Feb. 28, 1961 C. L. FENDER 2,972,923

FLOATING TREMOLO AND BRIDGE CONSTRUCTION
FOR LUTE-TYPE MUSICAL INSTRUMENTS

Filed Nov. 6, 1958 2 Sheets-Sheet 1

Fig. 1.

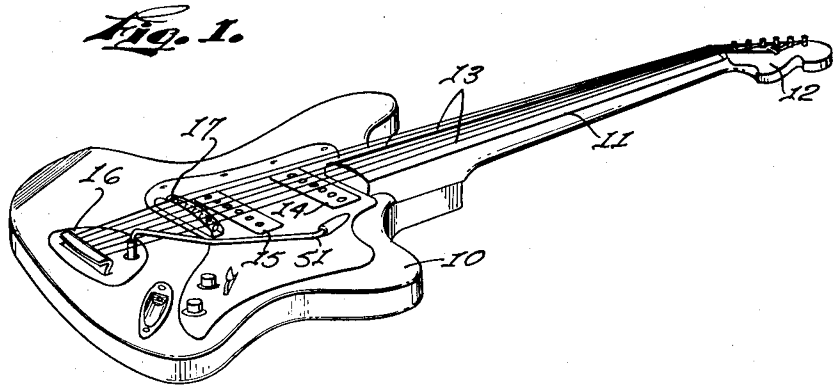


Fig. 2.

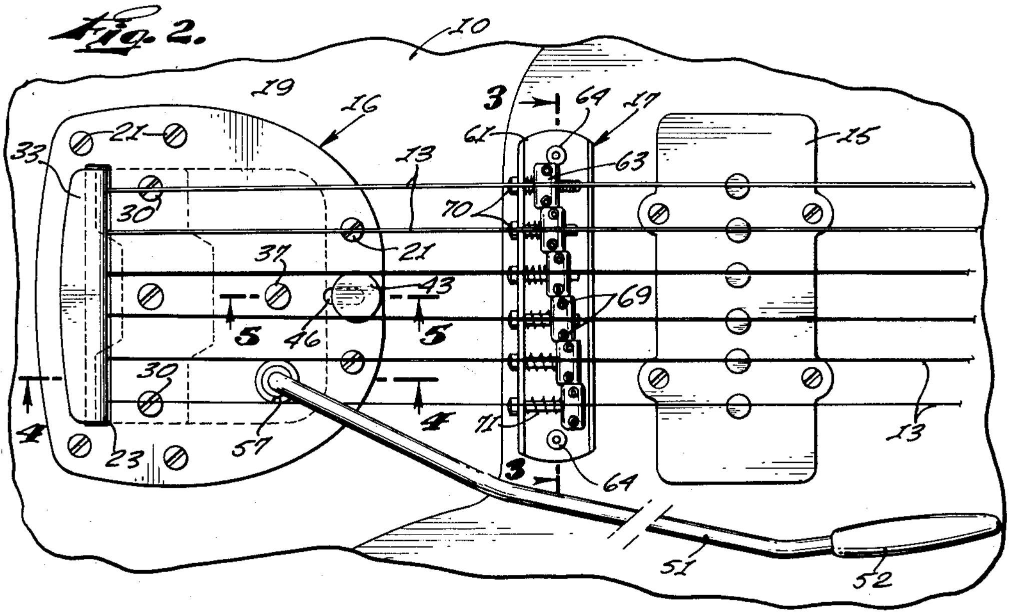
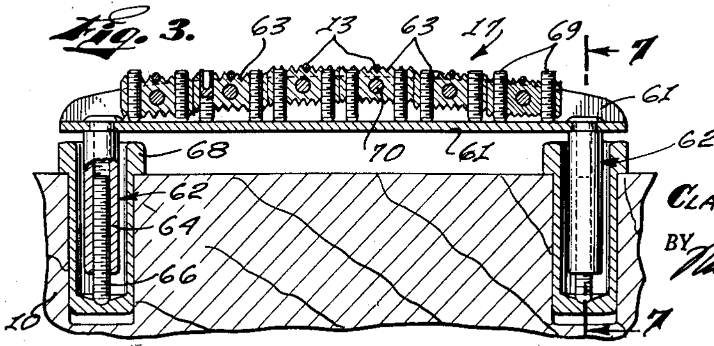


Fig. 3.



INVENTOR.
CLARENCE L. FENDER

BY Richard L. [signature]

ATTORNEY

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Fig. 4.

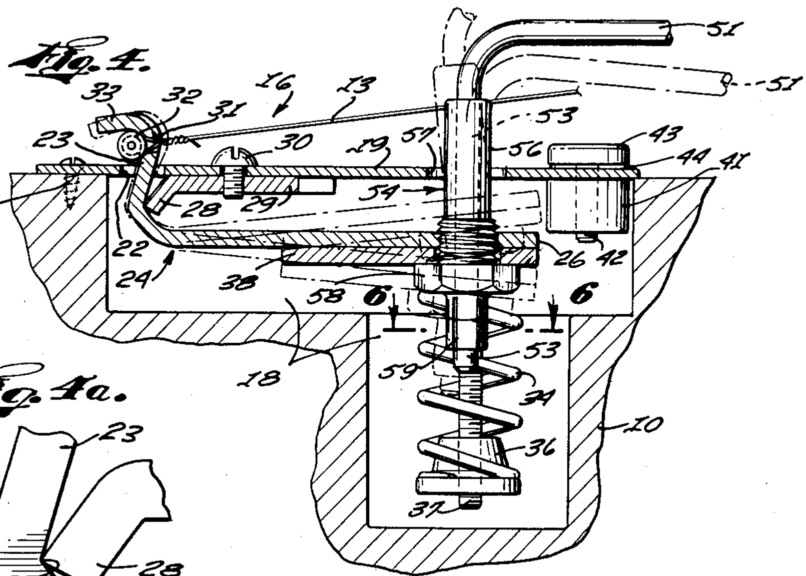


Fig. 4a.

Fig. 5.

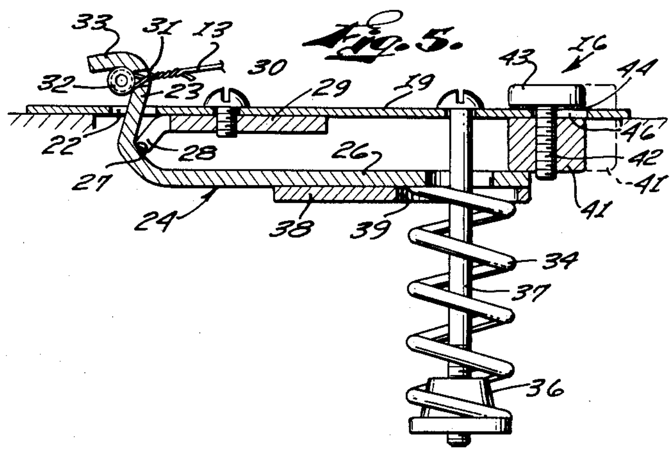


Fig. 6.

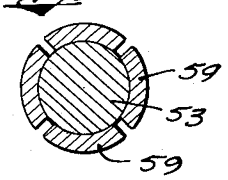
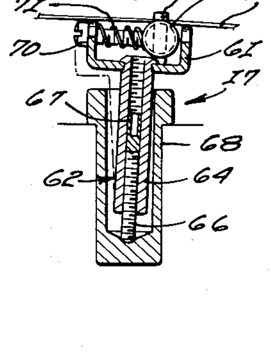


Fig. 7.



INVENTOR.
CLARENCE L. FENDER

BY Richard L. [signature]

ATTORNEY

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FLOATING TREMOLO AND BRIDGE CONSTRUCTION FOR LUTE-TYPE MUSICAL INSTRUMENTS

Clarence L. Fender, 2212 E. Revere, Fullerton, Calif.

Filed Nov. 6, 1958, Ser. No. 772,310

14 Claims. (Cl. 84—313)

This invention relates to a tremolo and bridge construction for stringed instruments, particularly guitars and similar lute-type instruments. The invention also relates to a method of tuning a tremolo-type stringed instrument.

Conventional tremolo and bridge devices for guitars and the like are characterized by the presence of one or more of a number of defects and limitations, some of which will now be briefly indicated. In tremolo devices of the floating or balanced variety, in which the string tension is counter-balanced by a spring bias, the amount of friction present is frequently such that the neutral position is not achieved with sufficient accuracy and reliability to insure maintenance of proper intonation. Furthermore, and very importantly, such balanced or floating tremolo devices are so constructed that it is a difficult and laborious operation to replace one or more strings and effect proper tuning thereof. This is because the breaking of a string results in an imbalance between the over-all string tension and the counterbalancing spring bias, and has the effect of causing the unbroken strings to become sharp. After the broken string is replaced, the tuning thereof has the effect of changing the tuning of the remaining or unbroken strings. The result is that the strings must be alternately and repetitiously tuned, by a tedious trial and error procedure, until perfect tuning of all strings is again achieved. From the above, it will also be understood that the breaking of a string during a performance renders the entire instrument substantially unusable for the performance, since the remaining strings will then be out of tune and since proper tuning cannot again be achieved except through a long and tedious procedure.

With relation to conventional bridge constructions, it is important that each string have its own individual bridge which is fully adjustable in a number of directions. Furthermore, it is undesirable that each tremolo movement effect reltaive sliding or rubbing between each string and the associated bridge element, which makes it important that the bridge move automatically with the tremolo means. However, the bridge movement should not be such that the bridge elements change their vertical positions relative to the guitar body by any appreciable amounts, or that the bridge elements tip or cock relative to the guitar body.

In view of the above and other factors characteristic of conventional tremolo and bridge devices, it is an object of the present invention to provide a musical instrument characterized by the absence of friction, extreme simplicity of string replacement and fine tuning, complete adjustability of the individual bridge elements relative to the strings, and the absence of any sliding or rubbing between the strings and the bridge elements during tremolo movements or at any other time.

A further object of the invention is to provide a tremolo device of the balanced type having a knife-edge fulcrum, stop means to determine a neutral position at which tuning may be achieved and maintained, and adjustable spring means to counteract the string tension.

A further object of the invention is to provide a floating bridge device which moves with the strings during tremolo operation without friction, and which is fully adjustable to change the effective length of each string, change the elevation of each string above the body and the neck, change the lateral position of each string, and change the elevations of the strings as a group.

A further object is to provide a bridge construction having a plurality of individual bridge elements, each of said elements being formed with a plurality of grooves into which a string may be selectively mounted to thereby adjust the lateral string position.

A further object is to provide a tremolo device in which grip means are provided to movably associate the tremolo control arm with other elements of the device and in such manner that long-continued movement of the control arm with the hand of the guitarist does not create undesirable looseness or play tending to prevent the control arm from remaining in a desired position.

A further object is to provide a balanced tremolo incorporating spring means which are readily adjustable from the exterior of the guitar without removal of the cover plate, in combination with stop means which operate in conjunction with the spring means to determine the desired neutral position at which tuning may be readily and accurately achieved and maintained.

A further object is to provide a tremolo device incorporating means to shift from tremolo to standard operation without alteration of tuning, and incorporating means to maintain the proper tuning of the remaining strings after one string has broken.

A further object is to provide a method of tuning a tremolo-type stringed instrument.

These and other objects and advantages of the invention will be more fully set forth in the following specification and claims, considered in connection with the attached drawings to which they relate.

In the drawings:

Figure 1 is a perspective view illustrating a guitar incorporating tremolo and bridge means constructed in accordance with the present invention;

Figure 2 is a greatly enlarged fragmentary plan view of the tremolo and bridge portion of the guitar of Figure 1;

Figure 3 is an enlarged fragmentary transverse sectional view taken on line **3—3** of Figure 2;

Figure 4 is an enlarged fragmentary longitudinal sectional view taken on line **4—4** of Figure 2, and illustrating the tremolo elements in various positions;

Figure 4*a* is an enlarged schematic illustrating the knife-edge relationship between the knife blade and the string plate;

Figure 5 is an enlarged longitudinal fragmentary sectional view taken on line **5—5** of Figure 2, but omitting a showing of the wooden body of the guitar;

Figure 6 is an enlarged transverse fragmentary section on line **6—6** of Figure 4, showing the frictional gripping means for the stem of the tremolo control arm; and

Figure 7 is a fragmentary section taken on line **7—7** of Figure 3 and illustrating a rocking post at one end of the floating bridge means.

Referring to the drawings, the invention is illustrated as embodied in an electric guitar having a body **10**, fretted neck **11**, head **12**, strings **13**, and electromagnetic pickups **14** and **15**. The pickups **14** and **15** are selectively operable to sense the vibrations of strings **13** and transmit currents corresponding thereto to suitable amplifying and loud-speaker means, not shown.

The strings **13** are stretched or tensioned between suitable tuning pegs or screws (on head **12**) and the tremolo device **16** which forms part of the present invention. The tremolo device **16** cooperates with a floating bridge **17** to provide a perfect tremolo action in the absence of friction and with complete adjustability.

Proceeding first to a detailed description of the tremolo device **16**, and with particular reference to Figures 2 and 4–6, the major portion of the tremolo device is mounted in a suitable cavity or recess **18** provided in body **10**. The recess or cavity is covered by a base or cover plate **19** which is fixedly secured to the guitar body **10** by means of screws **21**. Base plate **19** is formed with a transverse slot **22** to receive, in non-interfering relationship, the upwardly extending force-arm portion **23** of a string plate or lever **24**. String plate **24** also has a relatively long force-arm portion **26** disposed in recess **18** beneath and generally parallel to base plate **19**. Plate or lever **24** may also be termed a string-engaging element, or a connector element.

The long and short force-arm portions **26** and **23** of string plate **24** meet each other at a relatively sharp pivot angle or groove **27** (Figure 4*a*). Such angle or groove is adapted to seat fulcrum means in the form of two knife-blade portions **28** of a fulcrum element **29**, the latter being suitably secured beneath base plate **19** by means of screws **30**. The knife-blade portions **28** are provided at opposite sides of fulcrum element **29**, and are formed of hardened steel as is the string plate **24**. The result is a substantially frictionless pivoting action between the knife-blade portions **28** and the string plate **24** at the pivot angle or groove **27**.

The upwardly extending force-arm portion **23** of string plate or lever **24** is provided above base plate **19** with a plurality of transversely-spaced holes **31** adapted to receive the ends of the respective strings **13**. The string ends are connected to eyelets **32** which seat beneath an upper hook portion **33** of the string plate to maintain the strings in tensioned condition. Since the strings are tensioned across the floating bridge **17** to the tuning screws on head **12** of the instrument, it will be understood that the strings provide a very substantial force tending to effect clockwise pivoting of string lever **24** on the knife-edge means **28**, as viewed in Figures 4 and 5.

Spring bias means are provided to adjustably counterbalance the above-indicated force exerted by the tensioned strings **13**, and are illustrated to comprise a helical compression spring **34** having its upper end seated beneath the outer edge of the relatively long force arm **26** of string plate or lever **24**. The lower end of spring **34** seats on an adjustable seat element **36** comprising a frustoconical nut which is threaded over a bolt **37**. The head of bolt **37** rests on the upper surface of base plate **19**, and the shank of the bolt extends downwardly through plate **19** and through a relatively large opening in force arm **26**. Turning of bolt **37**, by means of a screw-driver or the like, has the effect of raising or lowering seat element **36** depending upon the direction of bolt rotation, it being understood that the force of spring **34** is sufficient to prevent rotation of the seat or nut **36**.

An inertia plate **38** is suitably connected beneath the outer portion of force arm **26**, and has an opening **39** into which the upper end of spring **34** is inserted for seating upon the lower surface of force arm **26**. The inertia plate **38** thus serves to effect proper positioning of the upper end of the spring, and also serves to give the string plate **24** sufficient mass that it will not tend to vibrate with the strings **13** and provide an undesired damping action. The tremolo action thus takes place only upon deliberate pivoting of the string lever **24** as will be indicated subsequently.

Stop means **41** are provided to determine the neutral or intermediate position of string plate **24**, to thereby greatly facilitate tuning and string replacement and also to effect other functions as will be indicated. The stop means is illustrated to comprise a short cylinder which is slidably mounted beneath base plate **19** above the extreme outer edge of force-arm portion **26** of the string plate. More specifically, the cylinder **41** is threaded, riveted, or otherwise secured over the shank **42** of an actuating button **43** which is disposed above the base plate **19**. Button **43** seats on a flat spring **44**, the latter providing frictional resistance to sliding of the button (and thus stop means **41**) longitudinally of the instrument and between the limits permitted by a longitudinal slot **46** in the base plate.

When the stop **41** is in the retracted position shown in Figure 4, it is completely clear of the string plate **24** and does not interfere with pivotal movement of the string plate between the positions illustrated. On the other hand, when the stop is slid to the operative position shown in Figure 5, it prevents upward pivoting of the string plate past the illustrated position. Since the force arm **26** of string lever **24** is much longer than the force arm **23** thereof, it is pointed out that the positioning of the outer end of force arm **26** in engagement with, or very close to, stop **41** effects a very precise positioning of the eyelets **32** at the ends of strings **13**. Thus, even in situations where the outer end of force arm **26** is not exactly even with the lower surface of stop **41**, but is still close to such lower surface, the eyelets **32** will be very close to the neutral or intermediate positions assumed when the precise position of Figure 5 is achieved.

The pressure of bias spring **34** is adjusted, by turning the bolt **37** and as will be described in detail subsequently, so that the string plate **24** will be in the neutral position shown in Figure 5, even though the stop **41** is shifted away from the illustrated stop position, when the strings **13** are all perfectly in tune. Should a string then break, it merely required to shift the stop **41** to the Figure 5 position. The outer end of the string plate **24** will then be biased upwardly (Figure 5) against the lower surface of stop **41**, since the breaking of a string reduces the string tension tending to effect clockwise pivoting of the string plate **24**. However, as soon as the broken string is replaced and properly tuned, the over-all tension of strings **13** will again be such that string plate **24** will remain in the neutral position (Figure 5) even after the stop **41** is shifted to its inoperative position (Figure 4). If it is impossible to replace the string before continuing playing, the stop **41** still prevents the remainder of the strings from being out of tune.

The string plate **24** is manually pivoted about fulcrum **28**, in order to effect the tremolo action when stop **41** is inoperative, Figure 4, by means of a control arm **51** having a handle **52** adapted to ride with the hand of the guitarist. Such riding is permitted by pivotally mounting a downwardly-extending stem portion **53** of control arm **51** in a socket device **54** which is mounted in the force arm **26** and the adjacent inertia plate **38**. Stated more specifically, the socket device comprises a sleeve **56** which extends upwardly through an opening **57** in base plate **19** with sufficient clearance to prevent any interference therebetween. Sleeve **56** is sufficiently large in internal diameter to permit insertion of stem **53** without substantial binding, and has an externally threaded portion which is threaded into the force arm **26** and into inertia plate **38**. Such threading is accomplished by means of a nut or wrench-hold portion **58** having integral, downwardly-extending gripping bars or segments **59** (Figure 6) the normal internal diameter of which is slightly smaller than that of stem **53**. The nut **58** and gripping bars **59** are formed of hard, resilient metal, so that the gripping bars **59** may be bent outwardly sufficiently to permit insertion of the stem to the position shown in Figure 4. However, the gripping bars **59** then resiliently grip the stem to resist movement thereof and provide a drag against pivoting of the steam in the socket means.

The described construction of socket **54** is superior to previously-known constructions, in which the stem **53** was threaded into a socket, since the gripping bars 59 provide the above-mentioned drag even though the device has been used for a long period of time. It is important that the control arm 51 remain at any position desired by the guitarist, since otherwise it will pivot due to the action of gravity, or due to movement of the guitar, and interfere with playing. Threaded constructions have the desired effect for a certain period of time, but after substantial use the threads wear and result in play or clearance which causes the handle to pivot loosely in the socket and not remain in the position desired.

Proceeding next to a detailed description of the floating bridge 17 which moves with the strings 13 upon actuation of the control arm 51 to pivot string plate 24 about knife means 28, this comprises a support channel or plate 61 which is rockably mounted upon a pair of rock post assemblies 62. A plurality of individual bridge elements 63 are adjustably supported on the upper surface of the web of channel 61 and provide support for the individual strings 13. It is an important feature of the floating bridge means 17 that the rock post assemblies are relatively long, and pivot about support or fulcrum points disposed a substantial distance beneath the strings 13, in order that the bridge movement resulting from shifting of the strings 13 does not effect substantial tipping of channel 61 but instead merely causes the channel to move longitudinally of the instrument. Stated otherwise, the channel 61 does not tip, cock or toggle a substantial amount, to thereby cause substantial variation in the elevation of string 13, but instead merely moves longitudinally with the strings 13 between the positions shown in solid and phantom lines in Figure 7. The pivotal movement of channel 61 is about an axis parallel to the axis of string lever 24, and disposed a substantial distance below the face of the body 10.

Each rock post assembly 62 is adjustable in length, and to this end is constructed with an internally-threaded sleeve element 64 having threadedly inserted therein a threaded pin or screw 66. The upper end of each sleeve 64 is rigidly secured in an opening in the web of bridge channel 61, the relationship being such that a small wrench may be inserted downwardly through the sleeve and into a socket 67 (Figure 7) in the upper end of screw 66 in order to effect adjustment of the latter. The lower end of each screw 66 is rounded to seat in a rounded socket at the bottom of a thimble 68 which is seated fixedly in a round hole in body 10. The internal diameter of each thimble 68 is substantially greater than that of the sleeve 64 inserted therein, permitting rocking of each rock post assembly 62 without interference. It is therefore a simple matter to alter the effective length of the rock post assembly 62 by merely inserting the previously-indicated wrench and turning the pins or screws 66.

Each of the individual bridge elements 63 comprises a short cylinder or barrel which is externally threaded to provide support for a string 13 at any one of a plurality of selected lateral positions. The depths of the threads of the various cylinders 63 are related to the diameters of the strings 13 to be associated therewith, in such manner as to insure that the strings will remain in desired grooves in which they are placed by the guitarist.

Each bridge 63 is supported on a pair of leg elements 69 comprising screws threaded transversely therethrough and extending downwardly into engagement with the web of bridge channel 61. The legs or screws 69 may be turned, by means of a suitable wrench, to adjust the elevation of the bridge element above the bridge plate. Adjustment of each bridge elment 63 longitudinally of the instrument is effected by means of a screw 70 which is rotatably inserted (not threaded) through one of the webs of bridge channel 61, and is threaded through a bridge element 63 perpendicular to the axis thereof and also perpendicular to a plane containing the legs 69. A helical compression spring 71 is provided around each screw 70 to maintain the associated bridge element 63 spaced the maximum permitted distance away from the channel flange through which screw 70 is inserted.

Method of tuning and operation

Let it be assumed that the instrument is initially without strings, and that spring 34 is relatively loose. The guitarist then inserts the strings 13 through the holes 31 in force arm portion 23 of string lever or plate 24, and connects them in taut condition, but not up to pitch, to the tuning screws on thead 12. Each string is mounted across an individual bridge or barrel element 63.

The guitarist then pushes actuating button 43 to slide the stop 41 to operative position or to the left as viewed in Figures 4 and 5, after which he turns the screw 37 to effect substantial upward shifting of seat element 36. The latter effects compression of spring 34 to force the relatively long force arm portion 26 of string plate 24 relatively tightly against stop 41. Such spring tightening is caused to be sufficient that the string plate will not pivot away from the stop 41 even though the tension of strings 13 is increased until the strings are brought up to pitch.

The strings 13 are then brought up to perfect pitch, and all adjustments of the tuning screws and of the bridge 17 are made. It is emphasized that each string 13 may be tuned and perfectly adjusted individually, without regard to the other strings. This would not be possible were it not for the presence of the stop 41 which operates, in conjunction with the tightly set spring 34, to lock the string plate 24 during adjustment of the string tension for tuning purposes.

The bridge 17 is adjusted in a number of ways, the first of which relates to changing the height of the strings 13 above the fretted neck 11. In this regard it is desired that the individual bridge or barrel elements 63 be as close as possible to the web or plate portion of channel 61, since mounting of an element 63 an excessive distance above the web of channel 61 may result in undesirable results including tipping over of the element 63 when the associated string is picked strongly or sharply.

To the above end, wrenches are inserted into the sleeves 64 to turn the threaded pins or screws 66 in a direction lengthening the rock post assemblies 62, and until the bridge channel 61 is relatively far above the face of body 10. The various leg elements 69 are then rotated to shift the associated threaded barrels 63 and thereby adjust the exact elevation of each string 13 above the neck. If it develops that one or more of the barrels 63 must be shifted downwardly into engagement with the web of channel 61, the screws 66 are turned in directions effecting lowering of channel 61. If, on the other hand, it develops that none of the barrels 63 is very close to the web of channel 61, the pins 66 are turned in directions effecting further elevation of the channel 61. The end result is that one or more barrels 63 should be relatively close to the channel web, and the remainder of the barrels spaced thereabove by different distances as desired by the particular guitarist and as required by the neck construction.

The guitarist then makes minute adjustments in the lateral positions of the strings 13 on the bridge. This is accomplished by shifting the strings in one lateral direction or the other until various threads of barrels 63 are engaged. Such an adjustment constitutes a substantial improvement over previous constructions, in which only a single bridge groove was provided for each string 13.

The guitarist may then adjust the effective length of each string by turning the associated screw 70 to shift the barrel 63 longitudinally of the string. This adjustment is made with reference to string harmonics and in a manner known to the art. It is pointed out that before this adjustment is made the guitarist makes certain that the rock post assemblies 62 are coaxial with thimbles 68, and are not tipped to either of the positions illustrated in Figure 7. The friction of the strings 13 upon the barrels 63 then causes the barrels 63 to move with the strings instead of sliding relative thereto, so that the barrels and support channel 61 rock with the assemblies 62 about the pivot or fulcrum points at the lower ends of screws 66. Such rocking occurs due to operation of the tremolo device 16 to tension or relax the strings 13, as previously stated.

After the guitar is completely adjusted, and in perfect tune, the guitarist turns the screw 37 (Figures 4 and 5) in a direction effecting lowering of the seat element 36 and consequent reduction in the pressure of spring 34. This should be accomplished relatively slowly, and is accompanied by a slight tapping by the hand of the guitarist against the underside of control arm 51. As soon as the pressure of spring 34 is reduced sufficiently to permit force arm 26 to pivot a slight distance away from the underside of stop 41, such slight tapping upon the underside of the control arm produces a click which is audible to the guitarist. The guitarist then knows that the spring 34 is almost in perfect balance with strings 13. He then turns the screw 37 a very slight amount in the opposite direction, until the upper surface of force arm 26 is in very light engagement with the underside of stop 41.

The guitarist then pushes button 43 in a direction to shift stop 41 to the inoperative position shown in Figure 4. Because of the balancing operation previously described, such shifting of the stop 41 out of the way of force arm 26 does not effect any movement, or only an infinitesimal movement, of the string lever 24.

The instrument is then in condition to be played with tremolo operation. The guitarist causes the handle 52 of the control arm 51 to ride in his hand, this being permitted due to the pivotal relationship between stem 53 and socket 54. When a tremolo is desired, the guitarist moves the handle 52 upwardly and downwardly, causing rocking of string plate or lever 24 between the phantom line position shown in Figure 4, or between various intermediate positions. Such rocking of the string plate effects relaxation or tensioning of strings 13 to lower or raise the pitch thereof and thus produce the tremolo both above and below perfect pitch. As the strings 13 are relaxed, the bridge channel 61 moves to the right to the position shown in solid lines in Figure 7 or to a similar position. As the strings are tightened, the bridge 61 moves to the phantom line position of Figure 7 or to a similar position.

The above rocking actions occur without engagement or interference between any of the described elements. The only points of friction are at the bottoms of screws 66 and at the knife-edge elements 28. The friction produced at these points is so extremely small that, upon release of the control arm 51, the string plate 24 returns to the exact neutral position producing the perfect pitch to which the instrument was tuned. In fact, the construction may be assumed to be frictionless.

Should one of the strings 13 break while the musician is actually engaged in playing a piece during a public performance, the musician may maintain the perfect pitch of the remaining strings by merely sliding the stop button 43 to the left and thereby causing the string plate 24 to remain in the neutral position shown in Figure 5. This movement of the stop may be accomplished after downward pivoting of arm 51 to overcome the increased resultant upward bias on arm 26. The musician may thereafter, at the first available opportunity, replace the broken string in a minute or two and tune it without reference to the tuning of the other strings. When the broken string is properly tuned, it is known that the string plate 24 will again remain at the neutral position even after the stop 41 is slid back to the inoperative position shown in Figure 4. Tremolo operation may then be resumed.

Various embodiments of the present invention, in addition to what has been illustrated and described in detail, may be employed without departing from the scope of the accompanying claims.

I claim:

1. A musical instrument of the lute class, which comprises a body, a neck connected to one end of said body, a plurality of strings connected to tuning screws at the outer end portion of said neck, said strings extending longitudinally above said neck and over said body, a string element pivotally connected to said body for pivotal movement about an axis transverse to said strings, means to connect said string element to said strings on one side of said axis to thereby tend to effect pivotal movement of said string element in a predetermined direction around said axis, spring bias means provided between said spring element and said body and tending to effect pivotal movement of said spring element in the opposite direction about said axis to thereby counterbalance the tension of said strings, adjustable stop means movable to an operative position which limits the amount of pivoting of said string element due to the action of said spring bias means and maintaining said string element in a predetermined position despite an increase in the pressure exerted by said spring bias means, means to adjust the pressure of said spring bias means until the spring tension on said string element is exactly neutralized when said string element is in said predetermined position, a bridge element mounted between said strings and said body and located intermediate said string element and said neck, means to pivotally associate said bridge element with said body to permit pivotal movement of said bridge element relative to a second axis generally parallel to said first-mentioned axis and spaced therefrom whereby said bridge element may move with said strings, the distance between said bridge element and said second axis being sufficiently great that movement of said bridge element with said strings produces only a slight tipping of said bridge element, and manually-operable means to effect pivoting of said spring element about said first-mentioned axis when said stop means is in inoperative position in order to increase and decrease the tension on said strings and thus provide a tremolo effect.

2. The invention as claimed in claim 1, in which said bridge element includes a plurality of individual bridges one for each string, a support plate for said individual bridges, and means to shift said individual bridges independently both longitudinally of said strings and toward and away from said support plate; and in which said means to pivotally associate said bridge element with said body includes relatively long rocker posts connected to said support plate and adjustable in length to vary the spacing between said support plate and said body.

3. A bridge for a guitar or the like, which comprises a pair of sockets adapted to be mounted in the body of said guitar and having fulcrum or pivot surfaces at the lower inner portions thereof, a bridge channel, a pair of sleeves connected to said bridge channel and extending downwardly into said sockets, said sleeves being much smaller in diameter than said sockets, a pair of screws threadedly associated with said sleeves and extending downwardly therefrom for engagement with said fulcrum or pivot surfaces of said sockets, a plurality of threaded barrels mounted on the upper surface of said bridge channel between the flanges thereof with their axes generally parallel to the plane of said sleeves and said screws, a pair of threaded legs threaded downwardly through each of said threaded barrels for engagement with the upper surface of the web of said bridge channel, said threaded legs extending perpendicular to the axis of each threaded barrel and also perpendicular to said channel web, a plurality of screws rotatably inserted through one of said flanges and threaded one through each of said threaded barrels perpendicular to the axes thereof and also perpendicular to said plane, and a helical compression spring mounted around each of said last-mentioned screws and seated between the associated channel flange and threaded barrel.

4. In a guitar-type instrument having a plurality of tuned strings thereon, a string plate lever element con-

nected to at least one of said strings, said lever element having a pivotal association with said instrument, said string being connected to an end portion of said lever, resilient means operatively associated with said lever, and a stop means on said instrument, opposed to said resilient means and in operative association with said lever.

5. The invention as claimed in claim 4, in which said string plate lever element is connected to a plurality of the strings of said instrument, in which said stop means is movably mounted on said instrument for manual movement to a position out of operative association with said lever element, and in which said resilient means is disposed in opposition to the tension of said plurality of strings.

6. The invention as claimed in claim 4, in which said string plate lever element is connected to a plurality of the strings of said instrument, in which manually-operable actuating means are connected to said lever element to effect pivoting thereof and thus vary the pitch of said plurality of strings, and in which said resilient means is disposed in opposition to the tension of said plurality of strings.

7. The invention as claimed in claim 4, in which said string plate lever element is connected to a plurality of the strings of said instrument, in which said resilient means is disposed in opposition to the tension of said plurality of strings, in which manually-operable actuating means are connected to said lever element to effect pivoting thereof and thus vary the pitch of said plurality of strings, and in which said stop means is movably mounted on said instrument for manual movement between a position in operative association with said lever element and a position out of operative association with said lever element.

8. The invention as claimed in claim 4, in which said string plate lever element is connected to a plurality of the strings of said instrument, in which said resilient means is disposed in opposition to the tension of said plurality of strings, and in which manually operable means are provided to vary the bias exerted on said lever element by said resilient means, said last-named means being adapted to adjust said bias until it counteracts the combined tension of said plurality of strings when said lever element is in the predetermined position at which movement thereof in at least the string-tension increasing direction is prevented by said stop means.

9. The invention as claimed in claim 4, in which said string plate lever element is connected to a plurality of the strings of said instrument, in which said resilient means is disposed in opposition to the tension of said plurality of strings, in which manually-operable actuating means are connected to said lever element to effect pivoting thereof and thus vary the pitch of said plurality of strings, in which said stop means is movably mounted on said instrument for manual movement between a first position in operative association with said lever element and a second position out of operative association with said lever element, and in which manually operable means are provided to vary the bias exerted on said lever element by said resilient means, said last-named means being adapted to adjust said bias until it counteracts the combined tension of said plurality of strings when said lever element is in the predetermined position at which movement thereof in at least the string-tension increasing direction is prevented by said stop means, whereby said plurality of strings may all be tuned when said stop means is in said first position and will remain tuned when said stop means is shifted to said second position.

10. The invention as claimed in claim 4, in which said lever element is pivotally associated with said instrument by means of a knife-edge shaped element mounted on said instrument and forming a fulcrum, and in which said lever element is indented to receive the knife edge of said fulcrum element.

11. The invention as claimed in claim 4, in which said string plate lever element is connected to a plurality of the strings of said instrument, in which manually-operable actuating means are connected to said lever element to effect pivoting thereof and thus vary the pitch of said plurality of strings, and in which a bridge element is pivotally mounted on said instrument in operative association with said plurality of strings, said bridge element being adapted to pivot about an axis which is transverse to said strings and is disposed sufficiently far from said strings that operation of said actuating means does not effect substantial tipping of said bridge element.

12. The invention as claimed in claim 11, in which said axis is disposed a substantial distance below the face of the body of said instrument.

13. The invention as claimed in claim 4, in which the means to effect pivotal association between said lever element and said instrument include a pivot element associated with the body of said instrument, in which means are provided to connect all strings of said instrument to said lever element on one side of said pivot element and relatively close thereto, in which said resilient means comprises spring means operating between said body and a portion of said lever element located on the other side of said pivot element and relatively remote therefrom, said spring means being adapted to counterbalance the tension of said strings to thereby maintain said lever element in floating relationship, in which means are connected to said lever element and are manually operable to effect pivoting thereof about said pivot element to thereby vary the tension of said strings to alter the pitch thereof, in which said stop means comprises a movable element movably mounted on said body, said stop element being movable between a first position adapted to limit the degree of movement of said lever element in the direction effected by an increase of the bias of said spring means, said stop element also being movable to an inoperative position permitting free movement of said lever element, and in which means are provided to adjust the bias of said spring means.

14. The invention as claimed in claim 4, in which said instrument has a body with a recess or opening therein, in which a base plate is fixedly mounted over at least a portion of said recess and has a slot therein extending transverse to said strings, in which said lever element has a relatively long force arm portion disposed in said recess beneath said base plate and extending generally parallel thereto, said lever element also having a relatively short force arm portion extending upwardly through said slot, said lever element also having a groove portion between said long and short force arm portions, in which means are provided to connect said relatively short force arm portion to all of the strings of said instrument, in which a knife element is mounted on said base plate in said recess and in engagement with said groove portion of said lever element to provide a fulcrum therefor and to divide said lever element into said relatively long and relatively short force arm portions, in which said stop means comprises a stop movably mounted on said base plate in said recess and adapted when in operative position to prevent movement of said relatively long force arm portion toward said base plate after a predetermined position of said lever element has been achieved, in which said resilient means comprises a compression spring disposed in said recess and engaged with said relatively long force arm portion at the outer end portion thereof, in which adjustable seat means are provided for said spring and are positioned to cause said relatively long force arm portion to pivot toward said stop, said seat means including means operable from the outer side of said base plate to adjust the bias of said spring until the tension of said strings is exactly counteracted when

said lever element is in engagement with said stop, and in which an actuating arm is connected to said lever element to effect limited pivotal movement thereof.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,972,923 February 28, 1961

Clarence L. Fender

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, lines 10, 11, 20 and 34, for "spring", each occurrence, read -- string --.

Signed and sealed this 12th day of September 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

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