United States Patent

[11] 3,583,272

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[54] **TUNING MECHANISM FOR A STRINGED MUSICAL INSTRUMENT**
11 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **84/267,** 84/397, 84/312
[51] **Int. Cl.** **G10d 3/14**
[50] **Field of Search** 84/267, 297, 312

[56] **References Cited**

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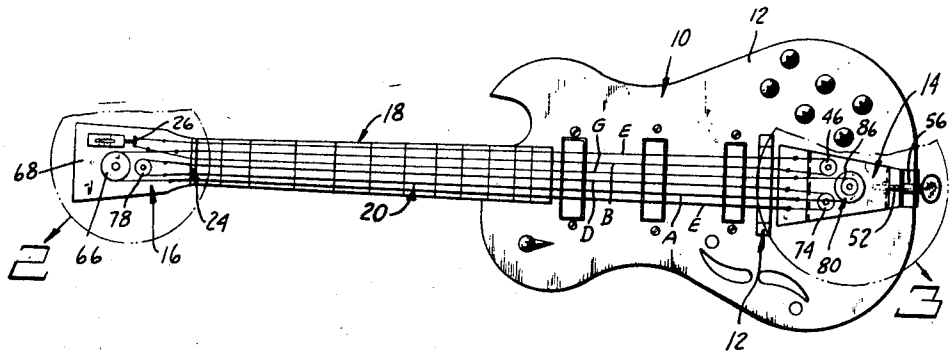
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Assistant Examiner—Lawrence R. Franklin
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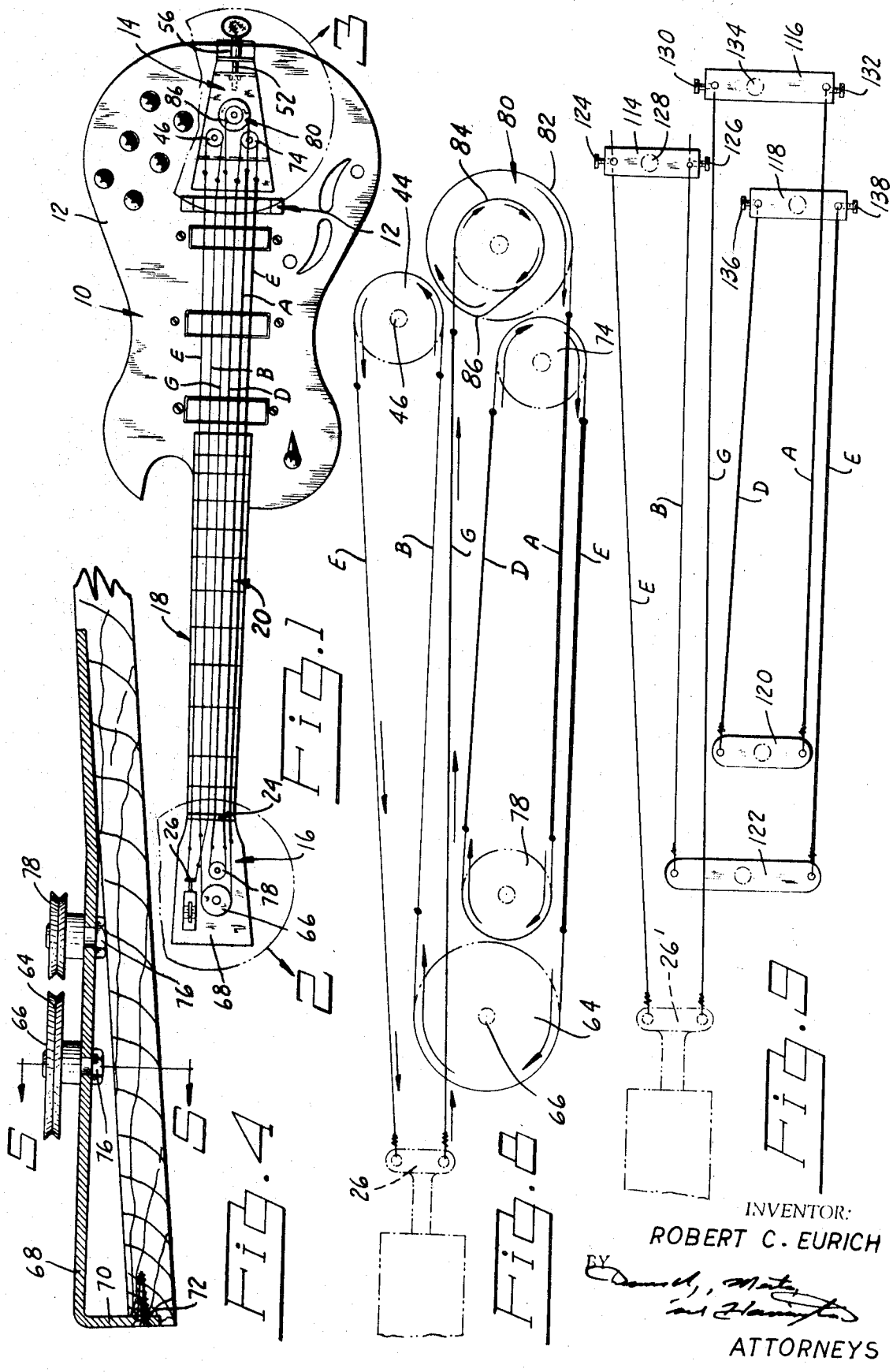
ABSTRACT: A musical instrument having multiple vibrating string segments, each segment forming a part of a continuous string assembly whereby the tension of each vibrating string segment can be adjusted for tuning purposes with a single tension adjustment of the complete assembly, wherein the string segments are in a state of stress with the magnitudes of the stresses being mutually related to each other with a predetermined ratio.



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SHEET 1 OF 2



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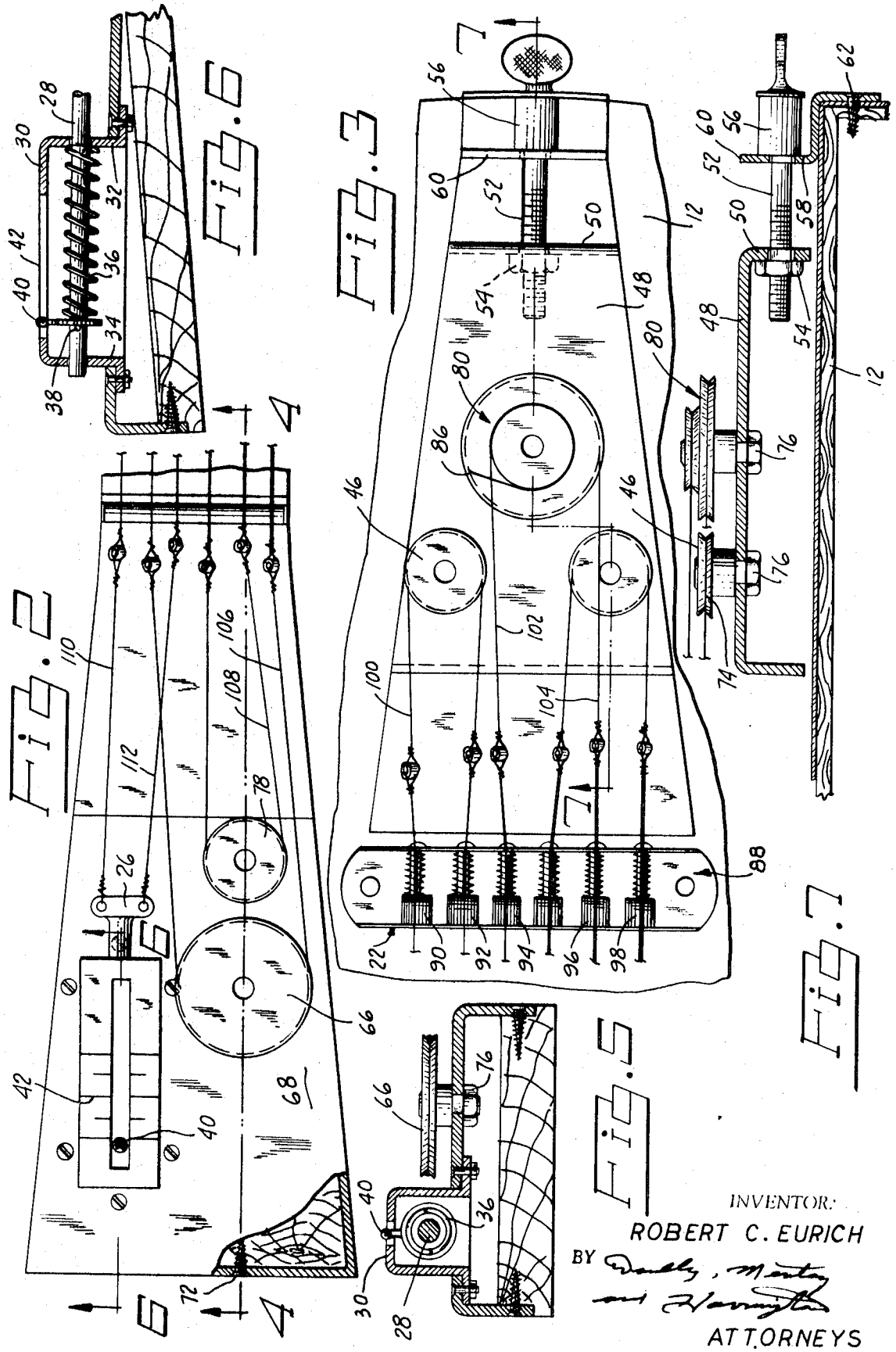
BY

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SHEET 2 OF 2



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TUNING MECHANISM FOR A STRINGED MUSICAL INSTRUMENT

GENERAL DESCRIPTION OF THE INVENTION

The improvements of my invention can be adapted to any stringed musical instrument having a plurality of vibrating strings. For purposes of this disclosure, I have illustrated and described a guitar, although the improvements of my invention can be used also in other instruments, such as violins or pianos.

A guitar comprises a hollow box or chest, usually made of wood. The chest has an upper side and lower side joined together by side pieces or ribs. A thin, narrow neck extends from the chest and a pegboard is carried at the outermost end of the neck. A tailpiece located at a lower part of the chest secures one end of the strings. The other ends of the strings are secured to the pegboard. One end of each string is wound about a tuning peg supported by the pegboard. As the peg is rotated, the tension on the associated string can be varied, thereby providing a rough tuning adjustment.

The strings are supported adjacent the tailpiece by a bridge, and a rib is located adjacent the pegboard for supporting the other ends of the strings. The vibrating segments of the strings are the sections extending from the rib to the bridge.

A fine tuning adjustment for each of the strings can be performed at the bridge by varying the point of support, thereby controlling the effective vibrating lengths of the strings. The tone of the vibrating strings depends upon the tension of the strings, their length, and their mass per unit length, as well as upon the construction and geometry of the other parts of the instrument. The tone is a function of the frequency of vibrations of the strings.

In the case of a guitar, the E string should have a gage of 0.012 inch; the B string gage should be 0.016 inch; the G string gage should be 0.025 inch; the D string gage should be 0.027 inch; the A string gage should be 0.037 inch; and the E string gage should be 0.050 inch. Each string must be individually tuned by appropriate adjustments of the tuning peg and the fine tuner. The maximum adjustment required depends upon the ambient temperature, among other factors. If the instrument is used in an environment that may be subject to changes in temperature, the artist will experience an out-of-tune condition which will necessitate a further tedious adjustment procedure. This is experienced, for example, when the artist is performing in a room when an air-conditioning unit is either turned on or turned off during his performance.

Unlike such prior art devices, my improved construction has a string assembly in which each string segment forms a continuation of another string segment. As the tension of one string segment is adjusted, a corresponding tension variation occurs in each of the other string segments. The tension in each of the strings may or may not be equal. The relative tensions in the string segments can be changed merely by changing the force transmitting ratio of one string segment with respect to another. This can be done either by means of a freely pivoted lever system or compound pulleys, as will be described subsequently. A common adjustment in the tension for each of the strings can be achieved also by adjusting as a unit each of the compound pulleys, or each of the freely pivoted levers, whichever is the case. This is the equivalent of adjusting the tension in one of the strings. Hence the ratios of the tensions in the strings always remain constant.

BRIEF DESCRIPTION OF THE FIGURES IN THE DRAWINGS

FIG. 1 shows a plan view of a guitar embodying the improvements of my invention.

FIG. 2 is an enlarged view of a portion of the instrument of FIG. 1 enclosed within the reference circle "2" of FIG. 1.

FIG. 3 is a plan view of the portion of the tailpiece enclosed within reference circle "3" of FIG. 1.

FIG. 4 is a partial cross-sectional view taken along the plane of section line 4–4 of FIG. 2.

FIG. 5 is a cross-sectional view taken along the plane of section line 5–5 of FIG. 4.

FIG. 6 is a cross-sectional view taken along the plane of section line 6–6 of FIG. 2. It shows a tension indicator for a first embodiment of my invention.

FIG. 7 is a cross-sectional view taken along the plane of section line 7–7 of FIG. 3.

FIG. 8 is a schematic representation of a string assembly used in the embodiment of FIGS. 1 through 7.

FIG. 9 is a schematic view representing a second form of my invention.

GENERAL DESCRIPTION OF THE INVENTION

In FIG. 1, numeral 10 designates generally the body or case. It has an upper section 12 on which is positioned an adjustable tailpiece assembly 14. An end piece 16, which normally would correspond to the pegboard of a conventional guitar, is located at the outermost end of a neck 18 extending from the case 10. Six strings generally indicated by reference character 20 extend from the end piece 16 to the tailpiece 14. They are trained over a bridge assembly 22 located near the tailpiece 14 and a rib 24 located near the endpiece 16. The individual strings are identified as an E string, a B string, a G string, a D string, an A string, and an E string. The two E strings differ only by their gage, the last-mentioned E string having a gage of 0.050 inches and the first-mentioned E string having a gage of inch and 0.012 inch.

The gages for the strings intermediate the two E strings are 0.016 inch for the B string, 0.025 inch for the G string, 0.027 inch for the D string, and 0.037 inch for the A string. It is possible, however, to use strings of different gages if appropriate changes are made in their tensions. The G string and the E string are anchored at the left-hand ends, as viewed in FIGS. 1 and 8, by an anchor element 26. This is carried by a plunger 28 extending within housing 30 for a tension indicator shown best in FIGS. 2 and 6. The housing 30 includes a pair of end walls 32 and 34 having openings which support the plunger 28. A compression spring 36 situated between the wall 32 and a stop 38 normally urges the plunger 28 in a left-hand direction. The position of the plunger is measured by a pointer 40 which registers with appropriate calibration markings 42 formed on the upper surface of the housing 30 as indicated in FIG. 2. The individual markings 42 can be made to correspond to desired vibrating frequencies during the tuning operation. The amount of the compression of the spring 36 will determine the tension in the vibrating strings.

The first E string is trained over a pulley 44 which is pivoted on a friction-free bearing post 46. This in turn is supported securely by a tailpiece plate 48 as seen in FIG. 7. This plate includes a sidewall 50 in which is formed a central opening through which a threaded shaft 52 extends. Shaft 52 is threaded within an adjusting nut 54 secured to the wall 50.

Shaft 52 is formed with an adjusting thumb grip 56 which forms a shoulder 58 that engages a stationary reaction plate 60. This plate in turn is secured by screws 62 to the right-hand end of the case 10. It overlaps the upper face 12, as indicated in FIG. 7.

The string that emerges from the other side of the pulley 44 forms a B string, and this string in turn is trained over another frictionless pulley 64 rotatably supported by a frictionless bearing post 66. The post 66 is supported by the stationary plate 68 which forms a part of the endpiece 16. This is seen best in FIG. 4. Plate 68 overlies the end of the neck 18, as seen at 70, and is held in place by screws 72.

The B string that emerges from the pulley 64 forms the lower E string as seen in FIG. 8. This string in turn is trained over pulley 74, seen in FIG. 7 as well as in FIG. 8. The pulley 74 is held by a frictionless bearing post 76 which in turn is supported by the stationary plate 48, the latter being adjustable by the operator as he rotates the thumb grip 56.

The string that emerges from the other side of the pulley 74 forms a D string. This in turn is trained over frictionless pulley

78 rotatably supported by the plate 68 in the end piece assembly.

The string emerging from the other side of the pulley 78 forms an A string which is trained over a compound pulley identified in FIG. 5 and 8 by reference character 80. This pulley comprises an assembly of two, integral, simple pulleys, the larger diameter pulley of this assembly being identified at 82 and the adjacent relatively smaller diameter pulley thereof being identified by reference character 84. The A string is trained over the large diameter pulley 82 until it reaches a point on the periphery of the pulley identified at 86. The string then changes or crosses over from the pulley portion 82 to the pulley portion 84. It then is trained over pulley portion 84 and emerges as the G string.

The left-hand end of the G string, as previously mentioned, is anchored to the anchor member 26. Because of the change in diameter of the strings that pass over compound pulley 80, the tension in the A string is less than the tension in the G string. Thus the G string tension is greater than the tension of any other strings because of the pulley ratio or the torque transmitting ratio achieved by the compound pulley 80. This increased tension of the G string, in the case of the embodiment disclosed here, is necessary in order to effect the proper G string tone.

The proper ratio of the tensions for the G string and A string can be achieved if the pulley diameter of the pulley portions 82 and 84 is 1.25:1.

It is apparent from the foregoing that if the operator should effect an adjustment by turning the adjustable thumb grip 56, the tension in each of the strings will be changed while the ratio of the tensions for the various strings remains constant. The amount of the tension can be measured by observing the deflection of the tension indicator spring 36 and comparing it to the calibrated readings 42. After this adjustment is achieved, a conventional fine tuning adjustment can be accomplished at the bridge 22. This includes a bridge plate 88 and a plurality of stringed bridge elements as shown at 90, 92, 94, 96 and 98. Each of these elements supports one of the strings. Each element is pivotably connected to an adjusting screw, and it is yieldably urged in one direction by a compression spring. As the adjusting screw for each of the elements 90 through 98 is turned, the effective point of support for the associated spring is changed, thereby changing slightly the effective vibrating lengths of the string. This of course affects the tone to a very slight extent.

In order to reduce the friction that normally would be present if the relatively stiff musical vibrating strings were to be trained over the pulleys, I have provided an auxiliary string section for each adjacent pair of strings as shown best in FIG. 5. For example, the E string is connected at its right-hand end to a transition string 100, which in turn is trained over the pulley 46. The right-hand end of the B string in turn is connected to the other end of the transition string 100.

The transition string 100 can be formed of a braided construction, if this is desired, in order to increase the flexibility without reducing its ability to withstand tension without permanent yielding.

A corresponding transition string 102 is trained over pulley 80 and it serves to connect the right-hand ends of the G string and the A string. A third transition string 104 is trained over the pulley 66 74 and serves to connect together the right-hand ends of the D string and the lower E string.

Corresponding transition strings are provided for the other ends of each of the vibrating strings. These are seen in FIG. 2 and form a part of the end piece assembly. Transition string 106 is trained over pulley 66 and connects together the lower E string and the B string. Similarly, transition string 108 is trained over pulley 78 and serves to connect together the A string and the D string. Transition strings 110 and 112 simply serve as anchor elements for the left-hand ends of the G string and the upper E string.

It will be apparent from the foregoing description that the tuning adjustment accomplished by turning the thumb fit 56 could be accomplished instead by adjusting the anchor point provided by the anchor element 26. Any change in the adjustment of the position of anchor element 26 of course would result in a corresponding change in the tension in each of the other strings regardless of whether the tailpiece 14 were to be held stationary. By preference, however, I have located the adjustment mechanism at the tailpiece rather than at the anchor element 26, and it is this embodiment of my invention that I have illustrated.

In FIG. 9 I have illustrated a second embodiment of my invention. It includes freely pivoted force transmitting levers rather than pulleys. The individual levers, however, perform the same function as the pulleys of the embodiment of FIGS. 1 through 8. For example, lever 114 would correspond to pulley 44, lever 116 would correspond to compound pulley 80, lever 118 would correspond to pulley 74. Lever 120 would correspond to pulley 78, and lever 122 would correspond to pulley 64. As in the previous embodiment, the left-hand ends of the upper E string and the G string are anchored to an anchor element identified by reference character 26'. The right-hand end of the E string is received through an opening formed in one end of the lever 114, and it is held in place by an anchor screw 124. The right-hand end of the B string is received through another opening formed in the other end of the lever 114, and it is held in that opening by an anchor screw 126. The lever 114 is pivoted on a pivot post 128 located on the midpoint between the two openings through which the strings E and B are received. It will be apparent, therefore, that the tension of string E will equal the tension of string B because of the 1 to 1 force transmitting ratio of lever 114. The lever 114 thus forms the equivalent of the pulley 44, although any resistance due to the flexing of the strings in the embodiment of FIGS. 1 through 8 is not present in the embodiment of FIG. 9.

The right-hand end of the G string and the right-hand end of the A string are connected to opposite ends of the lever 116. Each of these ends is formed with an opening for receiving associated strings, and the ends of the strings are anchored by anchor screws 130 and 132. Unlike the other levers, the lever 116 acts as a force multiplying lever because the pivot point is located eccentrically with respect to the midpoint between the anchored ends of the strings A and G. The pivot point is shown at 134. Thus the tension in string A will be less than the tension in string G by an amount determined by the ratio of the lever arms for the G and A strings. This lever ratio can be made the same as the pulley ratio for the compound pulley A.

The right-hand ends of strings D and E are anchored to opposite ends of the freely pivoted lever 118. The pivot point for lever 118, like the lever 114, is located at the midpoint. Anchoring screws 136 and 138 lock the right-hand ends of the strings D and E in openings formed in the ends of the lever 118.

The left-hand ends of the strings D and A are anchored to opposite ends of the freely pivoted lever 120, which are pivoted on posts connected directly to an endpiece plate such as that shown at 68 in FIG. 4. A corresponding lever 122 is freely pivoted on the endpiece anchor plate and the left-hand ends of the strings B and E are connected thereto, as indicated in FIG. 9.

Upon adjustment of the tailpiece, by means of the adjusting mechanism illustrated, for example, in FIGS. 5 and 7, the levers 118, 116, and 114 are adjusted relative to the endpiece, thereby changing the tension in each of the vibrating strings to effect a rough tuning. The freely pivoted characteristic of the levers of the FIG. 9 construction reduces the bearing friction that normally would be associated with the pulley arrangement of the embodiment of FIGS. 1 through 8. Furthermore, it eliminates the friction involved in bending the transition strings around the pulleys. It is not necessary in the FIG. 9 embodiment to employ transition string such as those shown at 100, 102 and 104 since the ends of the individual strings can be anchored directly to the ends of the freely pivoted levers. Strings of different gages then can be used without the necessity for providing a single continuous string, such as that

described with reference to FIGS. 1 through 8, wherein the various vibrating sections of the continuous string would have different gages. Conventional strings for stringed musical instruments thus can be used in the FIG. 9 construction.

Having thus described preferred forms of my invention, what I claim and desire to secure by U.S. Letters Patent is:

1. A stringed musical instrument comprising a first string anchor, a second string anchor, a plurality of strings, pivoted elements connected to at least one of said anchors, each pivoted element mechanically connecting together one of the ends of a pair of string whereby whereby the force of one string of the pair is transmitted through its said pivoted element to the other string of the pair, the other ends of one of said pairs of strings being connected to a stationary portion of said instrument, means for adjusting the distance between said one anchor and said stationary portion whereby the tension in said strings may be controlled with a single adjustment, and means for effecting unequal tension in the string of at least one of said pairs thereby providing a desired relative tone for said strings.

2. The combination as set forth in claim 1 wherein said pivoted elements are on both anchors, one end of one string being connected to the pivoted element for said first anchor and the other end of that same string being connected to the pivoted element for said second anchor.

3. The combination set forth in claim 1, wherein said pivoted elements are on both anchors, the connections between the pivoted elements and their anchors being friction-free bearings, one end of one string being connected to the pivoted element for said first anchor and the other end of that same string being connected to the pivoted element for said second anchor.

4. A stringed musical instrument comprising a case, a neck portion secured to said case, an endpiece carried by said neck portion, a tailpiece carried by said case, a plurality of strings extending along said case, pivoted elements on said tailpiece, each pivoted element mechanically connecting together the ends of a pair of said string whereby the force of one string is transmitted through said pivoted element to the other, the other ends of said strings being connected to said endpiece, and means for adjusting the distance between said pivoted elements and said endpiece whereby the tension in said strings may be controlled with a single adjustment, the pivoted elements on said tailpiece comprising pulleys, each pair of said string being joined together to form a unitary string assembly, said string assembly being trained over the pulleys on said tailpiece whereby a single adjustment in the tension by said adjustment means affects the string tension in each of said strings, at least one of said pivoted elements having its pivot point located closer to one of its associated strings than the other whereby the tension in said one string is greater than the tension in its other string.

5. The combination set forth in claim 4 wherein said adjusting means comprises a threaded connection between said case and said tailpiece whereby said tailpiece may be adjusted toward and away from said endpiece and relative to said case to effect a rough tuning adjustment for each of said strings.

6. The combination set forth in claim 4 wherein said endpiece comprises second pivoted elements, the other ends of said strings being connected to said second pivoted elements whereby said second pivoted elements establish a mechanical connection between each of a pair of strings, said adjusting means controlling the tension in each of said strings as the distance between the tailpiece and the endpiece is varied.

7. The combination set forth in claim 6 wherein said adjusting means comprises a threaded connection between said case and said tailpiece whereby said tailpiece may be adjusted toward and away from said endpiece and relative to said case to effect a rough tuning adjustment for each of said strings.

8. The combination as set forth in claim 6 wherein the pivoted elements on said endpiece comprise pulleys, said strings being joined together to form a unitary string assembly, said string assembly being trained over the pulleys on said endpiece whereby a single adjustment in the tension by said adjusting means affects the tension of each string.

9. The combination as set forth in claim 6 whereby the pivoted elements on said endpiece comprise levers each having a pivot point intermediate its ends, the ends of said levers being connected to the other ends of said strings.

10. A stringed musical instrument comprising a case, a neck portion secured to said case, and endpiece carried by said neck portion, a tailpipe carried by said case, a plurality of strings extending along said case, pivoted elements on said tailpiece, each pivoted element mechanically connecting together the ends of a pair of said strings whereby the force of one string is transmitted through said pivoted element to the other, the other ends of said strings being said endpiece, and means for adjusting the distance between said pivoted elements and said endpiece whereby the tension in said strings may be controlled with a single adjustment, said pivoted elements comprising levers, said levers being pivoted at a location intermediate their ends, on end of each lever being connected to one end of one string and the other end of each lever being connected to one end of another string whereby the force on one string is transmitted to the other, at least one of said pivoted elements having its pivot point located closer to one of its associated strings than the other whereby the tension in said one string is greater than the tension in said other string.

11. The combination set forth in claim 10 wherein said adjusting means comprises a threaded connection between said case and said tailpiece whereby said tailpiece may be adjusted toward and away from said end piece and relative to said case to effect a rough tuning adjustment for each of said strings.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,583,272 Dated June 8, 1971

Inventor(s) Robert C. Eurich

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 5, "Fig." should be --Figs.--. Column 3, line 63, "pulley 66 74" should be --pulleys 74--. Column 4, line 31, "1 to 1" should be --one to one--. Column 5, line 11, "string" should be --strings--. Column 5, line 18, "string" should be --strings--. Column 5, line 39, "string" should be --strings--. Column 5, line 46, "string" should be --strings--. Column 6, line 29, "and" should be --an--. Column 6, line 35, "insert --connected to--. Column 6, line 40, "on" should be --one--.

Signed and sealed this 26th day of October 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents