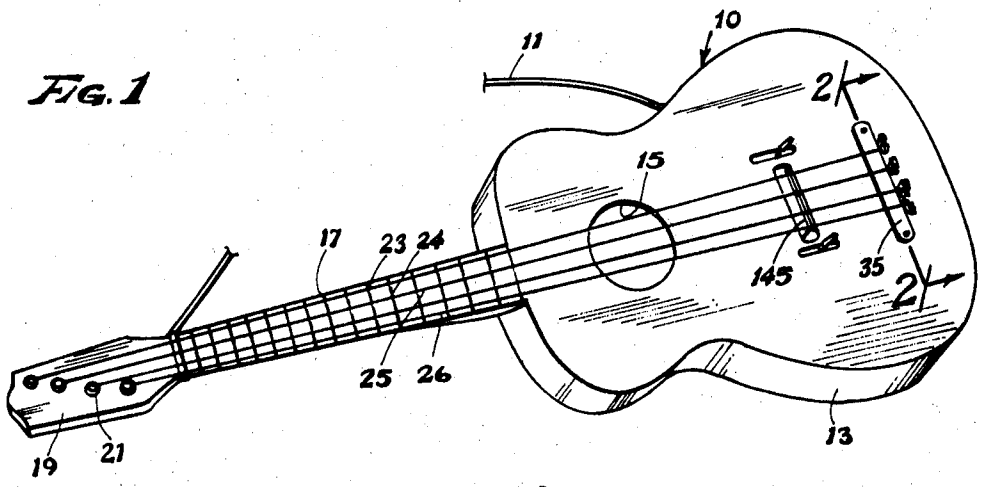
April 22, 1969 J. W. RYAN 3,439,571

STRINGED INSTRUMENT HAVING IMPROVED TUNING AND CHORDING MEANS

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FIG. 1



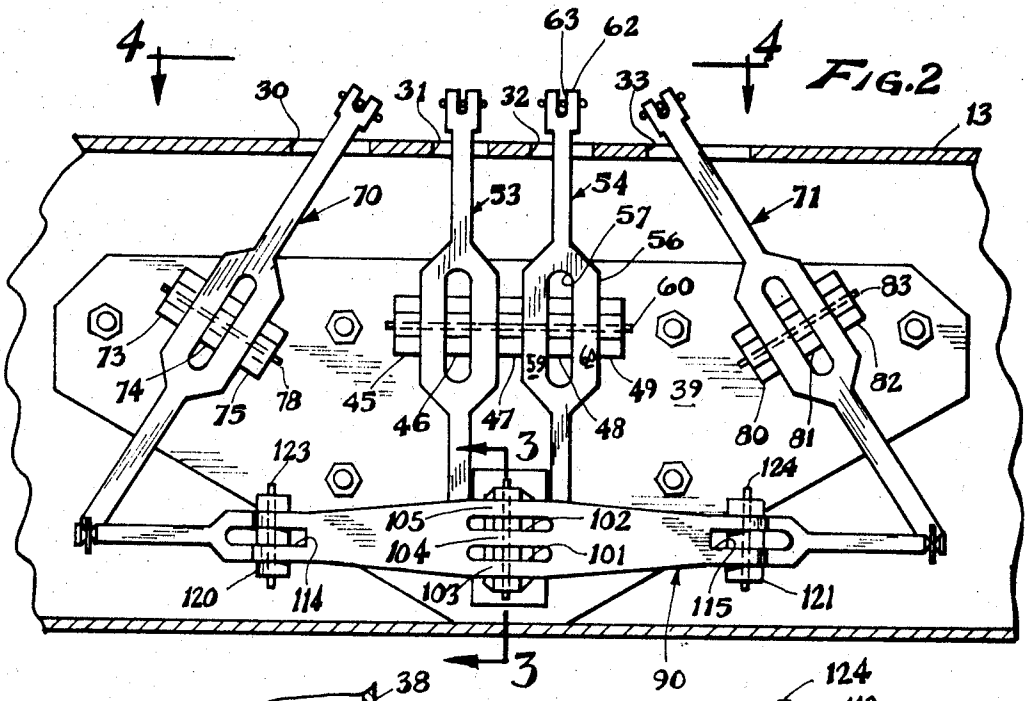


FIG. 2

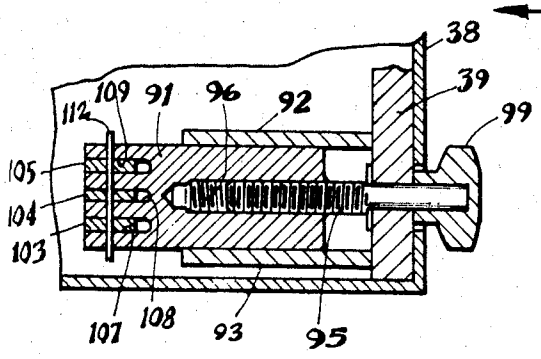


FIG. 3

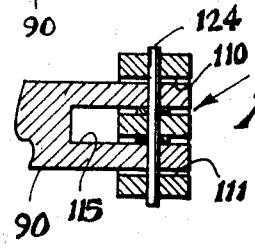


FIG. 18

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STRINGED INSTRUMENT HAVING IMPROVED TUNING AND CHORDING MEANS

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FIG. 4

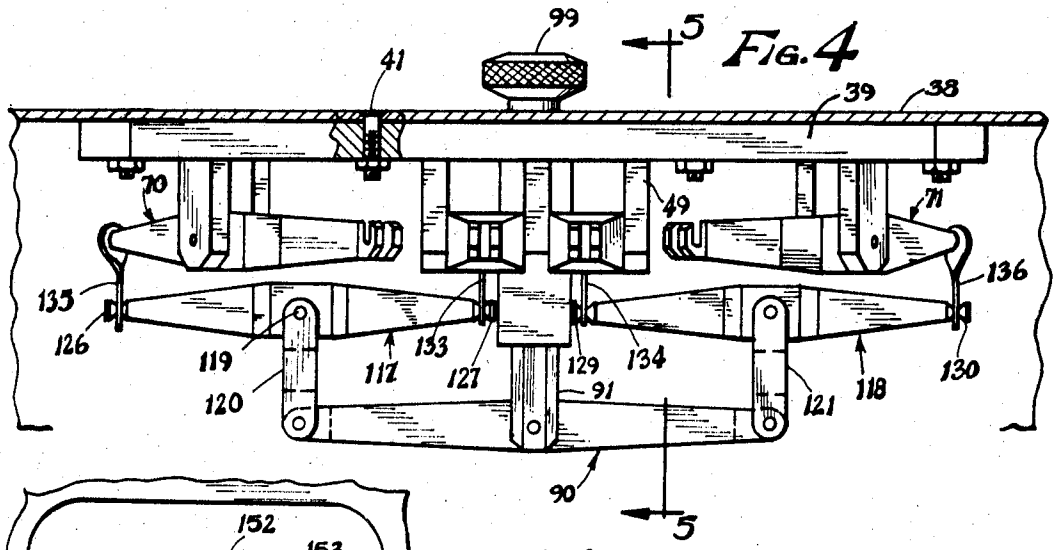


FIG. 6

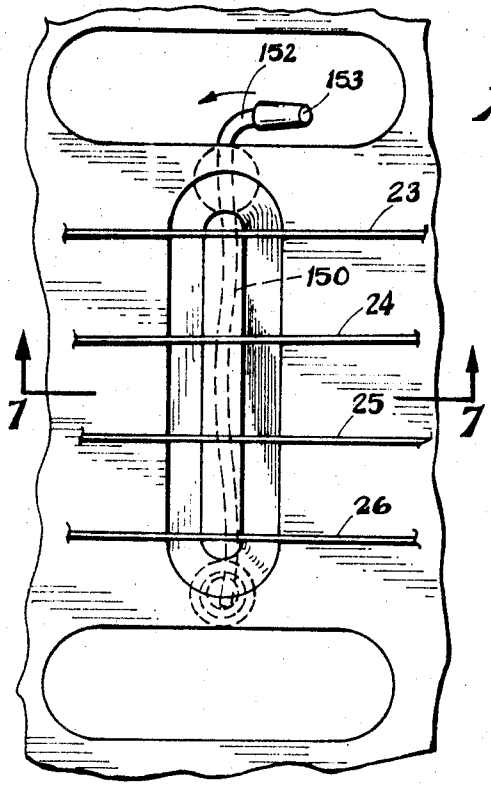


FIG. 5

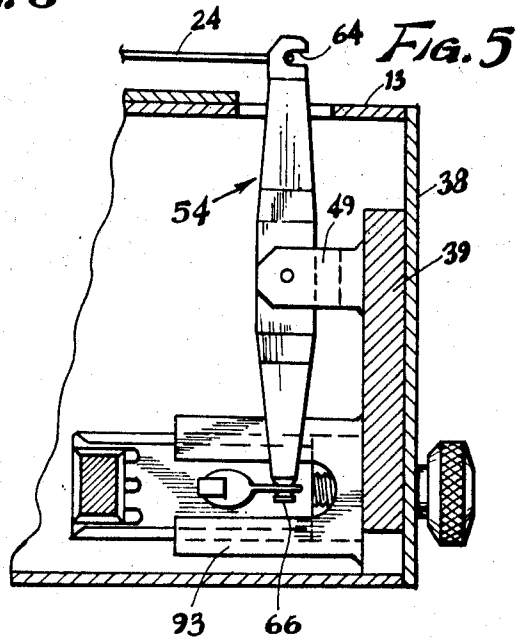
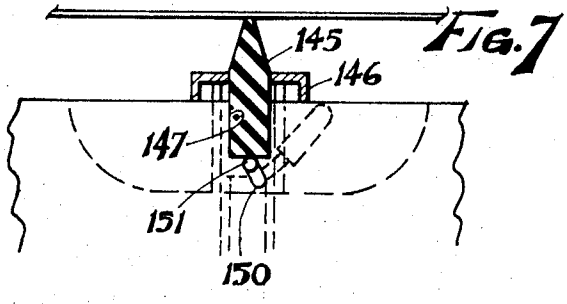


FIG. 7

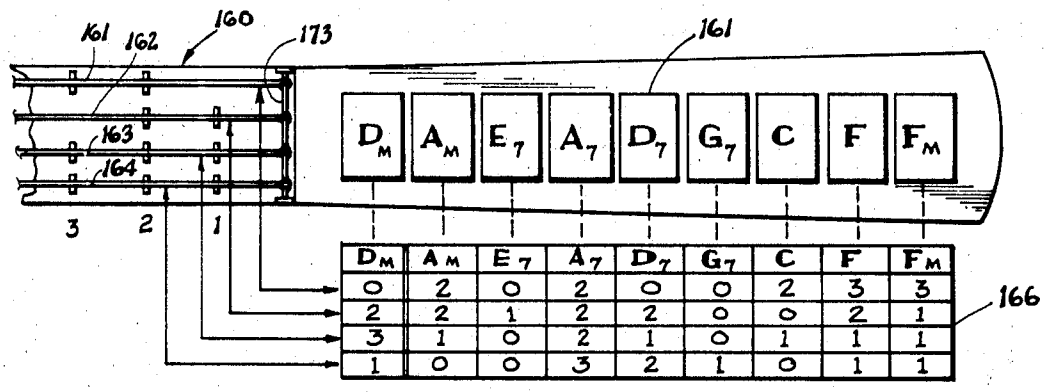


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STRINGED INSTRUMENT HAVING IMPROVED TUNING AND CHORDING MEANS

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D_M	A_M	E_7	A_7	D_7	G_7	C	F	F_M
0	2	0	2	0	0	2	3	3
2	2	1	2	2	0	0	2	1
3	1	0	2	1	0	1	1	1
1	0	0	3	2	1	0	1	1

166

FIG. 8

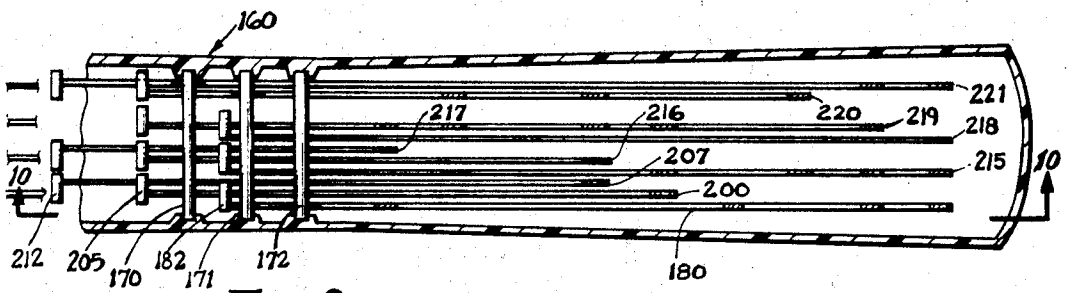


FIG. 9

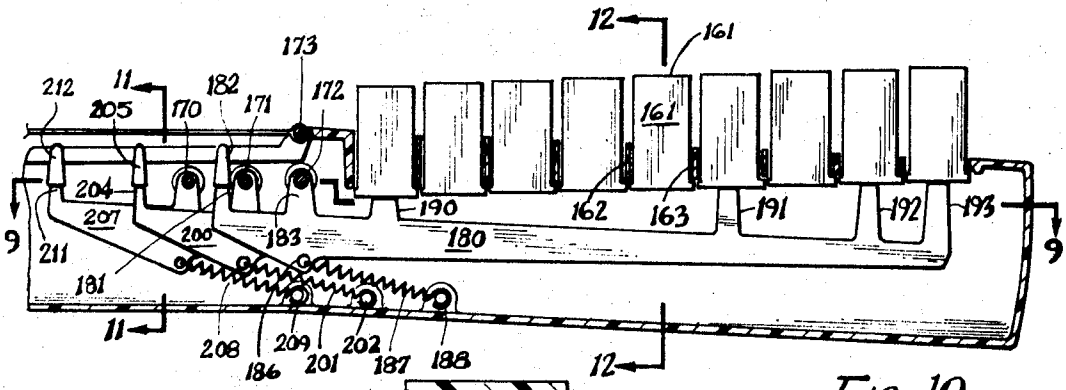


FIG. 10

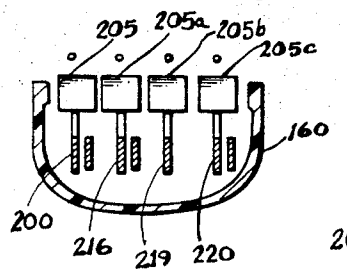


FIG. 11

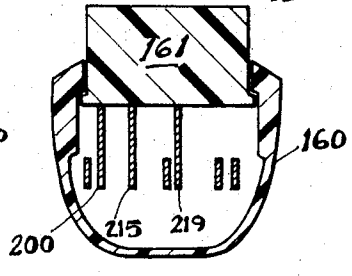


FIG. 12

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STRINGED INSTRUMENT HAVING IMPROVED TUNING AND CHORDING MEANS

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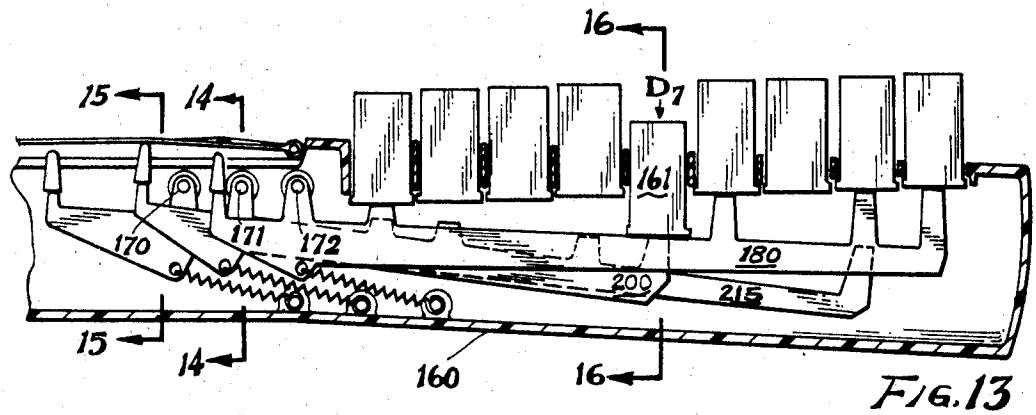


FIG. 13

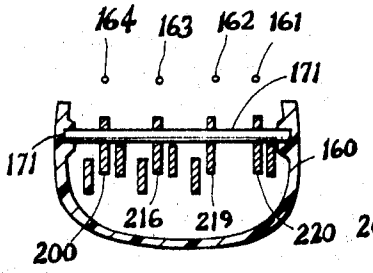


FIG. 14

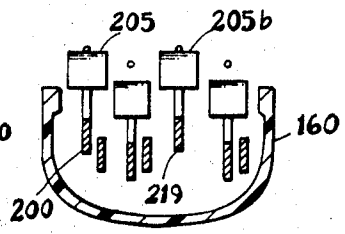


FIG. 15

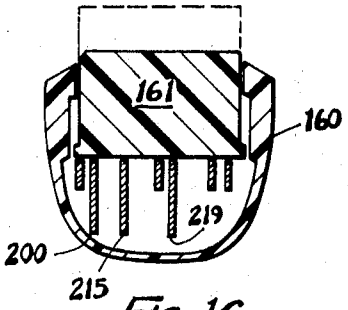


FIG. 16

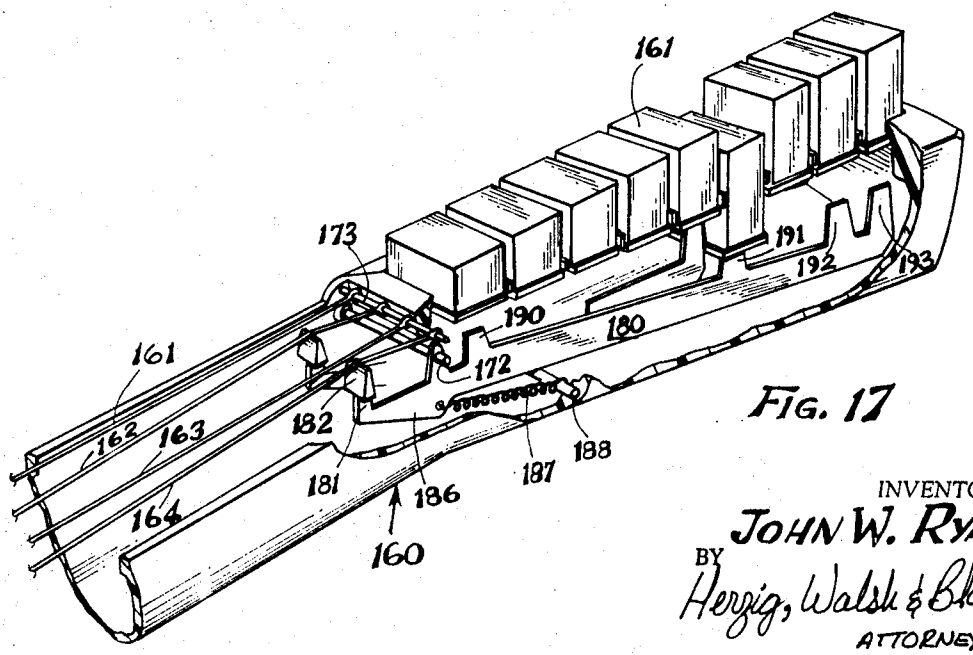


FIG. 17

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United States Patent Office 3,439,571
Patented Apr. 22, 1969

3,439,571

STRINGED INSTRUMENT HAVING IMPROVED TUNING AND CHORDING MEANS

John W. Ryan, Bel Air, Calif., assignor to Mattel, Inc., a corporation of California

Filed Jan. 3, 1967, Ser. No. 606,621
Int. Cl. G10d 3/14
U.S. Cl. 84—312 4 Claims

ABSTRACT OF THE DISCLOSURE

A guitar resonance chamber has upstanding levers pivoted therein and to the upper ends of which the guitar strings are attached. A whiffletree arrangement, forwardly of the upstanding levers, applies equal tuning forces to the lower ends of the levers and a manually actuable screw, accessible at the rear of the instrument, is arranged to actuate the whiffletree arrangement.

This invention relates to musical instruments of the stringed type such as for example, guitars. The invention is described herein in exemplary form as applied to a guitar.

Stringed musical instruments ordinarily are provided with a set of strings each of which is tuned to a certain frequency and tone quality. Tuning is ordinarily accomplished by having means for individually adjusting the tension of each string. Ordinarily, quite frequent tuning is necessary to maintain the strings at the necessary tension to produce required tone values. Accordingly, tuning is more or less tedious and time consuming. It is accordingly an object of this invention to provide improved means for holding and tensioning the strings of the instrument, so constructed that all of the strings are equally tensioned and so that the tension of all of them can be varied simultaneously and equally for tuning. In a preferred form of the invention the string tensioning means takes the form of an assembly of pivoted whiffletree members, each having one end connected to hold a string and arranged for having tensioning force applied to the opposite end. In this manner, balanced tensions are exerted on the strings compensating for variations in the physical characteristics of the strings themselves to the end that improved and simultaneous tuning can be realized. In effect the instrument is self-tuning.

A further object resides in the provision of particular means for realizing the balanced tensioning of the strings comprising yokes (or single-trees) pivotally mounted at their mid-points and each having one end connected to a string; secondary yokes with each end of each secondary yoke connected to an end of a yoke which has a string connected to its opposite end, the mid-points of the secondary yokes being linked to the ends of a double-tree yoke pivotally mounted at its mid-point, so that the tension in each string is balanced against the tension in other strings.

As a further novel aspect of the invention, it provides improved and simplified means for automatic chording by the operation of keys or buttons. Chording devices to be used in connection with stringed instruments have been known in the past and have embodied a number of different constructions varying in detail. In all of these known prior art devices an arrangement was provided whereby the chording device operated in cooperation with the frets of the instrument to depress one or more strings downwardly on to a fret, thus simulating manual chording by depressing strings with the fingers. The herein invention embodies a new and novel construction wherein the chording is accomplished by upward movement of members into contact with the strings. In other words,

in effect individual frets cooperating with individual strings are moved upwardly to accomplish the chording. This construction has a number of very significant utilities and advantages. It has particular advantage and utility in combination with the improvements described above for maintaining the strings similarly tensioned. This lies in that the improved chording means does not interfere with the tuning of the instrument and the maintenance of the tuning. Furthermore, the nature of the improved construction is such that it can be built as a simplified, compact assembly adapted to be built into the neck of the instrument in a position beneath the panel of finger operated keys. In other words, the mechanism of the chording device can be housed within this part of the instrument, thus avoiding cumbersome and unwieldly mechanisms built on to or attached to the outside of this part of the instrument and having operating elements which come down onto the strings.

Accordingly, it is a further object of the invention to provide an improved chording mechanism for stringed instruments having the characteristics set forth in the foregoing, and more particularly that the device embodies members which move upwardly into engagement with one or more strings for chording.

A further object is to provide an improved chording device as set forth in the foregoing having a construction adapting it to be built into and housed within the neck part of the instrument, and beneath a key panel carrying the chording keys.

Another object is to provide an improved chording device as set forth in the foregoing embodying a plurality of elongated pivoted members operable by keys, each member having a part positioned to move upwardly into engagement with a string and the members having a construction such that a plurality of the said members may be simultaneously operated by manipulation of a single chording key.

Another object is to provide an instrument having combined therein the improved string tensioning means as described and the improved chording means.

Further objects and additional advantages of the invention will become apparent from the following detailed description and annexed drawings wherein:

FIGURE 1 is a perspective view of a guitar embodying the improved string tensioning means;

FIGURE 2 is a sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 2;

FIGURE 4 is a view taken along the line 4—4 of FIGURE 2;

FIGURE 5 is a sectional view taken along the line 5—5 of FIGURE 4;

FIGURE 6 is a top plan view of a detail of FIGURE 1;

FIGURE 7 is a sectional view taken along the line 7—7 of FIGURE 6;

FIGURE 8 is a partial plan view of a stringed instrument embodying the improved chording means of the invention;

FIGURE 9 is a sectional view taken along the line 9—9 of FIGURE 10;

FIGURE 10 is a sectional view taken along the line 10—10 of FIGURE 9;

FIGURE 11 is a sectional view taken along the line 11—11 of FIGURE 10;

FIGURE 12 is a sectional view taken along the line 12—12 of FIGURE 10;

FIGURE 13 is a view similar to FIGURE 10 showing one chording key depressed;

FIGURE 14 is a sectional view taken along the line 14—14 of FIGURE 13;

FIGURE 15 is a sectional view taken along the line 15—15 of FIGURE 13;

FIGURE 16 is a sectional view taken along the line 16—16 of FIGURE 13;

FIGURE 17 is a perspective view of the improved chording device of FIGURES 8 to 16;

FIGURE 18 is a detail view of the linkage of the double-tree to a secondary yoke.

Referring now more in detail to FIGURES 1 to 7 of the invention, numeral **10** designates generally a stringed instrument in the form of a guitar having a carrying strap **11**. The body of the instrument **13** may be of conventional construction having a configuration as shown, the top surface of the sounding chamber having an opening **15** underneath the strings as shown. The instrument has an extending neck **17** of conventional construction at the end of which is a head board **19**. In the head are formed openings to receive the usual posts or pins such as shown at **21** around which the ends of the strings are wrapped, the posts being adjustable about their axes for tensioning the strings. The strings of the instrument are designated at **23, 24, 25,** and **26**.

The strings are individually held at their opposite ends in a manner whereby uniform tension is maintained in them as will be described. The holding means for the strings extend outwardly from the interior of the body of the instrument through openings as designated at **30, 31, 32,** and **33** in FIGURE 2, the ends of the holding means being adjacent to a reinforcing member **35** on the top surface of the instrument.

The holding and tensioning means for the strings are such as to maintain uniform tension in all of the strings. This construction is shown in detail particularly in FIGURES 2, 3, 4, 5, and 6. Numeral **38** designates the end wall of the body **13** of the instrument. Attached to this end wall is a reinforcing or stiffening member **39** having a configuration as shown in FIGURE 2 and being attached by bolts such as shown at **41** in FIGURE 4. This member supports a group of pivoted yokes which may also be described as whiffletree or single-tree members. Extending inwardly from the reinforcing member **39** are a group of supporting posts or brackets as designated at **45, 46, 47, 48,** and **49** in FIGURE 2. Numerals **53** and **54** designate the two intermediate yokes or single-tree members. These members are similar in construction. Referring to the member **54**, it has an enlarged central part as designated at **56**, this part having an elongated opening **57** providing side parts on opposite sides of the opening. The single-tree **54** has its opening **57** fitted over the extending support post or bracket **48**. The side parts fit between the posts or brackets **47** and **48** and the posts or brackets **48** and **49**. The yoke **53** is of similar construction being similarly mounted on the post or bracket **46** between the posts **45** and **47**. The yokes **53** and **54** are mounted to rotate about a central pivot axis, being pivoted on a pivot shaft **60** extending transversely through the posts **45** to **49** and through the intermediate part of the yokes **53** and **54**.

The yoke **54** has an enlarged upper end part **62** having a slot **63** as shown in FIGURE 2 and a rear slot **64** adapted for having the string **24** secured thereto. At the lower end of the yoke **54** it is rounded having oppositely spaced conical portions providing a small diameter for attachment to a connecting link as will be described, this end construction being designated at **66** in FIGURE 5.

Two additional yokes or single-tree members are designated at **70** and **71**. They are similar in construction to the yokes **53** and **54**. They are pivotally mounted in spaced relationship to the yokes **53** and **54**, but at inclined angles as may be seen in FIGURES 2 and 4. The yoke **70** is mounted by way of posts or brackets **73, 74,** and **75** extending inwardly from the reinforcing member **39**, the yoke **70** being pivotally mounted by way of a transverse pivot shaft **78**.

Yoke **71** is mounted by way of mounting posts or brackets **80, 81** and **82** and is pivoted on a transverse pivot shaft **83**.

As will be understood, from the foregoing, one of the strings **23, 24, 25,** and **26** is secured to one of the projecting ends of each of the yokes **53, 54, 70** and **71**. These yokes may be simultaneously adjusted about their pivots to tension the strings as will be described and this means is constructed so that uniform tension is maintained in the strings.

Numeral **90** designates a double-tree having a configuration as shown. The double-tree **90** is pivotally mounted on the end of adjustable guide stem or bracket **91** as shown in FIGURE 3. This stem is guided by guide plates **92** and **93** extending from the reinforcing member **39**. Numeral **95** designates a threaded stem received in a threaded bore **96** in the member **91**, this stem extending through the reinforcing member **39** to the exterior of the instrument and having a knurled adjusting knob **99** on the end thereof. The purpose of this adjusting knob will be described more in detail presently.

The double-tree **90** has a configuration as shown in FIGURE 2. It has an intermediate enlarged part having therein elongated opeings **101** and **102** so as to in effect, form laminations **103, 104,** and **105**. The end part of the support bracket **91** as shown in FIGURE 3 has slots formed therein as shown in **107, 108,** and **109** and laminations **103, 104,** and **105** of the double-tree **91** are fitted into the slots and the double-tree is pivoted to the member **91** by a pivot shaft **112**.

The left end of double-tree **90** has a slot as shown at **114** and the right end of the double-tree **90** has a slot as shown at **115**. The double-tree **90** is connected by links to additional secondary yokes or single-tree members as designated at **117** and **118** in FIGURE 4. These members have a configuration similar to the yokes **53, 54, 70** and **71**. The mid-point of yoke **117** is pivotally connected to a link **120**, the other end of which is pivotally connected to one end of the double-tree **90**. The mid-point of yoke **119** is pivotally connected to a link **121**, the other end of which is pivotally connected to one end of the double-tree **90**. The link **120** is slotted at each end having two slots at each end. Accordingly, one end interleaves into the mid-point of yoke **117** and is attached thereto by a pivot shaft **119**. The other end of link **121** interleaves with the end part of double-tree **90** as shown in FIGURE 2 and is pivotally attached thereto by the pivot shaft **123**. Link **121** has a similar construction being similarly pivotally attached to the yoke **118** and its other end being interleaved with the end part of double-tree **90** and being pivotally attached thereto by a pivot shaft as shown at **124** in FIGURE 2. FIGURE 18 shows the slots **110** and **111** at the end of link **121** which interleave with the bifurcations at the end of double-tree **90**, formed by slot **115**.

At one end of the yoke **117** it has a formation **126** like that designated at **66** at the end of yoke **54**, the yoke **117** having similar formation **127** at its opposite end. The yoke **118** has similar formations or configurations as designated at **129** and **130** at its ends.

The lower end of yoke **53** is linked to an inner end of yoke **117**. The lower end of yoke **54** is linked to an inner end of yoke **118**. The lower end of yoke **70** is linked to an outer end of yoke **117**. The lower end of yoke **71** is linked to the outer end of yoke **118**. The links just referred to are designated in FIGURE 4 in the same order at **133, 134, 135,** and **136**. These links are similar in construction. Referring to the link **135**, it is a linking member with a loop at one end looped over the end fitting at the lower end of yoke **70**. At its opposite end it has a loop lying in a plane displaced 90 degrees and this loop is fitted over the configuration or fitting **126** at the end of the yoke **117**.

From the foregoing, those skilled in the art will observe that each string is attached to one end of a pivoted yoke or single-tree. The opposite ends of two of these yokes are, in turn, linked to the opposite ends of a further secondary yoke, and the opposite ends of two of the yokes

are linked to the ends of another secondary yoke. The mid-points of the secondary yokes are, in turn, connected by links to the ends of a double-tree pivoted at its mid-point. The double-tree is manually adjusted to act through the yokes to adjust the tension in all of the strings. It will be observed from the arrangement of yokes that when the double-tree is adjusted, the tension forces exerted on the strings are balanced, so that there is uniform tensioning which is maintained during usage to the end that effective tuning of all strings can be realized simply by adjusting the manual knob **99**.

Referring to FIGURE 7 of the drawings, this figure shows an adjustable bridge for the strings. The bridge comprises a vertically adjustable member **145** which may be made of plastic or the like and the upper edge of which is tapered as shown. The member **145** is mounted in a transverse frame **146** having formed in it a guideway **147**, allowing vertical movement of the bridge member **145**. The bridge member **145** may be actuated by a transverse stem member **150** having deformations in it, as shown at **151**, engageable with the bottom of the member **145**. The stem **150** is journalled near its end portions and at one end has a bent part **152**, as shown in FIGURE 6, with an operating handle **153** on it. By swinging the handle **153**, the stem or shaft **150** is moved in a manner to lower and raise the bridge member **145** into contact with the strings.

From the foregoing, those skilled in the art will observe that the improvements of the invention as so far described achieve and realize the objects and advantages thereof, as set forth in the foregoing, particularly in that the strings of the instrument can be maintained uniformly tensioned. Tuning is greatly improved and facilitated and, in fact, the instrument can be described as self-tuning. It should be understood that strings may, of course, be individually tensioned in the usual manner by the holding posts or pins, such as indicated at **21** in FIGURE 1 of the drawings. After such initial tuning, the tuning is maintained and there can be renewed simultaneous tuning in the manner described by adjusting the manual knob **99**.

FIGURES 8 to 17 show an improved chording device. This improved chording device has adaptability for use with any stringed instrument which is chorded. This chording device may be adapted in an instrument having the automatic tuning mechanism of FIGURES 1 to 7, or may be embodied in an instrument not having such automatic tuning mechanism. The chording device has particular adaptability and utility when adapted and combined in an instrument having the automatic tuning mechanism for reasons as set forth in the foregoing, and as will become more apparent from the following detailed description.

In FIGURES 8 to 17, numeral **160** designates a neck part of a stringed instrument having strings **161**, **162**, **163**, and **164**. The end part or stem of the instrument neck **160** may be formed as a plastic housing having the chording mechanism built into it, the chording mechanism embodying members that move upwardly to come into engagement with the strings, as will be described. The top surface of the housing **160** has rectangular openings therein in which are received the chording keys, the center one being designated at **161**. Preferably, the chording keys are constructed in form of plastic blocks having the chords designated on them as shown in FIGURE 8. At the sides of the openings which receive the keys, there are formed vertical guide spacers, such as shown at **162** and **163** for the key **160** so as to guide the vertical movement of the keys. The keys are provided with bottom end flanges, as shown, to prevent them from coming out of the openings. The keys are normally biased into their upward positions, as will be described.

As indicated in FIGURE 8, there are chording positions as designated at **1**, **2**, and **3**. FIGURE 8 includes a chart **166** of various chords as designated thereon which are produced by depressing individual chording keys. The chart **166** designates the relative chording positions for each string with respect to each chord.

Within the housing **160** there is provided a group of elongated chording levers. These levers are generally similar in shape except as will be described hereinafter. The levers are in groups, each group being pivoted on one of the three transverse pivot shafts, as designated at **170**, **171**, and **172** in FIGURE 9, the ends of these shafts being journalled in bosses on the inside of the side walls of the housing **160**. The strings in this form of the invention are preferably simply attached to a transverse shaft **173**. Numeral **180** designates one of the chording levers illustrating the general shape of the levers. See FIGURES 10 and 17. The lever **180** is one of those pivoted on the shaft **172**. It has an upwardly extending projection **181** at its left end on which there is a plastic fitting or cap **182** which comes into engagement with the string **164** from underneath. The lever **180** has an upwardly extending projection **183** adjacent its left end which is pivoted on the pivot shaft **172**. The lever **180** has a downwardly extending projection **186** near its left end to which is attached a biasing spring **187** and the other end of which is attached to a shaft **188** so that the lever **180** is normally biased in a counter-clockwise direction. On the upper surface of the lever **180** are upwardly extending projections **190**, **191**, **192**, and **193** which are of varying length depending upon their distance from the pivot shaft **172** to thereby adapt them to simultaneously engage the bottom surfaces of key members, as illustrated in FIGURE 10. As may be seen, the lever **180** may be actuated by any one of four chording keys.

Numeral **200** designates a similar lever mounted on shaft **171** and similarly biased by a spring **201** attached to shaft **202**. Lever **200** has an upwardly extending projection **204** having an end piece **205**. Numeral **207** designates a further lever pivoted on the shaft **170**. It is biased in a counter-clockwise direction by a spring **208** connected to it, the other end of the spring being connected to shaft **209**. Lever **207** has an upwardly extending projection **211**, having a plastic cap **212** on it. It will be observed that levers **200** and **207** have only a single upstanding projection so that each of these levers is operable by only one of the chording keys. The remaining levers are designated by the numerals **215**, **216**, **217**, **218**, **219**, **220**, and **221**. The levers **215** and **218** are on the shaft **172**. The levers **216** and **219** are mounted on the shaft **171**. The levers **217** and **221** are mounted on the shaft **170**. From an inspection of FIGURE 9, it will be observed that whereas lever **180** has four upwardly extending projections; lever **200** has one; lever **207** has one; lever **215** has five; lever **216** has one; lever **217** has one; lever **218** has two; lever **219** has five; lever **220** has three; and lever **221** has two. The upwardly extending projections correspond to the positions of the chording keys and the columns of the chart **166** in FIGURE 8. Each lever can be actuated by any key having a position corresponding to a projection on that lever. It will be observed from FIGURES 8 and 9 that each chording key is in a position to engage simultaneously one or more of the upstanding transversely aligned projections, the keys being aligned with the columns of the chart **166** and the transverse groups of projections as shown in the figures. Thus it may be readily observed from the chart and figures what chord will be produced by depressing each key.

FIGURE 11 shows the normal position of the ends of levers **200**, **216**, **219**, and **220** having end caps **205**, **205***a*, **205***b*, and **205***c*. These levers can chord the strings at chording position **2**.

FIGURE 12 is a cross sectional view showing key **161** in the undepressed position over the projections on levers **200**, **215**, and **219** which are aligned transversely as may be seen in FIGURE 9, and with the key **161**.

FIGURE 13 shows the key **161** depressed and illustrating the actuation of the three levers by this key to

produce a chard as indicated in the chart **166**. FIGURE 16 is a cross sectional view like FIGURE 12 showing key **161** depressed and showing the actuation of the three levers **200**, **215**, and **219** by this key.

FIGURE 14 shows the pivot shaft **171** and the levers **200**, **216**, **219**, and **220** mounted on it.

FIGURE 15 is a figure similar to FIGURE 11, but showing the position of levers **200** and **219** when the key **161** is depressed, this key also depressing the lever **215** which is pivoted on the shaft **172**, this lever effecting chording at chording position **1**, as may be observed in FIGURE 13.

From the foregoing those skilled in the art will understand the construction and operation or utilization of the chording mechanism. The chording is effected by members moving upwardly into engagement with the strings in three chording positions. Any desired chords can be realized in accordance with the chart by depressing individual chording keys. The key depresses groups of levers as described, and end parts of which move upwardly into engagement with groups of strings, the levers being pivoted on transverse pivot shafts. The levers are biased by springs which cause the levers to normally urge the chording keys upwardly into normal positions.

Those skilled in the art will observe that the invention as described herein achieves and realizes all of the objects and advantages as set forth in the foregoing, as well as having many additional advantages that are apparent from the detailed description. The string tensioning and tuning means of FIGURES 1 to 7 makes possible simplified tuning and maintenance of tuning. The chording device of FIGURES 8 to 17 is unique and novel, particularly in that the chording is effected by moving members upwardly into engagement with the strings. The nature of the device is such that it is adapted to be built as a compact unit and housed within the neck of the instrument. The improved chording mechanism is highly adapted to use with the improved string holding and tensioning means and provides the new result that the chording means in no way interferes with the tensioning of the strings and the tuning of the instrument.

What is claimed is:

1. In a musical instrument having a resonance chamber, a neck attached thereto and a plurality of strings each having one end secured to said neck: frame means in said chamber; a plurality of first levers pivotally mounted, intermediate their ends, on said frame means; the other end of each string being secured to one end of said first levers; and manually operable tuning means comprising at least one secondary lever having its opposite ends connected respectively to the other ends of two of said first levers; said tuning means further comprising manually actuable means extending to the exterior of said chamber and arranged to apply a tuning force to the central portion of said secondary lever for applying equal forces to the other ends of all said first levers to vary the tensions of all said strings simultaneously.

2. An instrument as defined in claim **1** wherein said manually actuable means comprises a rotary threaded member journalled in a wall of said chamber; said tuning means further comprising a threaded member engaging the threads of said rotary member and operatively connected to said central portion of said secondary lever.

3. An instrument as defined in claim **1** wherein said chamber is defined in part by an upper wall along which said strings extends; a plurality of adjacent openings through said upper wall, said one end of said first levers extending upwardly through said openings with said strings secured thereto above said upper wall.

4. An instrument as defined in claim **1** wherein said chamber is defined in part by an upper wall along which said strings extends; a bridge movably mounted on said upper wall adjacent said openings and manually operable means for selectively moving said bridge upwardly into contact with said strings or downwardly therefrom.

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