July 1, 1969 R. A. SEBERS ET AL 3,452,635

STEEL GUITAR TUNING MECHANISM

Filed Jan. 4, 1967 Sheet 1 of 3

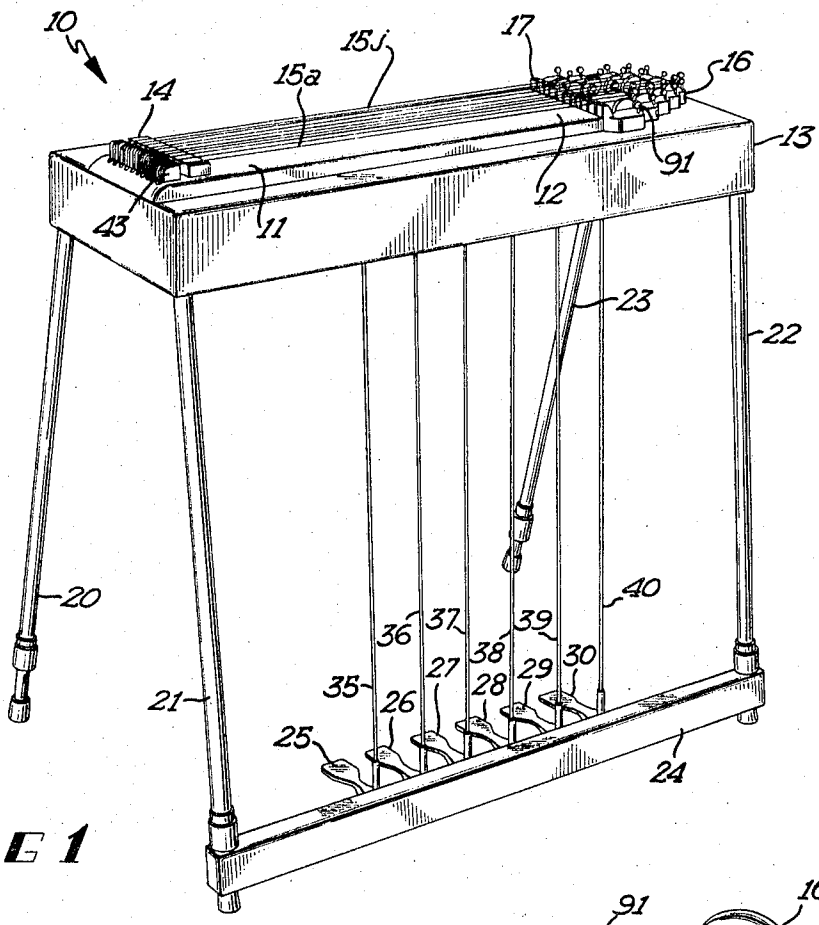


FIG 1

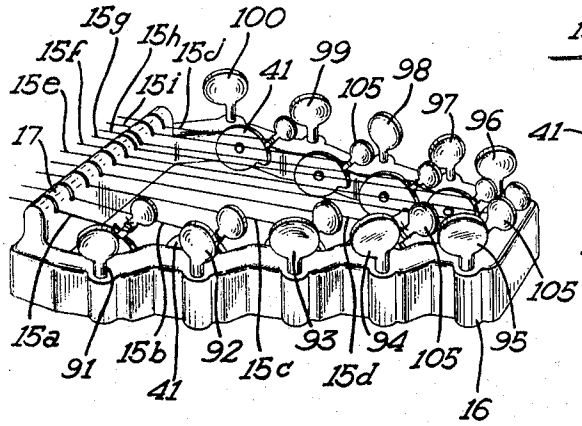


FIG 5

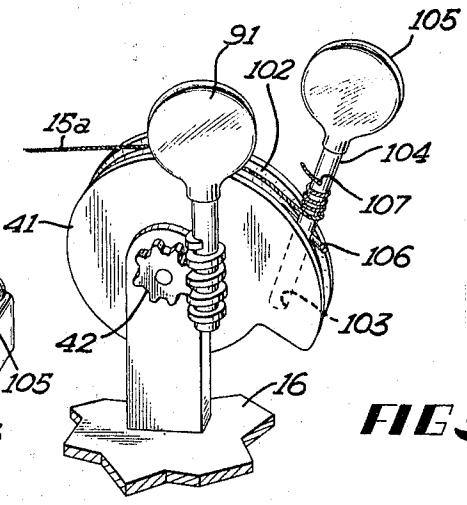


FIG 3

INVENTORS
RALPH A. SEBERS,
DONALD E. SMITH

BY Schroeder, Siegfried & Ryan ATTORNEYS

July 1, 1969 R. A. SEBERS ET AL 3,452,635

STEEL GUITAR TUNING MECHANISM

Filed Jan. 4, 1967 Sheet 2 of 3

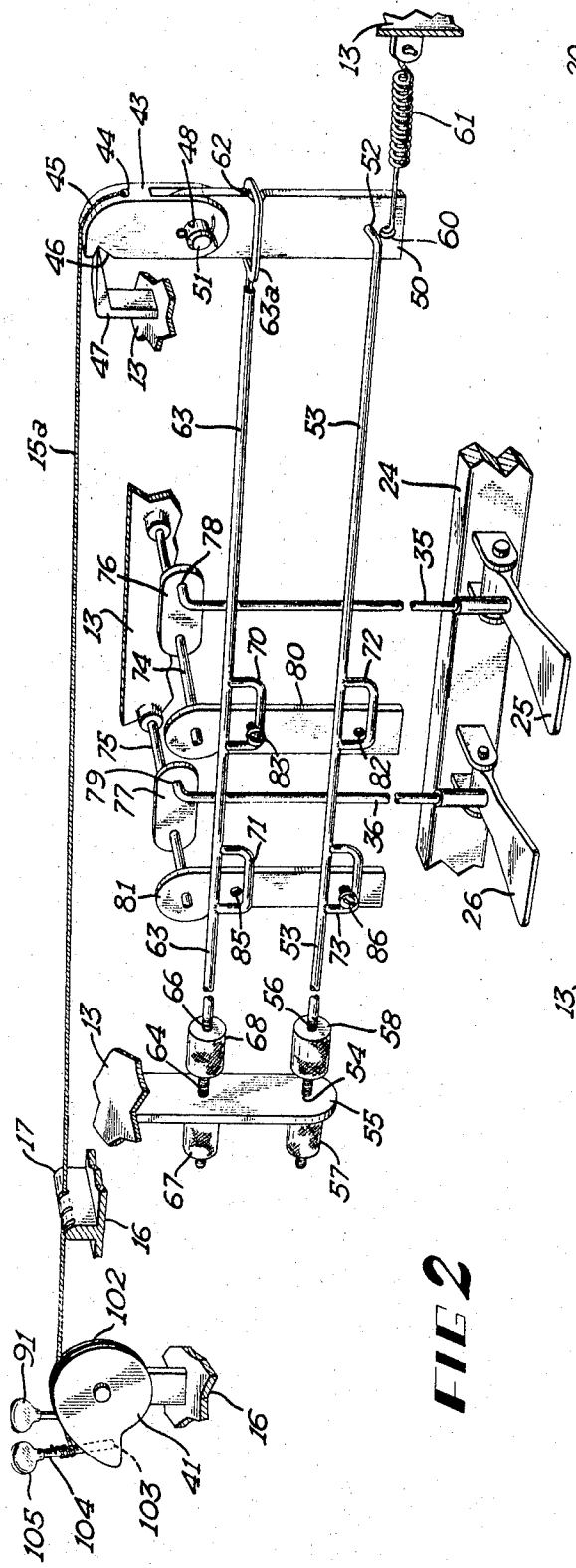


FIG 2

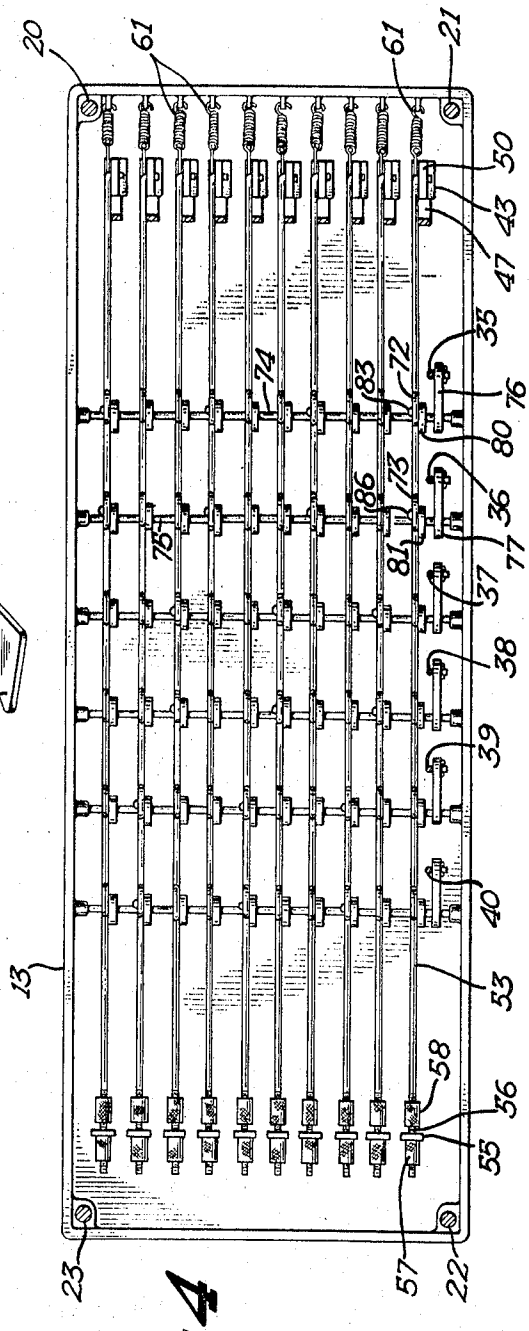


FIG 4

INVENTORS
RALPH A. SEBERS,
DONALD E. SMITH
BY
Schroeder, Siegfried & Ryan
ATTORNEYS

July 1, 1969 R. A. SEBERS ET AL 3,452,635

STEEL GUITAR TUNING MECHANISM

Filed Jan. 4, 1967 Sheet 3 of 3

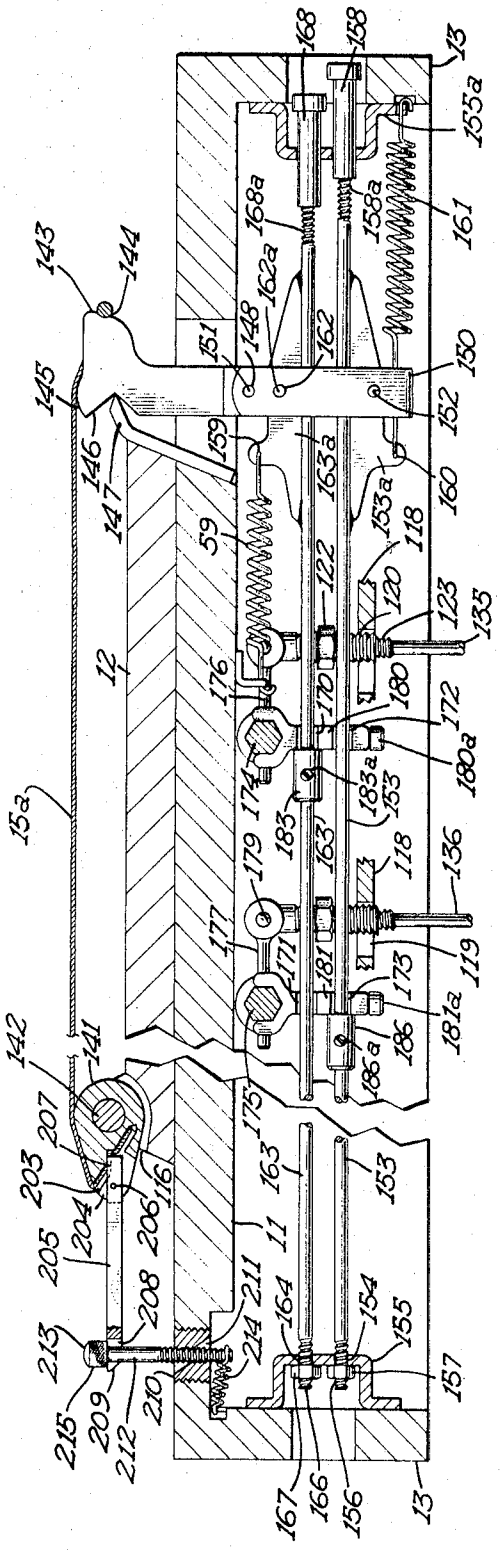


FIG 6

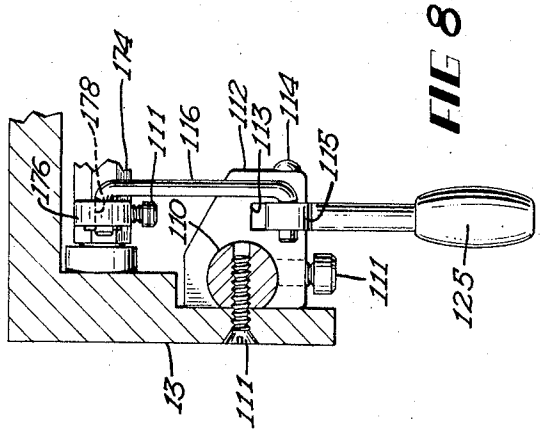


FIG 8

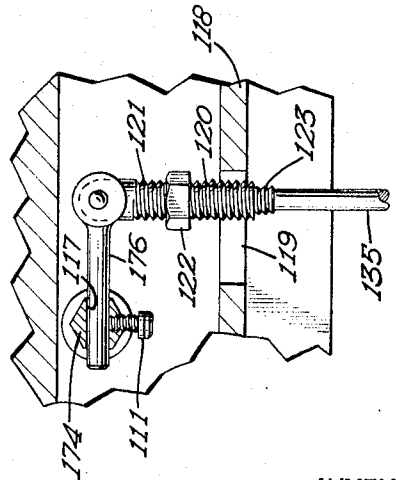


FIG 7

INVENTORS
RALPH A. SEBERS,
DONALD E. SMITH

BY Schroeder, Siegfried & Ryan ATTORNEYS

United States Patent Office 3,452,635 Patented July 1, 1969

3,452,635

STEEL GUITAR TUNING MECHANISM

Ralph A. Sebers, 2303 12th Ave., and Donald E. Smith, Rte. 3, both of Rochester, Minn. 55901

Filed Jan. 4, 1967, Ser. No. 611,528
Int. Cl. G10d 3/14
U.S. Cl. 84—312
23 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure of this application is directed to a mechanism for changing the pitch of a stringed instrument while it is being played by changing the tension on the strings through the use of controlled linkages forming one of the bridges. Through the use of foot or knee pedals, a change of key may be made without resort to touching the tuning head. A string tightening mechanism is provided permitting a quick replacement of a broken string.

The tuning mechanism includes means for increasing and decreasing the tension on a plurality of strings where the tension on certain of the same strings has varied previously and remained in such condition.

Prior art workers have recognized that it is desirable to be able to change the pitch of a string on a lute-type instrument such as a steel guitar by the manipulation of a lever which is usually foot operated. However, the mechanisms for accomplishing this desired operation are generally complicated and are generally designed so that they may increase or decrease the pitch of a string, but not both while one is taking place. That is, it is most desirable in the playing of an instrument such as a steel guitar, to be able to change the tension of the strings so as to increase or decrease the pitch by the use of a lever and while the lever is still held in place, change the tension on the string a second time which has the opposite effect as that first incurred. The attempts to adjust the tension on the strings has generally been confined to those types of devices in which the so-called neutral position of the tension on the string is balanced through the use of several springs. It will be recognized that as the springs are flexed, the neutral point tends to shift and thus the instrument must be retuned to achieve the neutral position. Thus an instrument in which the tension of the strings may be increased as well as decreased while already under a tension changing operation provides great versatility for the performer playing the instrument. Furthermore, it has been found that very little improvement has been made to the string tuning mechanism of the instrument and where a string must be replaced, a tedious task is encountered in making several turns of the string around a binding post before being secured at the proper pitch or tension of the string. The present invention provides an easy and uncomplicated means of securing the string to the tuning mechanism.

It is therefore a general object of the present invention to provide an improved tuning mechanism for a lute-type instrument such as an electric steel guitar.

It is another object of this invention to provide a means for increasing and decreasing the tension of a guitar string through the same relative movement of two different control arms.

It is a further object of this invention to provide means for limiting the increase or decrease in the tension on any string.

It is a further object of this invention to provide a tuning mechanism having means for increasing and decreasing the tension on a plurality of strings where the tension on certain of the same strings has varied previously and remains in such condition.

It is still another object of this invention to provide a tuning mechanism having lost motion devices to change the tension on the strings.

It is still another object of the present invention to provide an improved tuning mechanism having a coarse control device for setting the initial tension on the strings.

These and other objects and advantages of the invention will more fully appear from the following description, made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a perspective view of an electric steel guitar incorporating the invention;

FIG. 2 is a diagrammatic view of the invention showing the structure as used on each string;

FIG. 3 is a perspective view of a string tuning mechanism used with the invention;

FIG. 4 is a plan view of a guitar as seen from the bottom showing the operating mechanism;

FIG. 5 shows a perspective view of the string tuning mechanism used in the invention;

FIG. 6 is a diagrammatic view of the invention showing a modified structure as used on each string;

FIG. 7 is a detailed elevation view in partial section of the linkage arm connected to one of the transverse shafts; and

FIG. 8 is a detailed elevation view in partial section of a knee operated lever connected to one of the transverse shafts.

In FIG. 1, a steel guitar **10** having a body portion **11** and a neck portion **12** is secured to a body frame **13** which is box-like in shape with an opening facing downwardly. A magnetic pick-up **14** is secured to body portion **11** under ten strings **15***a* through **15***j*, the magnetic pick-up **14** forming no part of the invention. Secured to the end of neck **12**, is a string tuning mechanism referred to generally as numeral **16**, and a bridge **17**. Secured to each of four corners of frame **13**, are four adjustable telescopic legs **20** through **23**. Secured to legs **21** and **22** (which are the legs pointing to the front of the instrument) is a cross-bar **24**. Six foot pedals **25** through **30** are pivotally secured to cross-bar **24** and operate six vertically operated control rods **35** through **40** respectively.

Reference is now made to FIG. 2 wherein the controlling mechanism is shown which is associated with string **15***a*, it being understood that a like mechanism is associated with each of the strings connected thereto. String **15***a* is anchored over a cam **41** (also see FIG. 3) which is secured to the string tuning frame **16** by a rotatable member having a worm gear wheel **42** connected thereto.

String **15***a* extends over bridge **17** at one end of the guitar and over another bridge tail piece **43** in the form of a link which supports the string, and secures it in a locking bore **44**. In other words, the string passes over the upward portion of the link into an anchoring bore **44**. A groove **45** is formed across the top of the link which is somewhat rectangular in nature with a curved portion at the top to provide a good bearing surface for string **15***a*. Link **43** has a notched portion **46** fromed in the front or leading edge of link **43** near its upper end where string **15***a* passes thereover. A knife edge bracket **47** which is secured to frame **13** engages notch **46** to provide a fulcrum for lever **43**. Thus it will be seen that by moving link **43**, either clockwise or counterclockwise, the tension in string **15***a* will be increased or decreased respectively. The lower portion of link **43** is in the form of an inverted U-shaped member through which a bore **48** is formed transverse to the legs of the member. Another link **50** is connected to link **43** by a pin **51** passing through bores **48** and another hole formed in link **50** (not shown). Link

50 has a hole formed near the bottom thereof and an arm 53 is pivotally secured in hole 52 and extends towards the string tuning mechanism where it passes through a hole 54 formed in a guide member 55. Guide member 55 is in the form of an arm extending downwardly from frame member 13. The end portion of rod 53 has threads 56 formed thereon and a stop collar 57 is secured to rod 56 in such a manner as to restrict the movement of arm 53. Another hole 60 is formed in link 50 below hole 52 and has a spring 61 connected thereto which is under tension and secured to frame 13. That is, spring 61 exerts a force in the direction opposite that of the direction in which arm 53 is extended. A notch 62 is formed on the side of link 50 which contains spring 61 at a point approximately ¼ to ⅓ the distance from pin 51 towards hole 52. Another arm 63, having a looped portion 63*a* engaging notch 62, extends under the neck portion 12 and passes through a hole 64 formed in guide 55. Rod 63 also has a threaded portion 66 formed on the end thereof and a collar 67 secures rod 63 against movement.

It will now be seen that links 43 and 50 are in a state of equilibrium and that string 15*a* may be properly set for the right pitch. Since spring 51 exerts a force against link 50, upon movement of rod 63 away from link 50, it will be seen that link 50 pivots about arm 53 at hole 52 and that link 43 pivots clockwise about fulcrum 46 so that the tension on string 15*a* is increased. On the other hand, with rod 63 at rest, movement of rod 53 away from link 50 causes link 50 to pivot about loop 63*a* in notch 62 and thus through the use of pin 51, pivot link 43 counterclockwise to decrease the tension in string 15*a*. By the use of a pair of second stop collars 58 and 68 secured to screw threads 66 and 56 respectively, control may be had over the magnitude of the change in tension on string 15*a*. Thus collar 68 may be set to limit the increase in string tension and collar 58 may be used to limit the decrease in string tension.

Rod 63 has six depending loops formed therein extending between loop 63*a* and threads 64, loops 70 and 71 being shown. It will be understood of course that four additional loops are formed in rod 63 and as will be clearly shown, will operate with control rods 35 through 40. In addition thereto, arm 53 has six depending loops formed as a part thereof which extend between hole 52 and threads 56, loops 72 and 73 being formed directly below loops 70 and 71 of rod 63.

A pair of shafts 74 and 75 are rotatably secured to frame 13 and are located directly above loops 70 and 71 respectively. A pair of lever arms 76 and 77 are secured to shafts 74 and 75 respectively and have a pair of holes 78 and 79 formed in the opposite ends thereof which are connected to control rods 35 and 36 respectively. It will of course be understood that four additional shafts are secured transverse to the guitar frame 13, each having a lever arm secured thereto to be connected to the appropriate foot pedal through the appropriate control rod. A pair of levers 80 and 81 are secured to shafts 74 and 75 respectively and depend downwardly to cooperate with loops 70 and 72, and loops 71 and 73 respectively. A pair of screw holes are formed in lever 80, with a screw hole 82 cooperating with loop 72 and a screw 83 being secured in the screw hole cooperating with loop 70 so that the head of screw 83 slidably engages loop 70 at the end nearest the guide arm 55. In a reverse manner, a screw hole 85 is formed in lever 81 to cooperate with loop 71 and a screw 86 is secured in a hole which cooperates with loop 73 so that loop 73 is slidably engaged with screw 86.

Thus it will be seen that when pedal 25 is depressed, control rod 35 is moved downwardly causing arm 80 to rotate clockwise and since screw 83 engages loop 70, control rod 63 is moved towards guide arm 55 increasing the tension in string 15*a*. In a similar manner, depressing pedal 26 causes control rod 36 to be moved downwardly and rotate lever 81 clockwise, thus moving arm 53 towards guide arm 55 to produce a decrease in the tension on string 15*a*. It should be noted that loops 70 through 73 and the cooperating screws form a lost motion device so that when a pedal is depressed, if another pedal is depressed afterwards while the first is being held in its downward position, with screws 83 and 86 both located to control the same arm (53 or 63), no additional movement will be produced in link 43 and the tension on string 15*a* will remain the same. It will also be recognized that by connecting the arms of the other strings to pedals controlled by shafts 74 and 75, the pitch of several strings may be changed and thus a change of key may be made by the musician. It should also be recognized that the slots formed by the loops in arms 53 and 63 may be formed instead in levers 80 and 81 with the screws held by the arms to engage the slots at the ends opposite to that just described.

Stop collars 68 and 58 may be set to limit the increase or decrease in string tension and thus limit the range of the variation that may take place. Stop collars 68 and 58 may be set to provide the maximum travel of arms 53 and 63 and pedals 25 through 30 may have a stop associated therewith which will allow increments of the full travel of arms 53 and 63 thus allowing one pedal to flat or sharp a note and another pedal to add an additional change of pitch by one-half step or more.

It will also be recognized that the force required to depress pedals 25 through 30 will vary, according to the number of arms which are to be actuated. For instance, one pedal may move only two control rods while another pedal may move four. Thus the force required to depress the pedal will be approximately twice that for the pedal having only half as many control arms. Under such conditions, it may be advisable to provide an adjustable lever arm such as lever arms 76 and 77 by placing the control rods in the eye of an adjustable screw which will be moved radially towards, or away from, the rotating shafts such as shafts 74 and 75.

FIG. 5 shows the string tightening arrangement wherein frame 16 carries ten keys 91 through 100 which have a worm screw formed as a part thereof in the conventional manner. The worm screw engages the worm wheel such as worm wheel 42 (FIGS. 2 and 3), the worm wheel 42 being rotatably secured to frame 16 and having cam 41 formed on the end thereof. It will of course be recognized that the other strings are connected to a similar mechanism. Cam 41 has a groove 102 formed in the upper portion thereof which is formed to receive the string such as string 15*a* and coincides with a bore 103 formed transverse to the slot or groove 102 below worm wheel 42 and forward thereof. Bore 103 receives a slidable stud member 104 which has a finger engaging knob 105 formed at the end thereof. A hole is drilled transversely through stud 104 and is adapted to receive a pin 106 which lies in groove or slot 102 and restricts rotational movement of stud 104. Another hole 107 is formed above pin 106 in stud 104 and is adapted to receive the string such as string 15*a*. In using the mechanism, cam 41 is rotated to a position where stud 104 projects upwardly and the string is passed through the hole 107. Stud 104 is pulled upwardly to disengage pin 106 from groove 102 and is then rotated until the string is tightened by manipulation of knob 105 and is then pressed downwardly so that pin 106 again engages groove 102. Key 91 is then rotated until the string is tightened to its proper pitch.

Reference is now made to FIG. 6 wherein the controlling mechanism is shown associated with string 15*a*, it being understood that a like mechanism is associated with each of the strings connected thereto. String 15*a* is anchored over a cam 141 which is secured to neck 12 through a support member 116 and a stationary member such as a shaft 142.

String 15*a* extends over another bridge tail piece 143 in the form of a link which supports the string, and se-

cures it in a locking notch **144**. In other words, the string passes over the upward portion of the link into an anchoring notch or groove **44**. A groove **145** is formed across the top of the link with a curved portion at the top to provide a good bearing surface for a string. Link **143** has a notched portion **146** formed in the front or leading edge of link **143** near its upper end where string **15***a* passes thereover. A knife edge bracket **147** which is secured to frame **13** engages notch **146** to provide a fulcrum for lever **143**. Thus it will be seen that by moving link **143**, either clockwise or counterclockwise, the tension in string **15***a* will be increased or decreased respectively. The lower portion of the link **143** has a bore (not shown) formed transverse to the member. Another link **150** in the form of a U-shaped member is connected to link **143** by a pin **151** passing through the bore just described and another hole **148** formed in link **150**. Link **150** has a hole **152** formed near the bottom thereof and an arm **153** is pivotally secured in hole **152** through the use of a lug **153***a* formed therewith. Arm **153** extends towards the string tuning mechanism where it passes through a hole **154** formed in a guide member **155**. Guide member **155** is in the form of a bracket connected to the downwardly extending portion of frame member **13**. The end portion of rod **153** has threads **156** formed thereon and a stop collar **157** is secured to rod **156** in such a manner as to restrict the movement of rod **153** to the right as seen in FIG. 6. Another hole **160** is formed in lug **153***a*, the hole being below hole **152**, and has a spring **161** connected thereto which is under tension and secured to frame **13**. That is, spring **161** exerts a force in the direction opposite to that of the direction in which arm **153** is extended. Another hole **162** is formed in both sides of U-shaped link **150** at a point approximately ¼ to ⅓ the distance from pin **151** towards hole **152**. Another arm **163** has a lug portion **163***a* lying between the two legs of link **150** and secured thereto through hole **162** by a pin **162***a*. Rod **163** extends under the neck portion **12** and passes through a hole **164** formed in guide **155**. Rod **163** also has a threaded portion **166** formed on the end thereof and a collar **167** secures rod **163** against movement in a manner described previously relating to rod **153**. A spring **59** is connected to lug **163***a* through a hole **159**. Hole **159** is located vertically between pins **151** and **162***a* and the spring generally exerts less force than that of spring **161** and in a direction opposite to that of spring **161**.

It will now be seen that links **143** and **150** are in a state of equilibrium and that string **15***a* may be set for the correct pitch. Since spring **161** exerts a force against link **150**, upon movement of rod **163** away from link **150**, it will be seen that link **150** pivots about arm **153** at hole **152** and is aided by spring **59**, thus causing link **143** to pivot clockwise about fulcrum **146** so that the tension on string **15***a* is increased. On the other hand, with rod **163** at rest, movement of rod **153** away from link **150** causes link **150** to pivot about pin **162***a* and thus through the use of pin **151**, link **143** is rotated counterclockwise to decrease the tension in string **15***a*. By the use of a pair of second stop collars **158** and **168** having threads **168***a* and **158***a* respectively on rods **163** and **153**, control may be obtained over the magnitude of the change in tension on string **15***a*. The stop collars work against a guide member **155***a* which is secured to the end of the body frame **13**. A provision is made in the side of frame member **13** for adjusting collars **168** and **158** by the musician. In other words, collar **168** may be set to limit the increase in string tension and collar **158** may be used to limit the decrease in string tension.

A pair of shafts **174** and **175** are rotatably secured to frame **13** and are located directly above rod **163** and **153**. A pair of adjustable lever arms **176** and **177** are secured to shafts **174** and **175** respectively and have a pair of holes **178** and **179** formed in the opposite ends thereof which are connected to a pair of flexible cables or control rods **135** and **136** respectively. As described previously, four additional shafts are secured transverse to the guitar frame **13**, each having a lever secured thereto to be connected to the appropriate foot pedal through the appropriate control rod. A pair of downwardly extending levers **180** and **181** are secured to shafts **174** and **175** respectively by a pair of screws **180***a* and **181***a*. A pair of grooves **170** and **172** are formed in the edge of lever **180** to cooperate respectively with rods **163** and **153**. In other words, the grooves are of sufficient width to allow the rods to move freely in the space provided therein. In like manner, another pair of grooves **171** and **173** are provided in lever **181** to also accommodate rods **163** and **153** respectively in the same manner as just described. A pair of sleeves **183** and **186** are fitted over rods **163** and **153** respectively and are adapted to engage levers **180** and **181** respectively. They are secured in place by a pair of set screws **183***a* and **186***a*. If the rods are not to be controlled by a particular lever, then sleeves **183** and **186** should be moved to the left (as seen in FIG. 6) and thus they will not engage the particular levers.

It may also be desirable to widen lever **180** and have another pair of grooves similar to grooves **170** and **171** on the opposite side of lever **180** to engage the sleeves on the arms of the adjacent mechanism for the adjacent string. Of course the same variation may be made to all the other levers such as lever **181**.

It will therefore be seen that when control rod or cable **135** is drawn downwardly, causing arm **180** to rotate clockwise, control rod **163** is moved towards guide arm **155** thus increasing the tension in string **15***a*. In a similar manner, depressing another pedal to which is attached cable or control rod **136**, rotates lever **181** clockwise, thus moving arm **153** towards guide arm **155** to produce a decrease in the tension on string **15***a*. It should be noted that if another sleeve is located adjacent another lever on the same control arm, it will form a lost motion device so that when a pedal is depressed, if another pedal is depressed afterward while the first is being held in its downward position, with sleeves **183** and **186** both located to control the same arm (**153** or **163**), no additional movement will be produced in link **143** and the tension on string **15***a* will remain the same.

In FIG. 8, there is shown a variation of the foot operated pedal by using a knee lever **125**. Secured across the body frame on the side adjacent the player, is a horizontal rod **110** which is secured to frame **13** by the use of a fastening device such as screws **111**. A collar **112** has a bore formed therein and is adapted to slide along rod **110** and be secured thereto below the transverse shafts by suitable means such as screws **111**. A slot **113** is formed in collar **112** parallel to arm **176** and the upper end of knee lever **125** is secured in the slot by the use of suitable means such as a pin **114**. Knee lever **125** has an extendible lug portion **115** through which a bore is formed parallel to hole **178** and a connecting link **116** secures the two in operable relationship. In other words, the knee lever **125** may be operated at the same time that one or two pedals are depressed by the feet to provide an additional change in the pitch of the instrument.

Additional detail of the adjustable lever arms is shown in FIG. 7 where shaft **174** has a hole **117** formed therein through which lever arm **176** extends therethrough and is secured in place by suitable means such as screws **111**. It will be noted that lever arm **176** may have its link increased or decreased. A ledge portion **118** of the frame **13** has a notched portion **119** cut away but the back edge thereof is in close proximity to a barrel **120** which has a plurality of threads **121** formed on the outside thereof, the upper portion being connected with lever arm **176** by a pin in hole **178**. A nut **122** can be adjusted upwardly or downwardly to control the movement of cable or rod **135** if so desired. Cable or rod **135** has a threaded portion **123** on the end thereof which screws into internal threads formed in the barrel **120** of the mechanism. It will be

understood that the other members cooperating with the different shafts are all constructed in the same manner.

Returning again to FIG. 6 and in particular to a structure for anchoring the string at the tuning head end, it will be found that a bore **203** is formed in the end of cam **141** which extends downwardly and towards link **150** in its operable position. Communicating with bore **203**, is a cavity **204** which is formed in the end thereof and has a right angled portion which extends through bore **203**. A stud **205** is pivotally secured in cavity **204** by the use of a pin **206** and projects into the right angle corner of the cavity so as to intercept the bore **203**. The end of stud member **205** has a groove **207** formed in the end thereof to engage the string such as string **15***a*. In other words, string **15***a* is bottomed at the bottom of bore **203** and stud **205** is pivoted into engagement with the string and by the use of the right angle corner of the cavity, the string is locked in place and secured against movement. The end of stud member **205** has a U-shaped portion **208** formed therein which opens to the end thereof where a cam surface **209** is formed on the face portion. The camming surface **209** is slanted downwardly and towards link **150**. Secured in frame **13**, is a quick acting type nut of threaded arrangement and in the particular embodiment shown, a quick acting insert **210** is employed. Insert **210** is screwed into the frame in a normal manner and may be of the type supplied by the Reid Tool Supply Company, Muskegon Heights, Mich., carrying a catalog series number QA. As shown, threads are formed in the normal manner on insert **210** at the lower left side and upper right side with a slightly larger bore **211** formed in the insert which will allow a tiltable post **212** to be tilted counterclockwise to disengage post **205** at the U-shaped portion **208**. Post **212** has a rounded head **213** so that camming surface **209** will provide a smooth engagement therewith. A spring **214** is connected between frame **13** and the lower part of post **212** to provide a bias urging the upper portion of post **212** into engagement with the U-shaped portion **208** of stud **205**. A knurled portion **215** of the head of post **212** provides a gripping surface to rotate the screw and thus change the elevation of stud **205** and thus provide a fine tuning for the pitch of the string. It will be observed that in replacing a string, it is only necessary to engage the end of the string in notch **144** and pass the string downwardly into bore **203**, lock in place with stud **205** and snap it past the rounded head portion until the flanged head of post **212** engages the U-shaped end of stud **205** and locks it in place.

It will thus be apparent that there has been disclosed a new and improved structure for adjusting the tension on the strings of a musical instrument while playing the instrument so that a key change may take place. The mechanism allows one change to be placed "on top of the other" so that the musician while having one pedal depressed, may make another change, which may be opposite that originally made. Cooperating with the tuning mechanism, is an improved device for initially setting the tension on the string which provides greater simplicity and each of operation over previous structure.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts without departing from the scope of the invention which consists of the matter shown and described herein.

What is claimed is:

1. A tuning mechanism for a guitar having a body and a neck with a string under tension anchored thereto passing over the body and neck and tuning head at one end of the guitar neck, said mechanism comprising:

(a) knife edge fulcrum means extending longitudinally away from the tuning head and secured to the guitar body at the end opposite the neck;

(b) first link means having a V-shaped groove formed therein near the upper end thereof cooperating with said knife edge fulcrum means, said first link means having the string anchored thereto and passing over the upper edge of said link means;

(c) second link means pivotally secured to the lower end of said first link means;

(d) first arm means pivotally connected to said second link means in spaced relationship from said first link means;

(e) second arm means pivotally connected to said second link means at the lower end thereof;

(f) spring means connected to said second link means below said second arm means and said guitar body to apply a constant spring bias along said second arm means in opposition to the movement thereof;

(g) first stop means engaging said first and second arm means and restraining said arm means against movement towards said link means;

(h) and first selectable actuating means for selectably moving one of said first and second arm means away from said link means to change the tension in the guitar string.

2. The invention as set forth in claim **1** including:

(i) adjustable length controlling means connecting said first stop means to said arm means to tune said string to a predetermined pitch when said link means is at rest.

3. The invention as set forth in claim **1** including:

(j) second stop means engaging said first and second arm means to limit the increase or decrease in the tension on said string by a predetermined amount.

4. The invention as set forth in claim **1** including:

(k) second stop means cooperating with said first selectable actuating means to limit the increase or decrease in the tension on said string by a predetermined amount.

5. The invention as set forth in claim **1** wherein said first arm means and said second means include:

(l) a V-shaped notch formed in said second link means on the side opposite said knife edge fulcrum means and a looped portion formed on the end of said arm means and cooperatively engaging said V-shaped notch to provide a pivotal connection.

6. The invention as set forth in claim **1** wherein said first selectable actuating means includes:

(m) lever means pivotally connected to said guitar body, said lever means being pivotally secured to one of said first or second arm means;

(n) and a foot operated control rod extending substantially vertically from said lever means to impart rotation thereof which causes said first and second arm means to move away from said second link means.

7. The invention as set forth in claim **6** wherein said lever means includes:

(o) a first lever arms pivotally connected to one of said arm means;

(p) and a second adjustable lever arm secured to said first lever arm for changing the amount of force required to cause a movement of said first or second arm means.

8. The invention as set forth in claim **1** including:

(q) a cam means over which said string passes, said cam means being rotatably secured to said neck and having a cavity formed therein;

(r) a stud member pivotally secured in said cavity of said cam means and having said string engaged therewith to secure and set the tension on said string;

(s) and a locking member secured to said neck and cooperating with said cam means to rotatably move and hold said cam means at a selectable position.

9. The invention as set forth in claim **1** including:

(t) second selectable actuating means for selectively moving at least one of said first and second arm means away from said link means to increase or decrease the tension in the guitar string.

10. The invention as set forth in claim 9 including:
(u) lost motion means connected to at least one of said first and second arm means and said cooperating first and second selectable actuating means causing movement the first instance one of said selectable actuating means are actuated to move the same arm means.

11. The invention as set forth in claim 1 including:
(v) second spring means connected to said second link means between said first arm means and the pivotal connection with said first link means and said guitar body to apply a constant spring bias along said first arm means to aid in the movement thereof.

12. The invention as set forth in claim 3 including:
(w) guide means secured to each end of said guitar body cooperating with said first and second arm means and said first and second stop means to set the tension of the cooperating guitar string when at rest and to limit the change in tension on said string by a predetermined amount.

13. The invention as set forth in claim 1 including:
(a) a cam means over which said string passes, said cam means being rotatably secured to said neck and having a bore formed threin below the axis of rotation;
(b) a thumb screw secured to said neck and cooperating with said cam means to rotatably move and hold said cam means at a selectable position;
(c) a stud member rotatably secured in said bore of said cam means and having said string wound thereabout to set the tension on said string;
(d) and a stud locking member locking said stud against rotation in said bore.

14. The invention as set forth in claim 1 including:
(e) a cam means over which said string passes, said cam means being rotatably secured to said neck and having a recessed portion for receiving said srting;
(f) a stud member secured to said cam means and arranged to rotate said cam means therewith, the end thereof having a camming surface slanting downwardly and rearwardly when at, or near, an operable position;
(g) and a tiltable post pivotally secured to said neck and extending upwardly to engage caid camming surface of said stud member, said tiltable post having a flange portion engaging the upper surface of said stud member when said stud member is in operable position.

15. The invention as set forth in claim 14 including:
(i) releasable fastening means cooperatively engaging said tiltable post and said neck providing means for lengthening and shortening the amount said tiltable post extends above said neck.

16. The invention as set forth in claim 14 including:
(j) a bore formed in said cam means through an end portion generally facing away from said link means;
(k) a cavity communicating with said bore and extending through said bore along a portion thereof, said cavity and bore being constructed and arranged to receive said string therein;
(l) and pin means pivotally securing said stud member to said cam means and to engage said string in said cavity and bore and secure said string against slipping.

17. The invention as set forth in claim 1 wherein said first and second arm means includes cable means under tension.

18. The invention as set forth in claim 1 including:
(h) a cam means over which said string passes, said cam means being rotatably secured to said neck and having a recessed portion for receiving said string;
(i) a stud member secured to said cam means and arranged to rotate said cam means therewith, the end thereof having a yoke portion extending outwardly and away from said cam means;
(j) and a locking member releasably secured to said neck and extending upwardly to engage said yoke portion of said stud member, said locking member having a flange portion cooperatively engaging the upper surface of said yoke portion when said stud member is in operable position.

19. The invention as set forth in claim 18 including:
(k) resilient biasing means secured between said movable locking member and said guitar body biasing said locking member into engagement with said yoke portion.

20. The invention as set forth in claim 1 including:
(l) a cam means over which said string passes, said cam means being rotatably secured to said neck and having a recessed portion for receiving said string;
(m) a stud member secured to said cam means and arranged to rotate said cam means therewith, the end thereof having a first locking member secured thereto and adapted to engage another locking member;
(n) and a second locking member secured to said neck and extending into operable engagement with said first locking member of said stud member, said first and second locking members securing said stud member and cam means against movement when in operable position.

21. A tuning mechanism for a guitar having a body and a neck with a plurality of strings under tension anchored thereto passing over the body and neck with a tuning head at the far end of the guitar neck, said mechanism comprising:
(a) a plurality of knife edge fulcrums, there being as many as there are strings, said fulcrums extending longitudinally away from the tuning head and secured to the guitar body at the end opposite the neck;
(b) a plurality of first links, each having a V-shaped groove formed therein near the upper end thereof cooperatively engaging one of said knife edge fulcrums and having a string anchored thereto and passing over the upper edge of said link;
(c) a plurality of second links, each pivotally secured to the lower end of a cooperating link of said plurality of first links;
(d) a plurality of first arms, each pivotally connected to a cooperating link of said plurality of second links and disposed in spaced relationship from said first link;
(e) a plurality of second arms, each pivotally connected to a cooperating link of said plurality of second links as the lower end thereof;
(f) a plurality of spring means connected below said plurality of second links at substantially the end thereof and said guitar body to apply constant bias to said links in opposition to the movement thereof;
(g) a plurality of first stops engaging said plurality of first and second arms and restraining said arms against movement toward said plurality of links;
(h) a plurality of shafts rotatably secured to said guitar body in a direction transverse to the neck thereon and disposed along said guitar body and neck;
(i) a plurality of foot pedals, each having connecting means cooperating with said plurality of shafts to produce rotation thereof;
(j) and a plurality of levers secured to said plurality of shafts, there being at least one half as many levers on each shaft as there are strings, certain of said levers selectably engaging one of said first or second arms cooperating therewith to increase or decrease the tension in the cooperating string of said plurality of strings.

22. The invention as set forth in claim 21 including:
(k) a plurality of lost motion devices connected between said plurality of levers and said plurality of

first and second arms, said devices selectively connecting certain of said levers to certain of said first and second arms.

23. The invention as set forth in claim 22 wherein:

(1) said lost motion devices and said first and second arms are disposed radially in the same direction along each of said plurality of levers so that the same directional rotation of said shafts will produce both an increase and decrease in the tension in said strings.

References Cited

UNITED STATES PATENTS

3,352,188 11/1967 Fender ---------- 84—312

RICHARD B. WILKINSON, *Primary Examiner.*

J. F. GONZALES, *Assistant Examiner.*

U.S. Cl. X.R.

84—306