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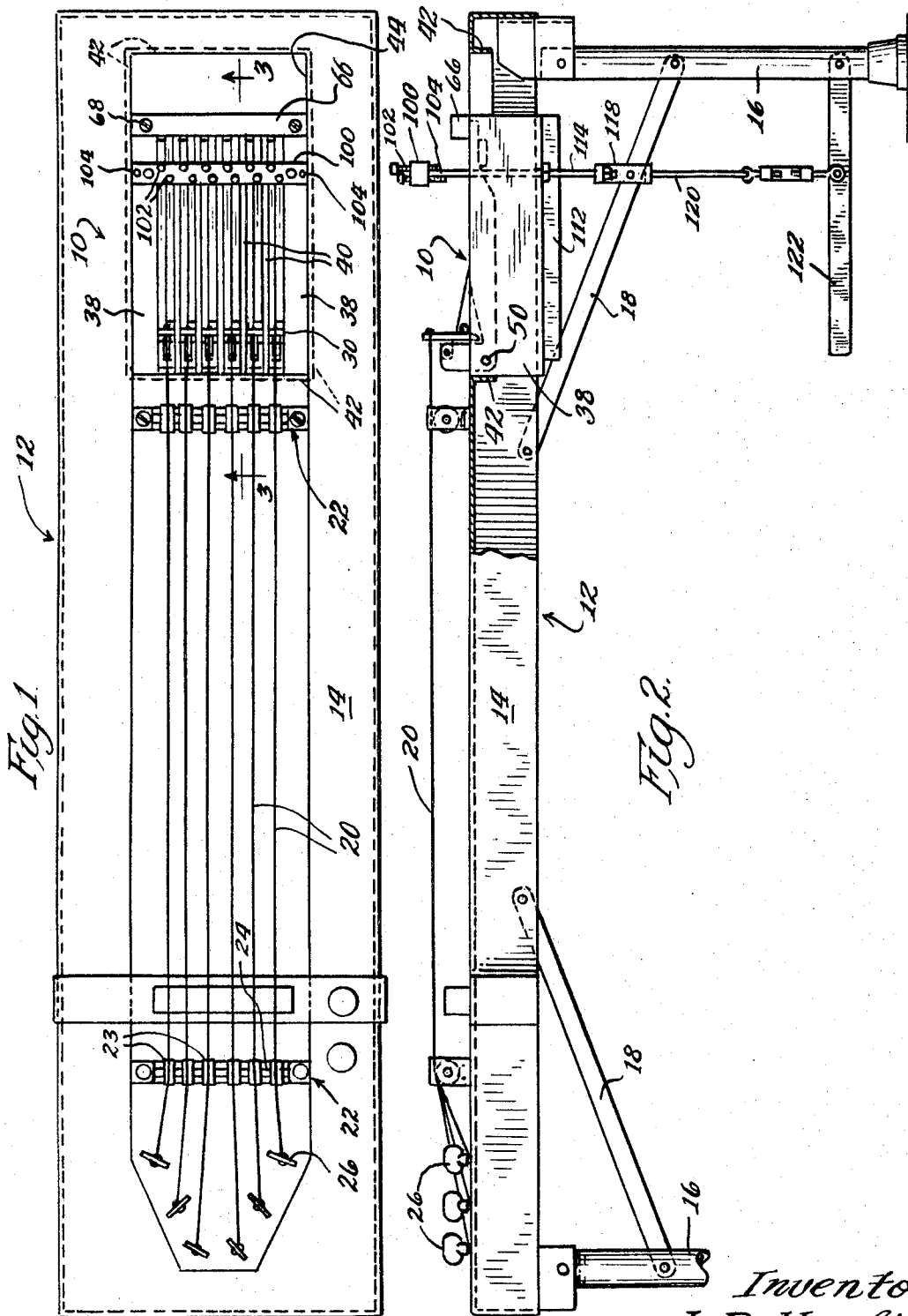
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3,404,595

CHORD TUNING MECHANISM FOR A STRING MUSICAL INSTRUMENT

Filed Jan. 17, 1966

3 Sheets-Sheet 1



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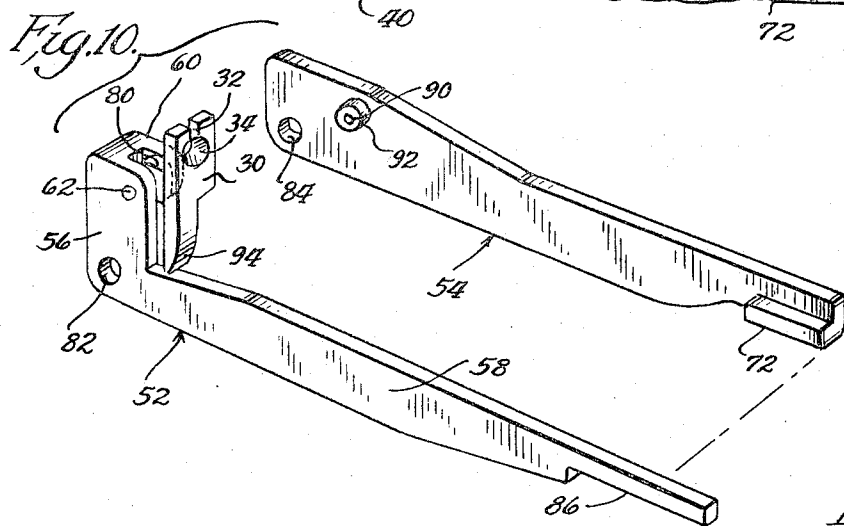
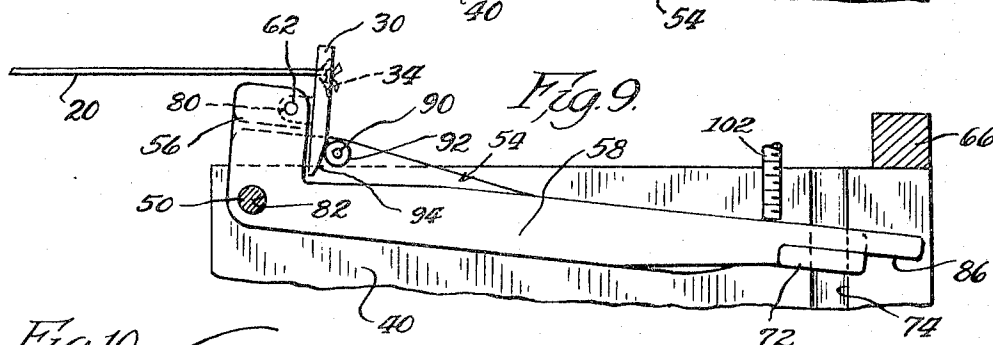
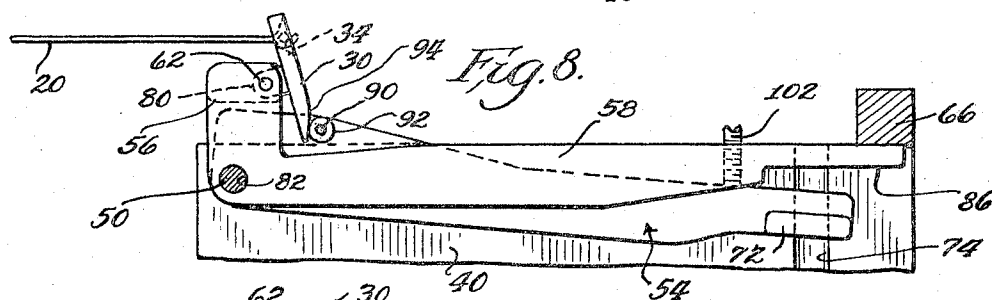
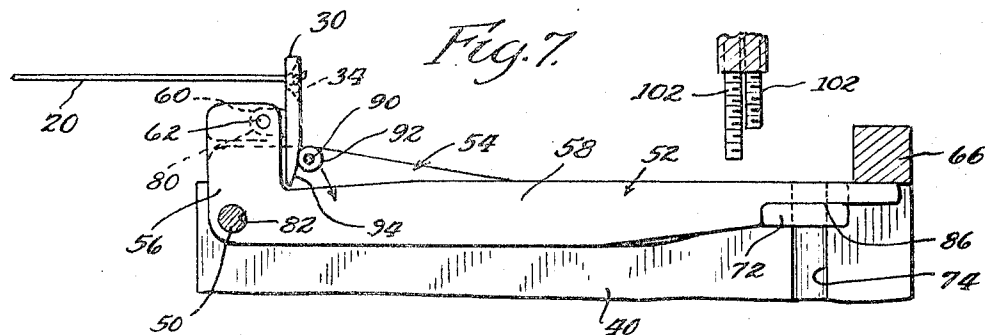
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CHORD TUNING MECHANISM FOR A STRING MUSICAL INSTRUMENT

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3 Sheets-Sheet 3



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3,404,595

CHORD TUNING MECHANISM FOR A STRING MUSICAL INSTRUMENT

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5 Claims. (Cl. 84—312)

ABSTRACT OF THE DISCLOSURE

A chord tuning mechanism for a string instrument wherein each string of the instrument has associated therewith a pair of depressible levers. Depression of one of the levers causes a reduction in tension in the string, while depression of both levers causes an increase in tension in the string. An interlock between the two levers allows the one lever to be depressed to the exclusion of the other, but depression of the other lever causes both levers to be depressed.

The present invention relates generally to chord tuning mechanism of the general type which is illustrated and described in United States Patent No. 2,458,263, granted on Jan. 4, 1949, and entitled "String Musical Instrument With Chord Tuning Mechanism," and the principal object thereof is to provide a chord tuning mechanism which is an improvement upon and has certain inherent advantages over that of said patent.

Chord tuning mechanisms of the type under consideration are used in connection with such string instruments as guitars, mandolins and banjos which are played by picking or stroking the strings thereof and, when so used, they enable players of the instruments automatically to perform chordal combinations without necessitating the usual, and sometimes extremely difficult manual fingering operations that are necessary to attain such chordal combinations. Thus, by the use of the present chord tuning mechanism, an unskilled musician is able to render a performance which, otherwise, would be beyond his natural or inherent ability.

For a full understanding of the improvements which are embodied in the present invention, it is a prerequisite that an understanding of the chord tuning mechanism of aforementioned Patent No. 2,458,263 be had. For this purpose, reference may be had to such patent. However, it is deemed sufficient to state herein that the common purpose of both the patented chord tuning mechanism and the present chord tuning mechanism is to provide a practical means which is operative in response to a common actuator for altering the tension of a group of pretensioned strings of a string musical instrument in such a manner that the tension of certain strings is increased so as thereby to raise the musical pitch thereof, while the tension of certain other strings is decreased so as thereby to lower the musical pitch thereof.

To accomplish this aim, as regards both the patented chord tuning mechanism and the present chord tuning mechanism, there is provided a pivoted rocker element for each of the strings selected for variable tensioning. Each selected string is anchored to its associated rocker element in such a manner that when the element is rocked or tilted in one direction from a neutral position the tension in the string is increased and when the element is rocked or tilted in the other direction from such neutral position of the string the tension is decreased. To actuate the rocker element in a selective manner, there are provided two operating levers which, in their normal positions, serve to maintain the rocker element in its neutral or normal untilted position wherein the string maintains its pre-adjusted tension. A unidirectional interlock between the two levers enables one lever to be individually

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depressed to the exclusion of the other lever but constrains such one lever to become depressed when the other lever is depressed so that, in such an instance, both levers move downwards in unison. Stated otherwise, when a force tending to depress one lever is applied, that lever alone becomes depressed. When a force tending to depress the other lever is applied, both levers become depressed. The two levers are so related to the rocker element that simultaneous depression thereof effects movement of the rocker element in such a manner that the associated string becomes increased in tension while individual depression of the one lever which is capable of such individual depression causes the string to become decreased in tension.

The present invention relates specifically to a novel relationship between the two levers and the rocker element for each selected string whereby a more positive actuation of the rocker element will take place than has heretofore been possible in connection with the chord tuning mechanism of said patent. The invention is further concerned with a novel lever mounting in the framework of the mechanism whereby the various levers are more effectively held in their normal or inoperative positions by a common limit stop which is effective against the major lever arms rather than against the minor lever arms as in the case of the mechanism of the aforementioned patent. Thus, the accumulation of any foreign particles such as dust or dirt between the limit stop and any given lever will not appreciably alter the initial or preadjusted tension of the associated string. An additional feature of novelty that is associated with and forms or constitutes a feature of the present chord tuning mechanism resides in the provision of a mounting for the biasing springs for the various pairs of coacting levers, the mounting affording greater spring stability than has heretofore been possible and also permitting the use of springs which are more reliable because of their increased size.

The provision of a chord tuning mechanism of the character briefly outlined above constituting the principal object of the invention, various other objects of the invention and the various advantages and characteristics of the present chord tuning mechanism will readily suggest themselves as the nature of the invention is better understood from a consideration of the following detailed description.

In the accompanying three sheets of drawings forming a part of this specification, one illustrative embodiment of the invention is shown.

In these drawings:

FIG. 1 is a plan view of a chord tuning mechanism embodying the invention;

FIG. 2 is a side elevational view of the mechanism;

FIG. 3 is an enlarged vertical longitudinal view taken on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged fragmentary plan view of the structure shown in FIG. 1;

FIG. 5 is a vertical transverse sectional view taken on the line 5—5 of FIG. 3;

FIG. 6 is a vertical longitudinal sectional view taken on the line 6—6 of FIG. 4;

FIG. 7 is a vertical longitudinal sectional view taken on the line 7—7 of FIG. 4 and showing one pair of co-operating tension-adjusting levers in their respective normal positions wherein the associated string is maintained at its preadjusted tension;

FIG. 8 is a sectional view similar to FIG. 7 but showing the levers in their tension-relieving positions;

FIG. 9 is a sectional view similar to FIGS. 7 and 8 but showing the levers in their tension-increasing positions; and

FIG. 10 is an enlarged exploded perspective view showing a pair of levers juxtapositioned preparatory to side-

wise assembly upon each other for installation in the mechanism.

Referring now to the drawings in detail and in particular to FIGS. 1 and 2, the improved chord tuning mechanism constituting the present invention is designated in its entirety by the reference numeral 10 and is illustrated in the drawings as being operatively associated with a string musical instrument (guitar) 12. The latter has a sounding board 14 of generally rectangular configuration and is supported by means of upstanding parts 16 at the four corners thereof. Diagonally extending struts or braces 18 extend between the posts and the sounding board to lend stability to the structure as a whole. Depending upon the height of the posts 14 the instrument 12 is designed to accommodate either a standing or a seated player.

Six musical strings 20 in side-by-side but spaced apart relation are stretched lengthwise of the sounding board 14 slightly above the level of the latter and the end portions of these strings rest upon a pair of fixed upstanding bridges 22 on the end portions of the sounding board. Each bridge includes a plurality of grooved rollers 23, one for each string, the rollers being freely rotatable on a common longitudinally extending supporting shaft 24, thus giving tractional support to the strings and increasing the life expectancy thereof. The left hand end of each string, as viewed in FIGS. 1 and 2, is secured to a conventional tuning key 26 and the right hand end of each string is operatively connected to the chord tuning mechanism 10 in a manner that will be set forth presently. The tuning keys are of the type that are ordinarily associated with guitars and similar musical instruments and they are capable, when turned in one direction or the other, of applying the desired tension to the various strings 20, suitable friction means being provided for maintaining the keys in whatever positions they may be set as well understood in the art.

The right hand end of each string 20 is anchored to one end of an individual rocker element 30 forming a part of the chord tuning mechanism 10, there being one rocker element for each string as shown in the drawings. Each rocker element 30 is in the form of a lever of the first class and it is pivoted medially of its ends as will be more fully described hereinafter. In order to secure the right hand end of each string 20 to its associated a downwardly extending slot 32 (see FIGS. 6 and 10) in the upper end portion of the rocker element 30 and the swaged or otherwise enlarged right hand end of the string is captured in a countersink 34 which communicates with the lower end of the slot 32. Each rocker element 30, while serving as an anchorage for the adjacent end of its attached string, also functions through appropriate manipulation thereof to alter the tension of the string for chord tuning purposes.

Referring now, additionally, to FIGS. 3 to 6, inclusive the chord tuning mechanism 10 involves in its general organization a frame work 36 which, as best shown in FIGS. 5 and 6, is generally of comb-shape in vertical transverse cross section so as to provide relatively thick side walls 38 which extend upwardly from the side marginal portions of a flat bottom wall 39, and in addition, a series of thin medial or intermediate upstanding partition walls 40. Downturned flanges 42 on the right hand end region of the sounding board 14 establish a large rectangular opening 44 within which the chord tuning mechanism 10 as a whole is seated and removably secured in place in any suitable manner. Preferably, the framework 36 is in the form of a casting of aluminum or any other similar light-weight metal. The partition walls 40 are spaced equidistantly apart and are in parallel relation with the side walls 38.

A horizontal cross pin 50 (see FIGS. 2, 3, 4, 7, 8, and 9) extends transversely across the framework 36 adjacent to the front end thereof and passes through aligned holes in the left hand upper corners of the two

side walls 38 and the partition walls 40. This cross pin 50 serves as a pivotal support for a series of primary and secondary levers 52 and 54 (see FIGS. 3, 4 and 10), the levers being disposed in pairs with each pair being confined between two adjacent partition walls 40. Each pair of levers is associated with and serves to support and operate one of the rocker elements 30 and these three members constitute, in effect, an individual tuning unit which is attached to one of the strings 20 for tuning purposes.

Considering now one pair of levers 52, 54 (the various pairs being identical), the primary lever 52 is in the form of a one-piece bell crank having an upstanding short arm 56 and a substantially horizontal long arm 58 (see FIG. 10). The short arm is located at the left hand end of the long arm 58 as viewed in the drawings and its upper end is provided with a laterally extending offset lug 60. A horizontal pivot pin 62 bridges the distance between the lug and the short arm proper and serves as a pivotal support for the associated rocker element 30. As best shown in FIGS. 1 to 3, inclusive, the various primary and secondary levers, when in their normal positions, extend in substantial parallelism and lie approximately in the same general horizontal plane as that of the sounding board 14, the distal or right hand ends of the levers being urged upwardly against the underneath side of a limit or stop bar 66 by a transverse series of vertically extending helical compression springs 64, there being one spring for each pair of levers 52 and 54. The bar 66 extends longitudinally and overlies the right hand end of the framework 36. The ends of the bar are anchored by vertically extending screws 68 to the upper right hand corners of the side walls 38 of the framework. The lower ends of the springs 64 seat within individual pilot sockets 70 in the right hand end of the bottom wall 39 of the framework 36, and the upper ends of the springs bear upwardly against laterally extending ledges 72 which are formed on the distal or right hand ends of the secondary levers 54, the ledges underlying the adjacent distal ends of the primary levers 52 so that the springs serve yieldingly to urge both the primary and secondary levers upwardly to their normal horizontal positions. Each spring 64 is confined between a pair of opposed substantially semi-cylindrical recesses or grooves 74 (see FIGS. 4 and 7) which are formed in adjacent partition walls 40 and, in effect, provide interrupted cylindrical cages for the spring.

As clearly shown in FIGS. 7 to 10, inclusive, each rocker element 30 which, as previously stated, is in the form of a lever of the first class is provided with a medial lug 80 by means of which the rocker element is pivoted to the pin 62 on the upper portion of the short arm 56 of the associated primary lever 52. The upper end of each rocker element 30 projects above the upper end of the associated short arm 56 while the lower end of the element projects downwardly alongside the rear or right hand face of such short arm. Aligned holes 82 and 84 (see FIG. 10) in the proximal or left hand ends of each pair of primary and secondary levers 52 and 54 receive the pivot pin 50 and thus such pin serves to maintain the two levers in their contiguous relationship of parallelism. The primary levers 52 are provided with downwardly facing recesses 86 in their distal or right hand ends for reception of the lateral ledges 72 when the levers 52 and 54 are in their normal horizontal positions (see FIG. 7).

Each secondary lever 54 functions as a lever of the second class and is provided at the proximal or left hand end with a laterally projecting pin 90 having a small roller 92 mounted thereon for free rotation relatively thereto. The outer end of the pin is upset to form a head for preventing axial displacement of the roller with respect to the pin. Such pin and roller assembly overlies the upper edge of the associated primary lever 52 and are in longitudinal register with the lower end of the associated

rocker element 30 so that the tension in the associated string 20 serves at all times yieldingly to tilt the rocker element in a counterclockwise direction as viewed in FIGS. 7, 8 and 9 and thus cause the lower end region of the rocker element to bear firmly against the roller 92. It will be observed that even in the absence of the springs 64, the tension of the strings 20 ordinarily would serve to maintain the various pairs of levers 52 and 54 in their elevated positions due to the relatively large amount of arms which exist between the points of attachment of the strings to the rocker elements 30 and the pivot axis for the levers. However, the springs are provided for the purpose of maintaining the pairs of levers against looseness when no strings are attached to the rocker elements, thereby facilitating initial assembly of the musical instrument preparatory to tuning the strings thereof.

Considering now the tuning facilities that are offered by each pair of levers 52 and 54 upon their associated string 20, it will be observed that with the levers both in their normal raised positions as shown in FIG. 7, the associated string 20 will assume its normal preadjusted tension and the reaction anchorage for the right hand end of the string will extend through the associated rocker element 30, the associated pin and roller assembly (90, 92), the associated secondary lever 54, and the ledge 72 on the latter distal end of the long arm 58 of the primary lever 52, to the limit bar 66.

So far as each pair of levers is concerned, upon depression of the secondary lever 54 as shown in FIG. 8, this lever will individually become lowered, the ledge 72 thereof moving away from the distal end of the primary lever 52. The lever 54, in so moving, will cause the pin and roller assembly (90, 92) to orbit bodily about the axis of the pivot pin 50 as indicated by the arrow in FIG. 7, thus imparting to this pin and roller assembly an appreciable component of rearward or right hand longitudinal motion which, ordinarily, would cause the roller 92 to move away from the rocker element 30. However, due to the fact that the string 20 is under initial tension, the rocker element 30 is constrained to swing in a counterclockwise direction as viewed in FIGS. 7, 8 and 9, thus causing the lower end thereof to follow the movement of the roller 92 and the upper end thereof to swing to the left as viewed in FIG. 8, thereby lessening the degree of tension in the string 20 and imparting to the latter a pitch which is slightly lower than the initial pitch for which the string was originally tuned. During such tuning operation, the primary lever 52 will remain in its normal horizontal position under the influence of the forward component of thrust which is offered thereto by the rocker element 30 which now acts as a lever of the second class with its fulcrum transferred to the roller 92, its power inlet being applied by the string 20, and its effective output taking place against the short arm 56 of the lever 52. To prevent undue displacement of the rocker element 30 when the secondary lever 54 is depressed as described above, the lower portion of the rocker element is relieved or rounded as indicated at 94 (see FIG. 10), thus providing a ramp surface for rolling engagement with the roller 92.

Upon depression of the long arm 58 of the primary lever 52, the distal end thereof will depress the ledge 72 on the secondary lever 54 and consequently the lever 54 as a whole so that both levers 52 and 54 will swing to their lowered positions in unison. With the levers thus interlocked and in the positions in which they are shown in FIG. 9, the relatively long moment arm that is afforded by the eccentricity of the upper end of the rocker element 30 from the pivot axis of the pin 50 will serve to draw the right hand end of the string rearwardly, i.e., to the right as viewed in FIG. 9, thus tensioning the string 20 to a slight degree beyond that of the normal tuned tension thereof. In this instance, the rocker element 30 (which in its free state has a first class lever mounting with respect to the lever 52) is translated into a lever of the third class, the roller 92 becoming the fulcrum, power being ap-

plied at the pin 62 and the lug 80, and the lever output being directed against the string 20 at the upper end of the rocker element.

The manner in which the pairs of levers 52 and 54 are selectively actuated either to depress the secondary levers alone or to depress both the secondary and primary levers conjointly, constitutes no part of the present invention and such selective depression of levers may be accomplished in the manner shown and described in aforementioned Patent No. 2,458,263. It will be understood that the tuning mechanism 10 may be equipped to make provision for selective multiple chord tuning under the control of a multiplicity of foot treadles as illustrated in the patent, but for simplification of description herein, the means for selective depression of levers to attain only a single chord tuning function is shown on the drawings hereof.

As best shown in FIGS. 2 and 5, a horizontal vertically shiftable crossbar 100 (see also FIG. 7) overlies and extends transversely of all of the levers 52 and 54 and carries a series of adjustable chord tuning screws 102, the lower ends of which project below the crossbar. The adjustable tuning screws 102 are disposed in pairs, there being one pair for each pair of levers 52 and 54. The screws are laterally spaced so that each screw directly overlies one of the levers 52 and 54 as the case may be. The crossbar 100 is guided in its vertical shifting movements by means of vertically extending guide posts 104 which are fixedly connected to and project upwardly from the right hand portions of the upper margins of the side walls 38. The ends of the crossbar are provided with vertically extending holes for slidably receiving the guide posts 104. The crossbar 100 is yieldingly maintained in an elevated position by two vertically extending helical compression springs 106, the upper ends of which abut against the end portions of the crossbar. The central and lower portions of the springs are loosely disposed in vertical bores 108 in the side walls and the bottom wall of the framework 36. Screw-type pull rods 114 (see FIGS. 3 and 5) extend vertically through the springs 106 and have their upper ends threadedly received in the ends of the crossbar 100. The central portions of the pull rods extend slidably through collars 116 which are welded or otherwise fixedly secured to the bottom face of the framework bottom wall and form stop shoulders or abutments for the lower ends of the springs 106. The lower ends of the pull rods 114 are suitably secured to the ends of a horizontal cross yoke or head 118 which, in turn, is pivotally connected to the upper end of an upstanding treadle link 120. The lower end of such link is pivotally connected to the central portion of a treadle 122, one end of the latter being pivotally connected to one of the posts 16.

From the above description it will be seen that upon depression of the treadle 122, the crossbar 100 is lowered against the yielding or biasing action of the springs 106 with the result that the lower ends of such adjusting screws 102 as may have been adjusted for chord tuning purposes will engage their respective levers 52 or 54 as the case may be and depress the same, thereby effecting the proper tension adjustment of the associated strings 20 for chord attainment purposes.

In adjusting the chord tuning mechanism of the present invention to make available a particular musical chord under the control of the crossbar 100, the instrument 12 will have been previously tuned in the usual manner of instrument tuning, utilizing the tuning keys 16 for this purpose. Thereafter, the foot treadle 122 will be fully depressed until the crossbar 100 strikes and comes to rest upon the upper edges of the side walls 38 of the framework 36. Thereafter, the various adjusting screws 102 will be adjusted to further vary the tension of the strings 20, depending upon which strings require further tensioning or slackening to produce the desired pitch changes. After the desired adjustments have been made, the foot treadle 122 is released and the tension of the various

strings 20 will return to normal as the levers 52 and 54 are restored to their normal substantially horizontal positions as limited by the presence of the limit bar 66.

From the above description, it will be appreciated that the novel construction and arrangement of the individual sets of rocker elements 30, primary levers 52 and secondary levers 54 as well as of the mountings therefor and the springs biasing thereof, afford an extremely sensitive chord tuning arrangement wherein little or no drag is placed upon the levers during depression or release thereof. The aforementioned pin and roller assemblies (90, 92) afford between the rocker elements 30 and their associated secondary levers 54 rolling antifriction connections which are responsive to the slightest displacement of the levers 54. The recessed partition walls 40 of the framework 36 afford additional clearance spaces for proper nesting of the springs 64 in between adjacent partition walls so that neither lateral nor longitudinal displacement of the springs is possible. The use of the limit bar 66 which is engageable with the distal ends of the long lever arms 58 of the primary levers 52 and with the distal ends of the secondary levers 54 assures accurate chord tuning even when small foreign particles become lodged between the bar 66 and the levers. The amount of angular displacement of a primary lever 52 due to the presence of a small foreign particle on the distal end region of the long lever arm 58 thereof can never be sufficiently great as appreciably to affect the tension in the associated string 20 inasmuch as such displacement, when considered in terms of movement of the short arm 56, is reduced by the reciprocal of the power factor of the lever. A similar displacement of a secondary lever 54 has no appreciable effect upon the tension in the associated string since such displacement involves no appreciable longitudinal shifting of the pin and roller assembly (90, 92).

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit or scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In a chord tuning mechanism for a musical string instrument, a tuning unit adapted to alter the tension of a pretensioned vibratory musical string associated with the instrument, said tuning unit comprising a primary lever in the form of a bell crank having a short arm and a depressible long arm, a depressible secondary lever fulcrumed at one end thereof coaxially with the primary lever and normally disposed in contiguous coextensive relationship with the long arm of the primary lever, a rocker element pivoted medially of its ends to the distal end of said short arm of the primary lever and having one end thereof adapted for attachment to an end of said musical string, a fixed abutment disposed above the level of the distal end region of the secondary lever and against which said distal end region is adapted to bear, a spring disposed beneath said distal end region and yieldingly urging the latter upwardly into engagement with said fixed abutment, means on said secondary lever engageable with the primary lever for causing depression of the secondary lever upon depression of said long arm, said secondary lever being independently depressible, means on said secondary lever engageable with the rocker element and effective upon depression of said long arm and consequent depression of the secondary lever to restrain rotation of the rocker element relative to the primary lever and thus cause an increase in the tension of the attached string, said latter means being effective when the secondary

lever is depressed to the exclusion of the long arm to allow rotation of the rocker element and thus cause a decrease in the tension of the attached string, said latter means comprising a freely rotatable roller carried by and movable bodily with the secondary lever.

2. A tuning unit as set forth in claim 1, wherein said roller is engageable with the rocker element adjacent to the end region thereof remote from its string-attached end, and wherein said latter end region is provided with a roller-engaging edge surface which is inclined with respect to the longitudinal axis of the rocker element.

3. In a chord tuning mechanism for a musical string instrument a framework including a rectangular bottom wall, a pair of upstanding spaced apart parallel side walls projecting upwardly from the marginal longitudinal side edges of said bottom wall, and a series of equally spaced intermediate longitudinal partition walls projecting upwardly from said bottom wall, each pair of adjacent walls defining therebetween a relatively deep narrow longitudinally extending slot-like enclosure, a tuning unit for the most part disposed within each enclosure and comprising a primary lever in the form of a bell crank having a short arm and a depressible long arm, a depressible secondary lever fulcrumed at one end coaxially with the primary lever adjacent to one end of the associated enclosure and normally disposed in contiguous coextensive relationship with the long arm of the primary lever, a rocker element pivoted medially of its ends to the distal end of said short arm and having one end adapted for attachment to one end of one of the strings of the instrument, a fixed stop bar common to said enclosures bridging the distance between said side walls and overlying the distal ends of all of the secondary levers, a spring interposed between the distal end of each secondary lever and said bottom wall and yieldingly urging the latter lever upwardly into engagement with said stop bar, means on the secondary lever engageable with the primary lever for causing depression of the secondary lever upon depression of said long arm, said secondary lever being independently depressible, and means on the secondary lever engageable with the rocker element and effective upon depression of the long arm and consequent depression of the secondary lever to restrain rotation of the rocker element relative to the primary lever and thus cause an increase in the tension of the attached string, said latter means being effective when the secondary lever is depressed to the exclusion of the long arm to allow rotation of the rocker element and thus cause a decrease in the tension of the attached string.

4. A chord tuning mechanism as set forth in claim 3 and wherein said means for restraining rotation of the rocker element relative to the primary lever comprises a freely rotatable roller carried by and movable bodily with the secondary lever.

5. A chord tuning mechanism as set forth in claim 4, wherein the overall diameter of each spring is slightly greater than the distance between adjacent walls and wherein the walls of each pair of adjacent walls are provided with opposed recesses therein between which one of the springs is confined and by means of which it is centered within the associated slot.

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