arm inwardly, causing the upper section 101*a* to rotate (note curved arrow) about the shaft 102*b*. Such action increases the tension on the guitar string 112, raising its tone.

As illustrated in FIG. 8, when wire 104 is depressed, the lever arm 105 overcomes the pull of string 113 and rotates about shaft 116. The movement of lever arm 105 inwardly permits the midsection of lever arm 101*a*, 101*b* to move outwardly (note straight arrow). In so moving, the upper section 101*a* of the lever arms rotates (note curved arrow) about the shaft 102*b*, decreasing the tension on the guitar string 112, lowering its tone.

To actuate the aforedescribed tension-varying systems, a unique and particularly useful mechanical linkage system has been devised and a preferred embodiment thereof is illustrated in FIG. 9. Rotatable tuning rods 19 are suspended laterally across the body of the guitar at right angles to the crossbar 20, with such a tuning rod 19 being provided for each foot pedal 18. When foot pedal 18 is depressed, the lateral tuning rod 19 is rotated (note curved arrow) by means of connecting rod 17 pulling down eyebolt 96. The eyebolt 96 thus acts as the rotating media and is adjustable so as to vary the "-moment arm." This adjustability provides infinite variations in pedal stroke.

When the tuning rod 19 rotates it simultaneously pulls down hook members 16 causing the wires 103—104 to be depressed. When wires 103—104 are depressed they raise or lower the tone of their corresponding guitar strings in the manner described above. There is of course a separate foot pedal 18 and tuning rod 19 for each set of wires 103 and each set of wires 104.

A fixed stop plate 91 is provided to limit the rotation of the tuning rod 19 by means of the fixed arm 92 with a setscrew 93 therein, the bottom of which contacts the plate 91. The amount of desired maximum rotation can be varied by the setscrew 92. To further enhance the flexibility of the mechanical linkage system, the distance between the lateral tuning rods 19 and the foot pedals 18 can be varied by screwing further in or out of the connecting rods 17 in which the threaded connecting elements attached to the pedals 18.

A series of holes are provided in each tuning rod 19 to receive the tuning screws 94 for any desired actuating arrangement. Threaded attachments 95 mounted on the tuning screws 94 move toward or away from the tuning shaft 19 as the tuning screws are screwed out and in, respectively, of the tuning shaft 19. Thus by screwing the tuning screws in and out the amount of tone raising or lowering of the guitar strings can be increased or decreased, respectively. Wire hooks 16 provide a simple and fast connection to the wires 103—104.

From the foregoing description of the preferred embodiments, it is clear that the present invention has the following advantages over the present devices on the market:

1. All of the rods and wires of the mechanism are the same length, and can be manufactured in quantity at low cost.

2. The user can change the arrangement on any pedal 18 with minimum effort.

3. Any combination of tone raising and/or lowering functions can be used on each pedal 18. Moreover, all of these functions are performed with identical devices on each pedal 18, and all parts are duplicates and require no special machining.

4. The pedals 18 and connecting rods 17 can be placed at any point under the instrument, thus providing flexibility in manufacturing and assembly and eliminating need for close tolerances.

5. The design of the variable radius tuning screws units 94, 95 have the inherent feature that all tone lowering and/or raising functions start the string movement at the same time and end at the same time. For example, if one pedal is chosen to raise one guitar string a full tone and another one-half a tone, both guitar strings start raising at the same time and end at the same time, namely at the end of the pedal stroke. There is, therefore, no lag of any movement.

6. Each pedal stroke can be individually adjusted to suit the player. Thus, if desired, all pedals 18 can be made to stop at the same level when depressed. Since some pedals are often depressed in pairs, they can be made to line up for any given stroke.

7. Since the turning cross rod 19 extends across the entire underside of the guitar, the popular "double-neck" guitars of today can be easily served by the assembly. Any pedal could operate strings on either or both "necks." Thus if a player desires four pedals for each "neck," he can perform this function with only four pedals instead of the usual eight.

These are but some of the many advantages and improvements over the prior art.

While preferred embodiments of the invention have been shown and described, many modifications thereof may be made without departing from the heart and scope of the invention, many given details being strictly exemplary. For example, rather than the lever arms 1 and 101*a*—101*b*, a rotatable wheel could be used with the guitar string 12,112 and the wire 3,103 being attached to the periphery thereof. These variations are only a few samples of those possible under the present invention.

What I claim as invention is:

1. A pitch-varying apparatus for stringed instruments having at least one sound-producing string (12,112) comprising:

A. a first elongated, pliant member (4,104) fixedly attached at one end to the instrument;

B. a movement-translating member (1,101*a*–101*b*) having the sound-producing string attached thereto;

C. a second elongated, pliant member (3,103) attached at one end to said movement-translating member;

D. restricted means (5,105), to which is attached the other ends of said first and second elongated members, for permitting movement of said other end of said second elongated member when said first elongated member is under added tension but not permitting movement when said second elongated member is under added tension; and

E. mechanical actuating means (16—19) for selectively and independently putting said added tension on said first and second elongated members; whereby when said mechanical actuating means puts said added tension on said elongated members, the tension on the sound-producing string is varied.

2. The apparatus of claim 1 wherein said movement-translating member is a Class A or first order elongated lever arm (1) rotatable about an axis between its two extremities and having the sound-producing string (12) attached to one extremity of the lever arm and said second elongated member (3) attached to the other extremity.

3. The apparatus of claim 1 wherein said movement-translating member includes at least two subelements (101*a*, 101*b*) connected together by a pivot element (102*a*), the sound-producing string (112) being attached to one and second elongated member (103) being attached to the other, the two subelements at its outer extremities being restrained (102*b*, 130)

from translatory movement but capable of pivotal movement; whereby said movement-translating member can break inwardly or outwardly.

4. The apparatus of claim 1 wherein said restricted means comprises an elongated arm pivotably mounted on the instrument, said two elongated members being attached to said lever arm on the same side of the pivot point, and relatively strong resilient means attached to said lever arm for permitting movement of said lever arm when said first elongated member is under added tension but not permitting movement when said second elongated member is under added tension.

5. The apparatus of claim 1 wherein said two elongated, pliant members are parallel, juxtaposed wires running a substantial extent along the length of the instrument.

6. The apparatus of claim 5 wherein said wires run generally parallel to the sound-producing string.

7. The apparatus of claim 6 wherein said mechanical actuating means comprises two parallel, independently rotatable rods (19) running perpendicularly across said two parallel wires, each of said rotatable rods having a projecting arm (94) extending along and parallel to one of said wires, said projecting arm having a connecting member (16,95) attached thereto and extending to said one of said wires and connected thereto; whereby tension is applied to each of said wires by rotating its corresponding rod.

8. A pitch-varying apparatus for stringed instruments having at least one sound-producing string (12,112) comprising elongated, pliant means (3, 103, or 4, 104) connected to the sound-producing string for varying the tone or pitch thereof and mechanical actuating means (16—19) for applying tension to said elongated member to cause it to vary the tone or pitch of said sound-producing string, the said mechanical actuating means comprising a rotatable rod (19) having a projecting arm (94) extending generally parallel to said elongated member, said projecting arm having a connecting member (16,95) attached thereto and extending and connected to said elongated member; whereby tension is applied to said elongated member by rotating said rod.

9. The apparatus of claim 8 wherein said projecting arm is threaded and in screwing relationship with said rod and the length of the projecting portion of the arm can be varied by screwing the arm in and out; whereby the tension being applied on said elongated member can be easily varied.

10. The apparatus of claim 8 wherein said connecting member is connected to said elongated member by an open, hooking element (16); so that the connection can be simply and easily made anywhere along the length of said elongated member.

11. The apparatus of claim 8 wherein said mechanical actuating means further includes an adjustable eyebolt projection (96) which can be screened in and out of said rod, a connecting rod (17) attached to said eyebolt, and a foot pedal attached to the other end of said connecting rod; whereby the amount of rotation of the rod can be easily varied by said eyebolt and said rod can be caused to rotate by depressing said foot pedal.