

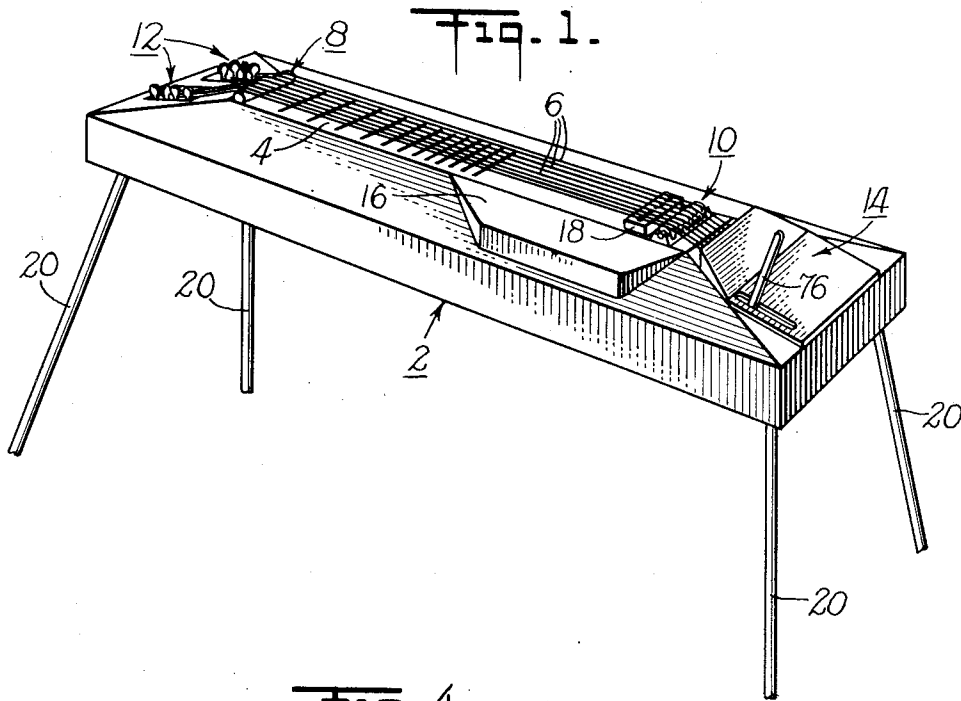
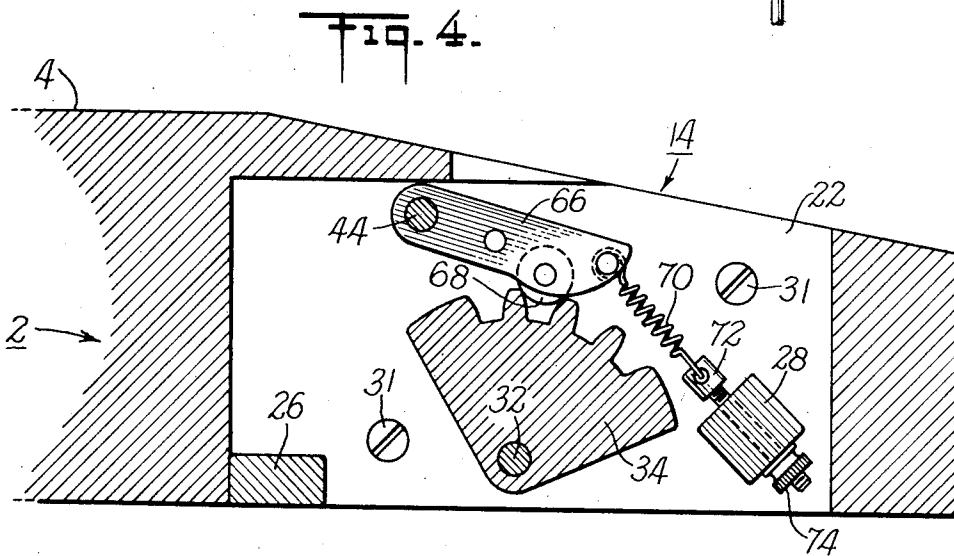
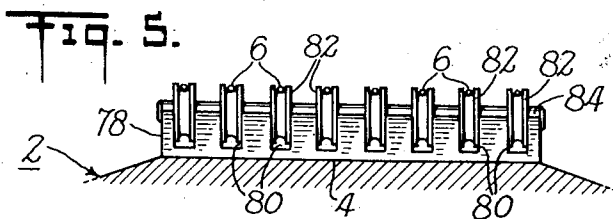
Oct. 6, 1953

G. BARR  
MUSICAL INSTRUMENT

2,654,283

Filed May 2, 1949

3 Sheets-Sheet 1



INVENTOR  
George Barr  
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**2,654,283**

MUSICAL INSTRUMENT

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3 Sheets-Sheet 2

Fig. 2.

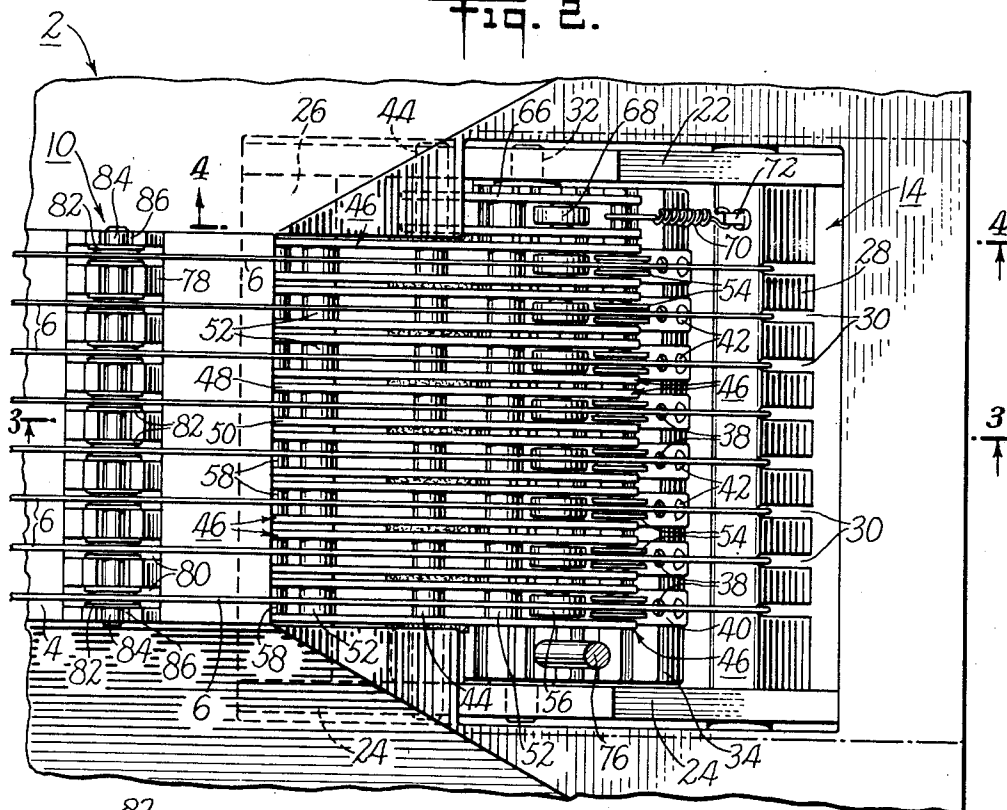
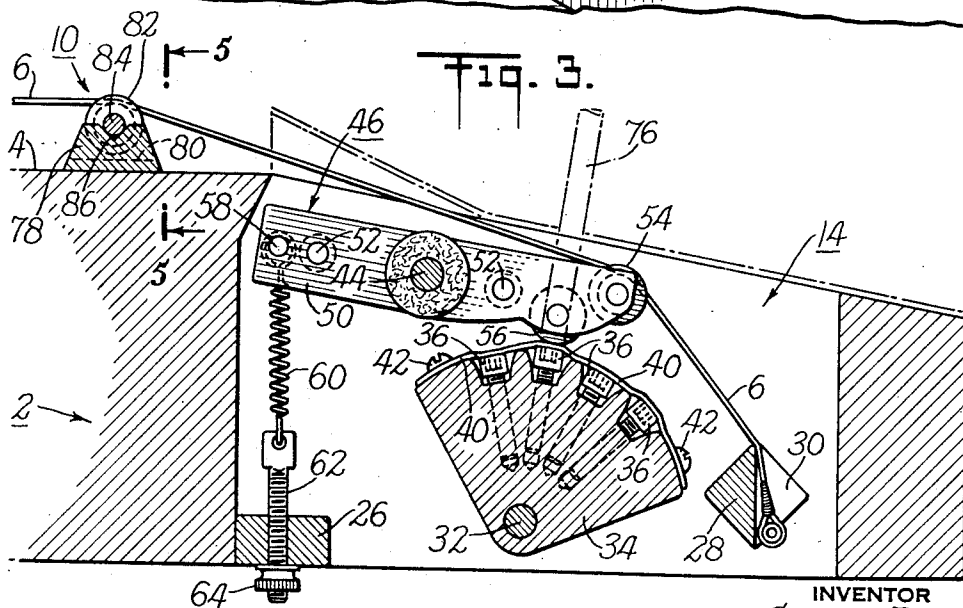


Fig. 3.



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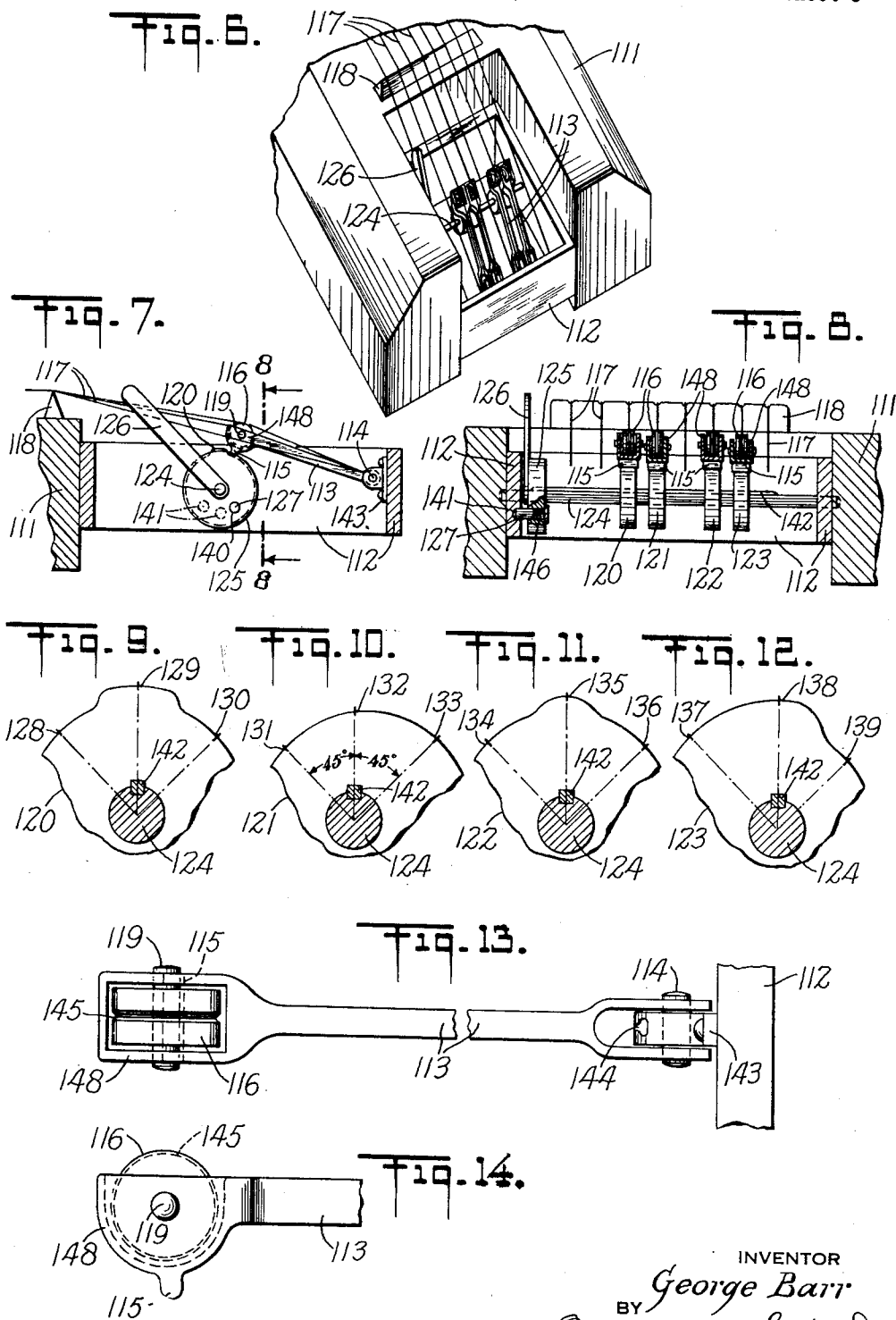
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G. BARR  
MUSICAL INSTRUMENT

2,654,283

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,654,283

## MUSICAL INSTRUMENT

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Application May 2, 1949, Serial No. 90,811

18 Claims. (Cl. 84—312)

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This invention relates to musical instruments and more particularly to that type thereof commonly known as string instruments in which groups of strings under relative tension, according to the laws of harmony, constitute the media whereby tonal vibrations are developed during a playing period.

This invention has for its object the provision of novel musical instruments including novel means whereby individual musical notes or groups of such notes, constituting chords, may be changed to thereby vary the same in pitch and in musical character without interruption of the current playing by the performer.

This invention contemplates particularly the provision of a novel instrument of the string type including novel mechanisms whereby the tension of the strings individually, or in selected groups, may be varied at will to thereby produce different musical tones and different chords without interference with the current playing by the performer and to selectively produce, at will, full chord combinations known in musical parlance as major chords, minor chords, seventh chords, diminished chords and other such combination of tones.

In place of the usual method of adjusting the tension of each string separately for raising or lowering its pitch to change the instrument tuning, in accordance with the present invention, the pitch of some or all of the strings is changed simultaneously by a simple mechanism. By employing the present invention it is possible to change the tone of any selected number of strings and thereby automatically to change the tuning by merely moving a tune-changing shift handle through a fixed angle. The present application covers improvements in a tuning mechanism the principles of which were first described in my earlier applications, Serial No. 315,949, filed January 27, 1940, and Serial No. 373,087, filed January 11, 1941, both of which were abandoned, and is a continuation-in-part of my copending application Serial No. 598,523, filed June 9, 1945, which issued May 3, 1949 as Patent No. 2,468,726.

This invention comprehends the use of a plurality of cam-like members adapted to change the tension of certain strings in the instrument at will. In the present application it is illustrated as employed in steel-guitar-type stringed musical instruments, for example, the type commonly referred to as the Hawaiian steel guitars; and it is illustrated by two such instruments, each employing eight steel strings, in one of which four tuning changes may be produced, and in the other three.

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Ordinarily a steel guitar player must be able to change the tuning of his instrument accurately and within a short interval of time between selections. Frequently a single selection may require several changes in tuning in the course of playing a single piece and such changes in tuning must of necessity be made instantaneously. This instantaneous shifting of tunings is practically impossible on an ordinary guitar. However, by employing the present invention, the tuning may be changed instantly by the musician regardless of his skill and without interrupting or causing a pause in his playing.

Therefore, one of the purposes of this invention is to provide means whereby anyone may shift tunings as rapidly and accurately as a skilled musician. Further, if the characteristic tones of any particular tuning or chord are easily perceptible to an individual, while the notes of another tuning are difficult for him to distinguish, the player may tune his instrument to the particular tuning or chord he is most familiar with and then mechanically shift or change to any of the remaining tunings. In that way the device has an educational value for, if a student could recognize the tones of one of the tunings but not of the others, he could tune the instrument in the known tuning but at the same time be sure of the proper notes after shifting to other tunings for studying their tones.

A further object of the proposed device is to provide an improved means of mechanically changing the tension of a string without the usual excessive wear. This is accomplished by means of novel tuning levers and rollers. A further object of this invention is to provide a fastening point for the end of the strings as close as possible to the effective pivot of the tuning lever. The purpose of fastening the strings at such a point is to reduce the relative travel of the string along the roller as the roller is raised and lowered for changing the tension on the strings.

Other objects and advantages of the present invention will appear from the description hereinafter and the features of novelty will be pointed out in the appended claims.

In the accompanying drawings, which illustrate examples of the invention without defining its limits:

Figure 1 is a perspective view of a stringed musical instrument, an eight string steel guitar, incorporating one embodiment of the novel mechanism of the present invention;

Figure 2 is an enlarged plan view of the novel tune-changing portion of the instrument of

55 Figure 1;

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Figures 3 and 4 are sections of this tune-changing mechanism taken on lines 3—3 and 4—4, respectively, of Figure 2;

Figure 5 is an elevation of the novel string bridge structure of this mechanism taken on line 5—5 of Figure 3;

Figure 6 is a perspective view of a portion of another eight string guitar incorporating another embodiment of the present invention;

Figure 7 is a longitudinal section of the mechanism shown in Figure 6;

Figure 8 is a lateral section thereof taken on line 8—8 of Figure 7;

Figures 9, 10, 11 and 12 are enlarged side elevations of the tuning cams of the tune-changing mechanism of Figure 6;

Figure 13 is a plan view of a tuning lever and roller thereof; and

Figure 14 is an elevation of the roller portion of the lever of Figure 13.

In the drawings, the novel features have been illustrated in guitar type instruments, but it is to be understood that these illustrated examples are not intended to define the limits of the invention which is applicable to many different forms of string instruments.

The stringed musical instrument shown in Figure 1 is an eight string steel guitar comprising a base member 2 of solid wood, or of other suitable material, shaped in the manner shown in this drawing for the convenience of the player and the appearance of the instrument. This base member 2 carries a fret board 4 mounted across the top thereof. Guitar strings of suitable type extend between the usual string-tightening posts or "machine heads," generally indicated at 12, and the novel string tune-changing mechanism of the present invention mounted at the other end of the base 2 and generally indicated at 14, therebetween passing over two bridges positioned beyond either end of the fret board and generally indicated at 8 and 10. The bridge 8 may be any suitable bridge such, for example, as the grooved round bar arrangement shown in the drawing. On the other hand, in accordance with the present invention, the bridge 10 is a novel bridge structure in which an individual roller is provided under each string to support the string and at the same time permit it to move longitudinally in response to operation of the tune-changing mechanism 14 without causing excessive wear on the string, and also to insure that the friction between the string and the bridge does not permit the strings from assuming its desired tension as determined by the setting of the tune-changing mechanism 14. This novel bridge 10 will be described in greater detail hereinafter.

An arm rest 16 is provided at one side of the base 2 to support the player's arm when playing, and an electrical pickup unit 18 is provided under the strings 6 to translate the tonal vibrations thereof to electrical signals which can be amplified and reproduced through an electronic amplifier and loudspeaker system, all in accordance with the usual practice in instruments of this type. The base 2 may be supported on suitable legs 20.

Referring to Figures 2, 3, and 4, the tune-changing mechanism 14 comprises 2 plate-like side frame members 22 and 24, of metal or other suitable material, held in parallel spaced relationship by two cross frame members 26 and 28 which are fastened to the side frame members 22 and 24 as by screws or other suitable means

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(not shown). The cross frame member 28 is slotted at 30 (see Figure 2) at points corresponding to the end positions of each string 6 to serve as an anchor for one end thereof in the manner customary in the tail-piece of a guitar. The other cross frame member 26 serves as an anchor for adjustable counterbalancing spring mechanisms, as will be hereinafter described. The tune-changing mechanism 14 is fastened to the guitar body 2 in any suitable manner, as by means of wood screws 31 passing through side members 22 and 24. A rotatable shaft 32 extends between the two side frame members 22 and 24. This shaft carries a cam-like structure 34 having the cross-section similar to a segment of a gear, as shown in Figures 3 and 4. This member may be formed of a solid piece of metal, plastic, or other suitable material; or it may be made up in laminated fashion of a plurality of cam elements of similar cross-section, one being provided for each string to be tuned. Each cam element of the cam structure 34 is provided with four cap screws 36 threaded into the cam, around the periphery thereof under each string to be tuned and between the teeth-like portions thereof, as can best be seen in Figure 3. Overlying these screws 36 around the periphery of the cam structure 34 extends a plurality of strips 40 of pliable metal such as brass, copper or the like, held in place on the surface of cam element by suitable means, such as screws 42. These strips 40 are provided with a series of holes 38, one above each of the screws 36, so that a tool can be inserted therethrough to turn each of the screws 36 to adjust it to the position desired.

A second rotatable shaft 44 also extends between the side frame members 22 and 24 near the upper edge thereof, and a plurality of tune-changing levers 46 are rotatably mounted thereon as shown in Figures 2, and 3. Each of these levers 46 comprises two plate-like side members 48 and 50 (see Figure 2) held in parallel spaced relationship by spacing rivets 52 therethrough on either side of the shaft 44. Each lever carries a rotatable grooved roller or pulley 54 rotatably mounted between the side members 48 and 50 at one end of lever 46, and a second roller 56 having a smooth surface rotatably mounted between the roller 54 and shaft 44 and so positioned that it is adapted to roll over the surface of the flexible member 40 above the adjustable screws 36 threaded into the cam structure 34. A tune-changing lever 46 is provided for each of the strings 6 to be tuned. Each such string passes from an anchor in the cross frame member 28, over the grooved roller 54 on the lever 46, thence over the roller bridge 10 to the other bridge 8 and then to the machine heads 12, as shown in Figures 1 and 3. The other end of each lever 46 remote from the roller 54 carries a cross bar 58 to which is attached one end of a tension spring 60. The other end of each tension spring 60 is secured to one end of a long screw 62 which passes freely through a hole in the cross frame member 28 and is held in place by a nut 64 which is threaded thereon on the under side of this member 28.

With the arrangement just described, the angular position of each of the levers 46 is determined by the position into which its screws 36 are adjusted, and it is held in this position by pressure of the guitar string 6 passing over the top of the pulley 54. In order that this string pressure is not so great as to make it difficult for the rollers

56 to move over the surface of the thin metal strips 40 surmounting the screws 36, the nut 64 may be adjusted to increase the tension on the spring 60 so as to counterbalance as much of the force of the strings 6 on rollers 54 as is desired to produce a sufficiently small residual pressure of the rollers 56 on the cam structure 34 to permit easy movement of the latter in changing tunings.

In order to insure that the cam member 34 stops in its predetermined position when changing from one tuning to another, a detent arrangement is provided, as shown in Figure 4, to insure the accurate positioning of the cam structure 34. In one end element of the cam structure 34 the adjustment screws 36 are omitted. A short lever member 66, similar in construction to the tune-changing levers 46, is pivoted on the shaft 44 and carries a pressure roller 68 which is adapted to roll over the gear-like surface of this last element of the cam structure 34. The depressions in the surface of this portion of the cam structure 34 and the diameter of the pressure roller 68 are so chosen that the roller drops part way into the depressions thereof and thus holds the cam structure 34 in its adjusted position. A tension spring 70 is provided to supply a force to bias this detent arm 66 toward the cam structure 34. One end of this tension spring 70 is attached to the free end of the lever 66, and its other end is attached to one end of a long screw 72 which passes through the cross frame member 28 and is secured there by means of a knurled thumbnut 74 so that the tension of spring 70 can be adjusted as desired to provide the required amount of pressure for this detent structure.

In a space corresponding to that occupied by the detent mechanism just described but at the other end of the cam structure 34, a tune-changing lever 76 is provided extending radially from the cam structure 34. Motion of this lever 76 from one detent position to another moves the cam structure 34 so that one row of adjustment screws 36 or another is positioned immediately beneath their corresponding pressure rollers 56.

With the novel mechanism above-described, it is readily apparent that each of the screws 36 can be adjusted, with a tool introduced through the holes 38 in the strips 40, so that each of the strings 6 can be set at any desired tension, i. e. pitch, for each of the four possible positions of the cam structure 34. The settings of the screws 36 determine the positions of the tune-changing levers 46 which, in turn, determine the position of the grooved string-contacting rollers 54, and each thereby determines the tension on its associated string. Hence, by this novel arrangement, a player by setting each of the adjusting screws 36 to the proper position, can tune the guitar so that each of its 8 strings will vibrate at a desired pitch and so that this pitch can be changed from one value to another in any desired order as the cam structure is rotated from one of its positions to another by means of its tune-shifting lever 76.

From the above-described operation of this novel tune-changing mechanism it is clear that the strings 6 undergo some longitudinal movement over the bridge 10 as their tension is changed from one value to the other by the tension-changing device 14. As pointed out above, in order to prevent the strings from being worn by this longitudinal movement at the point where they touch the bridge 10 in sliding contact, and to insure that friction at these contacting points does not prevent the strings from reaching their desired values of tension, a novel bridge structure

is provided. As shown in Figures 2, 3 and 5, this bridge structure comprises a base member 78 provided with a series of crosswise slots 80 in which a plurality of grooved rollers 82 are adapted to be rotatably mounted on a shaft 84 which lies in a groove 86 extending across the upper surface of the base member 78.

A second embodiment of my invention is shown in Figures 6 through 14. In this embodiment, the device is contained in a square frame 112 which is mounted in the end of a steel guitar 111 (Fig. 6). The strings 117 fasten at one end in the slot 144 of clip 143 and extended across the rollers 116 and bridge 118 whereby they fasten to the neck portion of the guitar, the latter not being shown.

The tuning device including a series of cams (four as employed herein) 120, 121, 122, and 123, keyed to cam shaft 124 by key 142. The shaft 124 is rotatably supported at its ends in the frame 112. Means for rotating said cams for changing from one tuning to another is provided by the shifting handle 126 which is fastened to the spring detent collar 125. The collar 125 is keyed to shaft 124 by key 142 and is provided with a cylindrical hole 140 in the side of the collar 125 adjacent the frame 112. A round nosed pin 127 is positioned in said hole 140 and adapted to slide therein. Said pin 127 is backed by a spring 146 which urges it to the left (Fig. 8) into engagement with three keepers or sockets 141 in the frame 112. Said sockets 141 are located at angles corresponding to the angles between the points 128 and 139 inclusive on the cams. In this application the angle between tuning points is shown as forty-five degrees (Fig. 10) although any practical angle may be used. Therefore the shifting of cams by moving the handle 126 through the angle of forty-five degrees to another position or tuning, moves pin 127 into engagement with one of the sockets 141 corresponding to the other set of tuning points located diametrically opposite said socket 141. The spring forces the pin 127 into the keeper socket 141 which retains the cams in the new position until such time as a further change in tuning is desired.

Between the frame 112 and the bridge 118, strings 117 ride in annular grooves 145 of rollers 116. Said annular grooves 145 are provided for maintaining the guitar strings correctly positioned on the rollers. Without the groove, the strings might move axially on the surface of the roller whereby a change in tuning would result from the variation in tension of the strings. Each roller 116 is mounted on a shaft 119 at the end of a lever 113. Said lever is pivoted at the opposite end by pin 114 to clip 43 which in turn is fastened to frame 112. The lever is also provided with a shoe portion 115 which is adapted to ride on the surface of its cam as a follower. The purpose of the above improvement is to provide a device for preventing wear and breakage of the string which occurs frequently when the strings ride directly on the cams. The slot 144 in clip 143 is provided for the purpose of holding the end of the string. It was positioned in clip 143 merely because that was the most convenient position for fastening the string as near to the pivot point 114 of the tuning lever 113 as possible. If it were practical, it would be desirable to fasten the string directly on the pivot pin 114 itself. The object of placing the slot or any means for holding the end of the string near to the pin 114 or pivot point of tuning lever 113 is to limit the distance roller 116 will travel along the strings 117 during a change in key. By such a limitation

the amount of wear is reduced to a minimum. The roller housing 148 is provided with a shoe 115 adapted to ride on the tuning cams as the direct follower. This shoe 115 is preferably made of a softer metal than the cams so as to allow the shoe to wear in place of the cams.

In order to explain the operation of this embodiment of the present invention, the applicant has illustrated a guitar equipped with means for providing the tunings of E-7th, A, and E-6th. If the musician is more familiar with the tones of the strings in the tuning of E-7th he would first shift the handle 126 to the extreme left (Fig. 7) and tune the strings of the guitar in the usual manner. The tuning of E-7th requires the eight strings to be tuned respectively to E, F-sharp, G-sharp, D, E, G-sharp, B and E reading from left to right (Fig. 8). With the handle 126 in the position shown in Fig. 7 for the tuning of E-7th, the third, fourth, sixth and seventh strings (left to right Fig. 8) will have been raised indirectly by points 130, 133, 136 and 139 respectively of the cams which produces notes G-sharp, D, G-sharp, and B. Since the first, second, fifth and eighth strings are not coupled with tuning cams, the tones E, F-sharp, E and E to which these respective strings were originally tuned are not effected by the device and therefore remain the same tone in all three tunings. The theory upon which this device is designed is that a string is raised or lowered in tone in proportion to the number of units of radial distance said string is moved away from or toward the axis of the cam rollers.

If the musician now desires to play in the tuning of A (notes E, F-sharp, A, C-sharp, E, A, C-sharp and E) he next shifts the handle 126 to the right (clockwise in Fig. 7). In order to start the handle moving, it is first necessary to overcome the resistance of the means for holding the cams steady in any selected position. This holding means includes the pin 127 which is positioned in the cylindrical hole 140 in collar 125. Said pin 127 is urged forward (to the left in Fig. 8) by spring 146 and is adapted to enter any one of the three cup sockets 141 in frame 112. When the handle 126 reaches a vertical position the tip of pin 127 is positioned for entering the central or intermediate socket 141. This corresponds to the tuning of A and cam points 129, 132, 135 and 138.

Thus the shifting of the handle 126 to the vertical position would rotate the cams through the same angle (45 degrees as illustrated) and the shoes 115 of the cam levers 113 would be positioned respectively on cam points 129, 132, 135 and 138. This shift would produce the notes A, C-sharp, A, and C-sharp. In the tuning of E-7th these same strings were tuned to G-sharp, D, G-sharp and B. Therefore the third string from the left has been raised one-half tone, namely, from G-sharp to A. By reference to cam 120, Fig. 9 it will be noted that point 129 is further from the axis of the cam and shaft 124 than is point 130. The increase of this distance by one unit raises the shoe 115 and roller 116 as the cam is rotated, whereby the tension of the string is increased sufficiently for raising its tone from G-sharp to A. If it were increased two units the string would be raised approximately one full tone.

In the reverse manner the fourth string from the left has dropped one half tone from D to C-sharp since the cam point 132 is nearer to the axis than point 133. The sixth string from the

left is raised one-half tone (G-sharp to A) and the seventh string is raised two half tones (from B to C-sharp) when changing from E-7th tuning to A. Therefore cam point 135 is one unit farther from the center than 136, and cam point 138 is two units farther from the center than point 139.

The third tuning, E-6th, includes the notes E, F-sharp, G-sharp, C-sharp, E, G-sharp, C-sharp, E. A drop of one half tone in the third, and sixth strings takes place in shifting from the tuning of A to E-6th. This change in tone is accomplished in a manner similar to that explained above. However it should be noted that the fourth and seventh strings remain the same tone in both keys (A and E-6th). This is easily accomplished by providing a cam surface between the points in the form of a true circle wherein the radii 124-137 and 124-138 are equal and; therefore, the seventh string is not effected by rotating the cam.

String 147, Fig. 7 is representative of the position of that portion of the string extending between the bridge 118 and fastening points of frame 112 and not coupled with tuning cams. The four strings coupled with tuning cams extend from the bridge 118, to the rollers 116, to the slots 144 in clips 143 and form a slight angle as they pass over the said rollers. As the rollers are raised by the cams the levers 113 and also that section of string extending between rollers 116 and slot 144, swing approximately about the same point. Therefore no relative motion between the string and the roller is set up in said rotation. Therefore by fastening the string to the lever pivot and eliminating their relative travel, the wear of the string is greatly reduced. This is self evident if you consider pivoting the levers on the left of the frame 112 (Fig. 7) and fastening the string to the right side as shown in Fig. 7. Then as the roller is swung about its pivot its arc of travel will diverge from the arc of travel of the original point of contact of the string with the roller.

However, although no relative travel results between the lever and string due to swinging the rollers and strings in an arcuate path about their common pivot as pointed out above, there is a relative travel which would wear the strings if it were not for the rollers. This travel causing wear from which the rollers are provided is due to their change in length as the tension increases or decreases.

With a device similar to the one illustrated and described in this embodiment, only three mechanical tuning changes can be made, but this does not in any way limit the number of manual tuning changes possible. As a matter of fact, the shifting lever may be placed in any position and the guitar tuned in the same manner as an ordinary guitar to any tuning to which the guitar could have been tuned before the invention was installed.

Although the application describes means for making three mechanical changes in tunings, as pointed out above, the invention is not limited to that number. The number of tuning points on the cams may be increased to provide any practical number of mechanical tuning changes desired. At the same time by standardizing the shaft 124 and cams 120 to 123, a musician could purchase a set of cams for any standard combination of tuning changes. Some combinations might require tone changes on all eight strings in which case eight cams would be required. If say five or six different tunings are also required

then each cam must be provided with five or six tuning points.

Although the present invention has been described as embodied in two different guitar constructions, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand. Thus, for instance, the novel features are capable of embodiment in many different types of stringed musical instruments. Such variations and modifications are considered to be within the purview and scope of the following claims.

#### I claim:

1. A device for changing the tuning of a multiple string steel guitar including, a cam shaft, a plurality of cams keyed to said shaft, one cam for each string to be tuned, each cam having at least three operating cam positions each corresponding to a tuning position for said device, a tuning lever cooperating with each cam and pivoted at one end, each lever provided with a shoe portion made of a softer material than said cams and adapted to ride on said cams as followers for taking the frictional wear in place of the cam, a roller mounted in the free end of each tuning lever for providing antifriction rolling support for each string, the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to hold said levers in engagement with said cams, an annular groove in each roller for maintaining the guitar strings accurately positioned on said rollers, a fastening point for each guitar string located approximately at the pivot point of said tuning levers, a collar keyed to said cam shaft, a shifting lever fastened to said collar for rotating said cams and changing the tuning of said guitar, and a socket means in combination with a spring actuated pin for indicating and temporarily holding said cams at predetermined tuning points in the arcs of rotation.

2. A device for changing the tuning of a multiple string steel guitar including, a cam shaft, a plurality of cams keyed to said shaft, one cam for each string to be tuned, each cam having at least three operating cam positions each corresponding to a tuning position for said device, a tuning lever cooperating with each cam and pivoted at one end, a roller mounted in the free end of each tuning lever for providing antifriction rolling support for each string, the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to hold said levers in engagement with said cams, an annular groove in each roller for maintaining the guitar strings accurately positioned on said rollers, a fastening point for each guitar string located approximately at the pivot point of said tuning levers, a collar keyed to said cam shaft, a shifting lever fastened to said collar for rotating said cams and changing the tuning of said guitar, and a socket means in combination with a spring actuated pin for indicating and temporarily holding said cams at predetermined tuning points in the arcs of rotation.

3. A device for changing the tuning of a multiple string steel guitar including, a cam shaft, a plurality of cams keyed to said shaft, one cam for each string to be tuned, each cam having at least three operating cam positions each corresponding to a tuning position for said device, a tuning lever cooperating with each cam and piv-

oted at one end, a roller mounted in the free end of each tuning lever for providing antifriction rolling support for each string, the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to hold said levers in engagement with said cams, a fastening point for each guitar string located approximately at the pivot point of said tuning levers, a collar keyed to said cam shaft, a shifting lever fastened to said collar for rotating said cams and changing the tuning of said guitar, and a socket means in combination with a spring actuated pin for indicating and temporarily holding said cams at predetermined tuning points in the arcs of rotation.

4. A device for changing the tuning of a multiple string steel guitar including, a cam shaft, a plurality of cams keyed to said shaft, one cam for each string to be tuned, each cam having at least three operating cam positions each corresponding to a tuning position for said device, a tuning lever cooperating with each cam and pivoted at one end, a roller mounted in the free end of each tuning lever for providing antifriction rolling support for each string, the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to hold said levers in engagement with said cams, a fastening point for each guitar string located approximately at the pivot point of said tuning levers, and means for rotating the cams to any selected tuning position, in combination with means for indicating and temporarily holding said cams at predetermined turning points in the arcs of rotation.

5. A device for changing the tuning of a stringed instrument including one or more cams each cam having at least three operating cam positions each corresponding to a tuning position for said device, a pivoted tuning lever adapted to ride on each cam, said levers being pivoted approximately at the fastening point of their respective instrument strings the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to hold said levers in engagement with said cams, and means for rotating said cams to any selected one of said tuning positions for raising and lowering said levers against the normal tension of said strings to change the tension and thereby the tone of any selected string.

6. A device for changing the tuning of a musical instrument having multiple strings including, in combination, a plurality of cam elements each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tuning levers adapted to ride on said cam elements, each of said levers carrying a guitar string, means for rotating said cams for raising and lowering said levers thereby to change the tension of the strings associated therewith, an indexing mechanism for positioning and temporarily holding said cams at predetermined positions, and adjustable elements on said cams at said positions for determining the extent of motion of said levers comprising radially positionable stops projecting through said operating positions of said cams to coact with said tuning levers.

7. A device for changing the tuning of a musical instrument having multiple strings including, in combination, a plurality of cam elements each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tun-

ing levers adapted to ride on said cam elements, each of said levers carrying a guitar string, means for rotating said cams for raising and lowering said levers thereby to change the tension of the string associated therewith, an indexing mechanism for positioning and temporarily holding said cams at predetermined positions, and adjustable elements on said cams at said positions for determining the extent of motion of said levers, comprising screws threaded into said cam elements at said operating positions.

8. A device for changing the tuning of a musical instrument having multiple strings including, in combination, a plurality of cam elements, a plurality of pivoted tuning levers adapted to ride on said cam elements, each of said levers carrying a guitar string, means for rotating said cams for raising and lowering said levers thereby to change the tension of the string associated therewith, an indexing mechanism for positioning said cams at predetermined positions, adjustable elements on said cams at said positions for determining the extent of motion of said levers comprising screws threaded into said cam elements, and a strip of pliable material around the periphery of said cam elements surmounting said adjustable elements to provide smoothly contoured paths on which said tuning levers ride.

9. A device for changing the tuning of a multiple string steel guitar including, in combination, a plurality of cam elements each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tuning levers adapted to ride on said cam elements, each of said levers carrying a guitar string, the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to urge said tuning levers into engagement with said cams, means for rotating said cam elements for raising and lowering said levers to change the tension of any selected string, and tension springs connected to each of said pivoted levers to provide a force counterbalancing the force exerted on said pivoted levers by said guitar strings.

10. In a multiple stringed musical instrument, in combination, a device for changing the tuning of the strings including, and a plurality of cam elements each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tuning levers adapted to ride on said cam elements, each of said levers carrying a guitar string, the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to urge said tuning levers into engagement with said cams, and means for rotating said cam elements for raising and lowering said levers to change the tension of any selected string, and a bridge member over which said strings pass adjacent said tuning device comprising a base member and a roller member mounted thereon for each string to provide anti-friction rolling support over said bridge member for each string as said tuning changing device is operated to vary the tension in said strings.

11. A device according to claim 7 characterized by the fact that the faces of said cams are provided with a plurality of parallel grooves parallel to the cam axis, said grooves having substantially parallel radial walls spaced apart by an amount substantially equal to the diameter of the heads of said adjusting screws.

12. A device for changing the tuning of a mul-

multiple string steel guitar, including, in combination, a cam shaft, a plurality of cams secured to said shaft, one cam for each string to be tuned each having at least three operating cam positions each corresponding to a tuning position for said device, a pivoted tuning lever cooperating with each cam, a roller mounted at one end of each tuning lever to provide anti-friction rolling support for each string, each string engaging its rolling support at an operating point opposite to its cam so that the operating tension of said strings exerts pressure normally to hold said tuning levers into engagement with said cams, and means for rotating the cams to any selected one of more than two tuning positions, and an indexing mechanism for indicating and temporarily holding said cams at predetermined turning points in the arcs of rotation corresponding to said tuning positions.

13. A device for changing the tuning of a multiple string steel guitar, including, in combination, a cam shaft, a plurality of cams secured to said shaft, one cam for each string to be tuned, each having at least three operating cam positions each corresponding to a tuning position for said device, a pivoted tuning lever cooperating with each cam, a roller mounted at one end of each tuning lever for providing anti-friction rolling support for each string, each string engaging its rolling support at an operating point opposite to its cam so that the operating tension of said strings exerts pressure normally to hold said tuning levers into engagement with said cams, a fastening point for each guitar string located approximately at the pivot point of said tuning levers, a shifting lever fastened to said cam shaft for rotating said cams to change the tuning of said guitar, and an indexing mechanism for indicating and temporarily holding said cams at predetermined tuning points in their arcs of rotation.

14. A device for changing the tuning of a multiple string musical instrument, including, in combination, a cam shaft, a plurality of cam elements each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tuning levers adapted to move said strings and to be moved by said cam elements, a first roller mounted on each of said levers through which movement is imparted to said strings by providing anti-friction rolling support therefor, a second roller mounted on each of said levers through which movement is imparted to said levers by providing anti-friction rolling support therefor, each string engaging its rolling support at an operating point opposite to its cam so that the operating tension of said strings exerts pressure normally to hold said tuning levers into engagement with said cams, and means for rotating said cam elements to move said levers and thus selectively set the tension on said strings at predetermined values.

15. A device for changing the tuning of a multiple string musical instrument, including, in combination, a cam shaft, a plurality of cam elements each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tuning levers adapted to move said strings and to be moved by said cam elements, a first roller mounted on each of said levers through which movement is imparted to said strings by providing anti-friction rolling support therefor, a second roller mounted on each of said levers through which movement is imparted to said

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levers by providing anti-friction rolling support therefor, each string engaging its rolling support at an operating point opposite to its cam so that the operating tension of said strings exerts pressure normally to hold said tuning levers into engagement with said cams, and an adjustable spring structure connected to each of said levers to exert forces thereon opposing the forces exerted thereon by the strings whereby the pressure applied to said cam elements by said second rollers may be minimized as desired.

16. A device for changing the tuning of a multistring steel guitar including, a cam shaft, a plurality of cams keyed to said shaft each having at least three operating cam positions each corresponding to a tuning position for said device, one cam for each string to be tuned, a tuning lever cooperating with each cam and pivoted at one end, a roller mounted in the free end of each tuning lever for providing anti-friction rolling support for each string, each string engaging its rolling support at an operating point opposite to its cam so that the operating tension of said strings exerts pressure normally to hold said tuning levers in engagement with said cams, and means for rotating the cams to any selected one of said tuning positions, in combination with means for indicating and temporarily holding said cams at predetermined turning points in the arcs of rotation.

17. A device for changing the tuning of a multistring steel guitar including, a plurality of cams each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tuning levers

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adapted to ride on said cams, a roller mounted on each lever for providing antifriction rolling support for each string, each string engaging its rolling support at an operating point opposite to its cam so that the operating tension of said strings exerts pressure normally to hold said tuning levers in engagement with said cams, and means for rotating said cams to any selected one of said tuning positions for raising or lowering said levers and rollers to change the tension or tone of any selected string.

18. A device for changing the tuning of a multistring steel guitar including, a plurality of cams each having at least three operating cam positions each corresponding to a tuning position for said device, a plurality of pivoted tuning levers adapted to ride on said cams to support and distort said guitar strings between their terminal anchors, the operating tension of said strings being applied to said tuning levers in a direction toward said cams normally to hold said levers in engagement with said cams, and means for rotating said cams to any selected one of said tuning positions for raising and lowering said levers against the normal tension of said strings to change the tension and thereby the tone of any selected string.

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