Nov. 13, 1951 J. W. McBRIDE 2,574,881

STRINGED MUSICAL INSTRUMENT

Filed Aug. 15, 1949 5 Sheets-Sheet 1

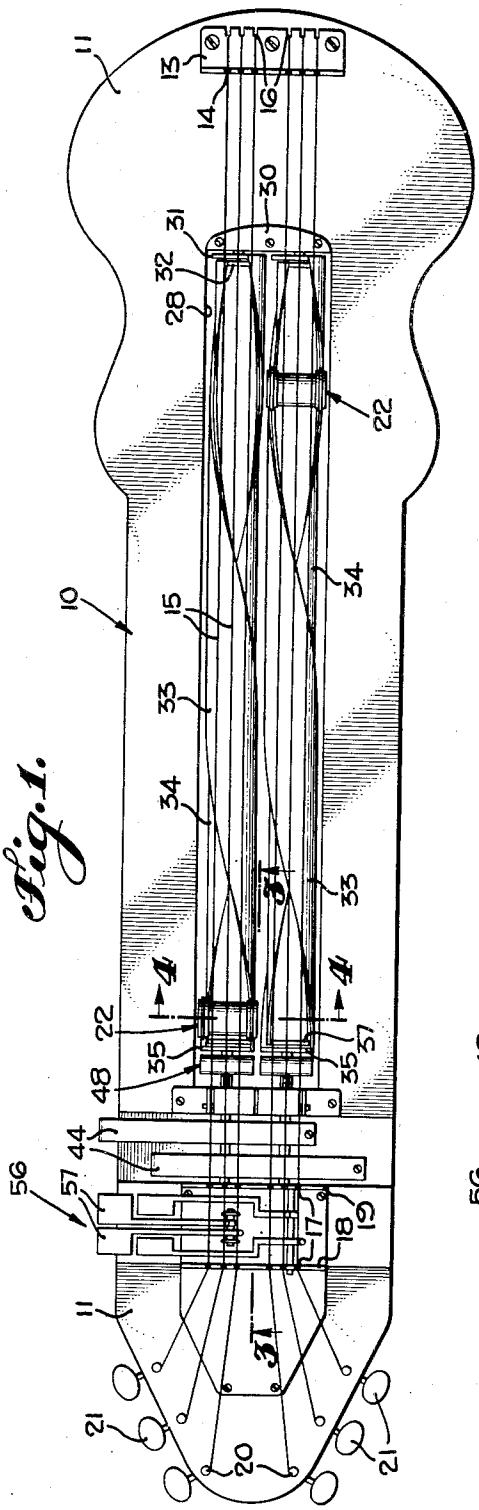


Fig. 1.

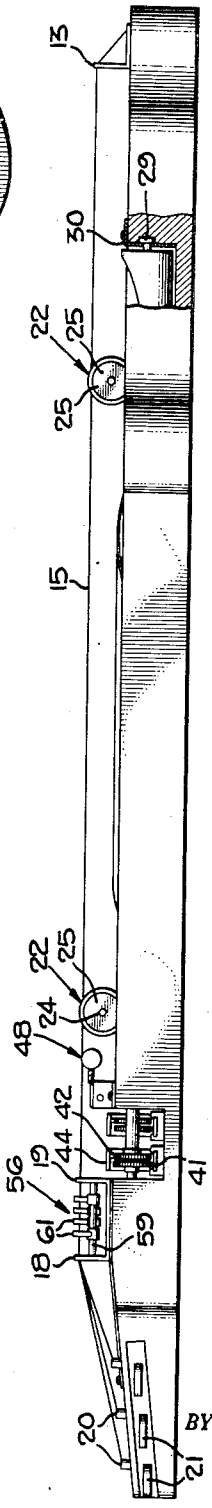


Fig. 2.

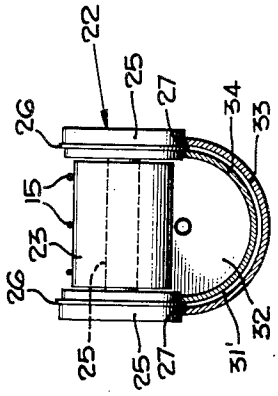


Fig. 4.

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STRINGED MUSICAL INSTRUMENT

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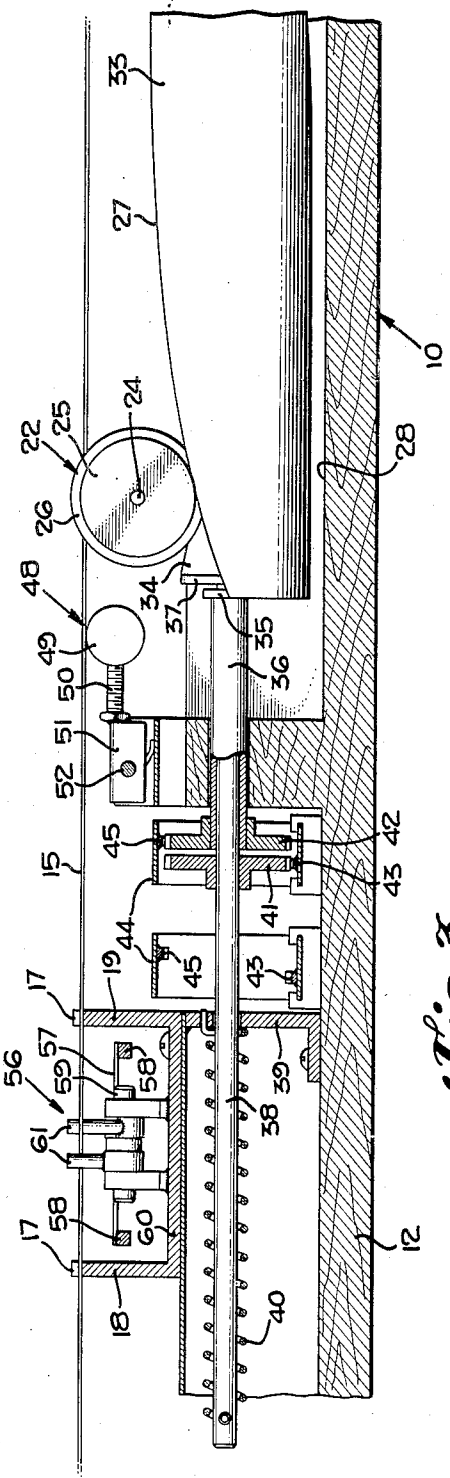


Fig. 3.

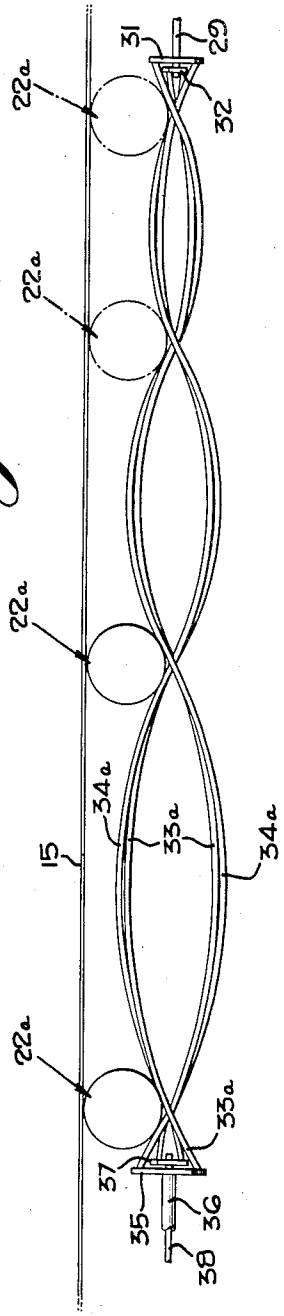


Fig. 10.

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STRINGED MUSICAL INSTRUMENT

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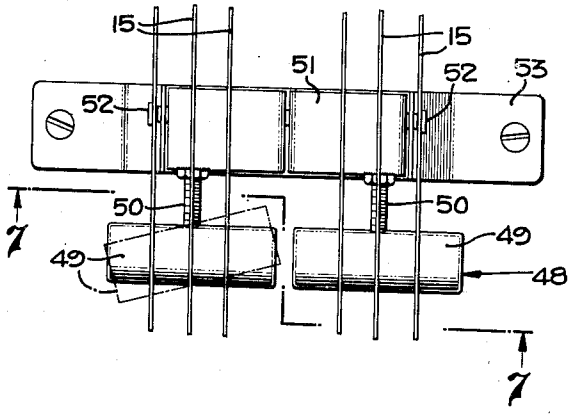


Fig.5.

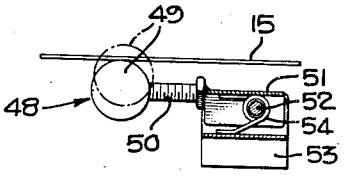


Fig.6.

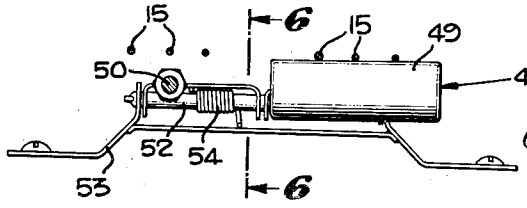


Fig.7.

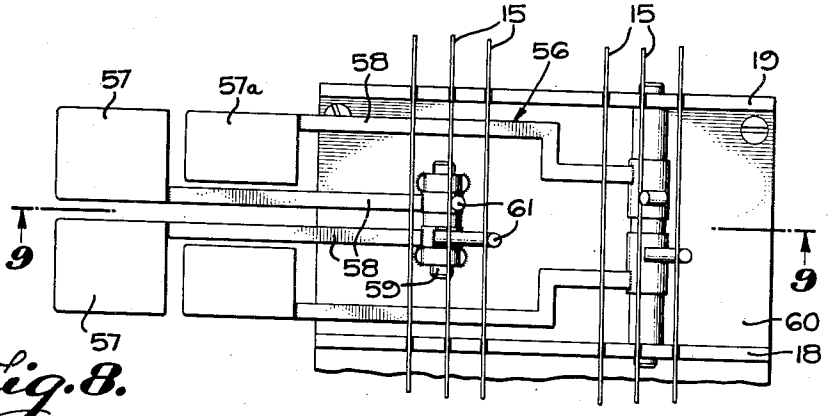


Fig.8.

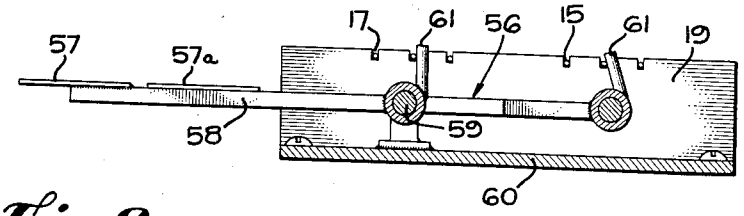


Fig.9.

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STRINGED MUSICAL INSTRUMENT

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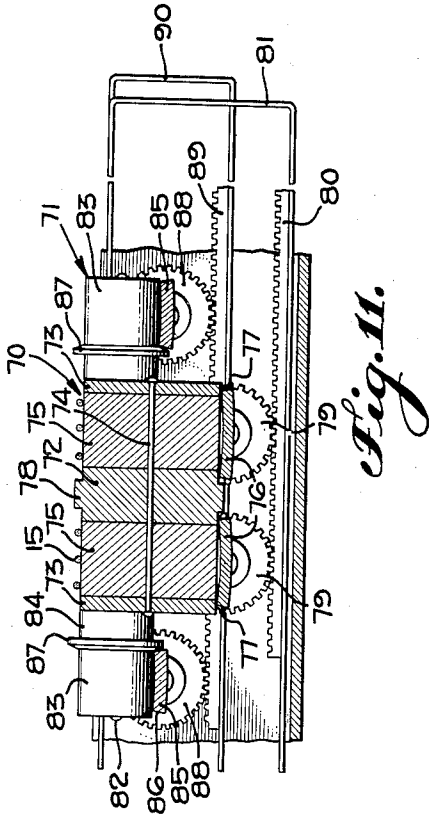


Fig. 11.

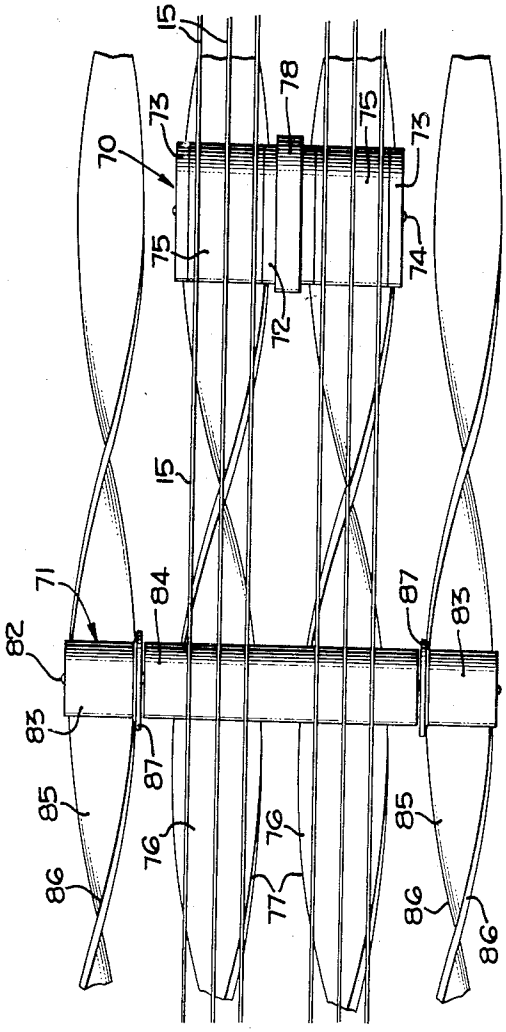


Fig. 12.

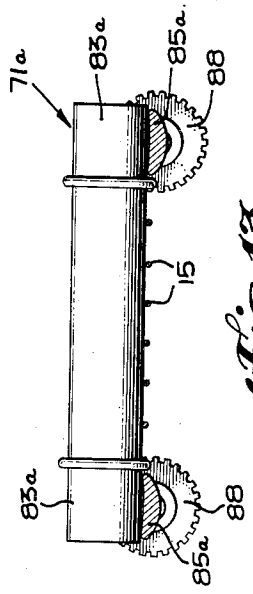


Fig. 13.

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STRINGED MUSICAL INSTRUMENT

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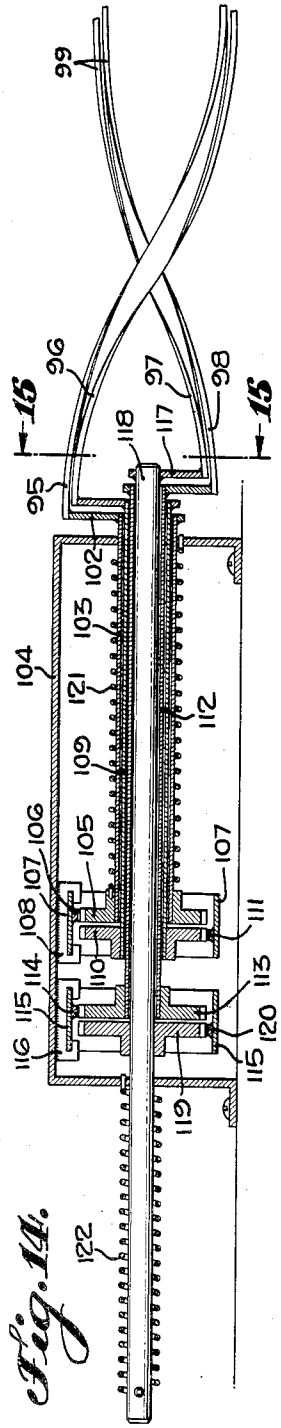


Fig. 14.

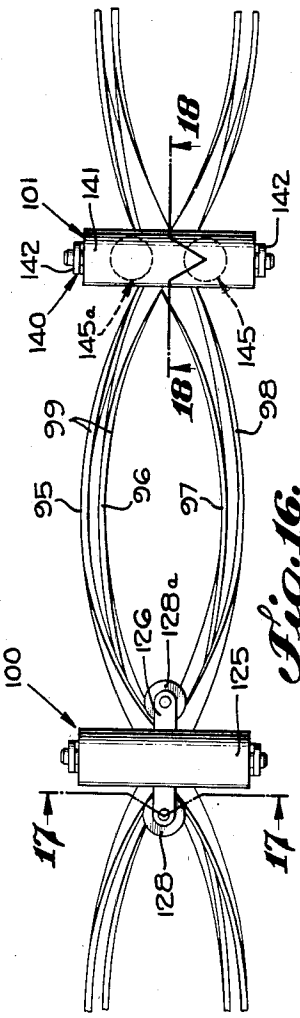


Fig. 16.

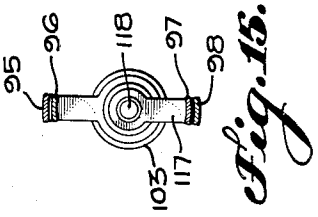


Fig. 15.

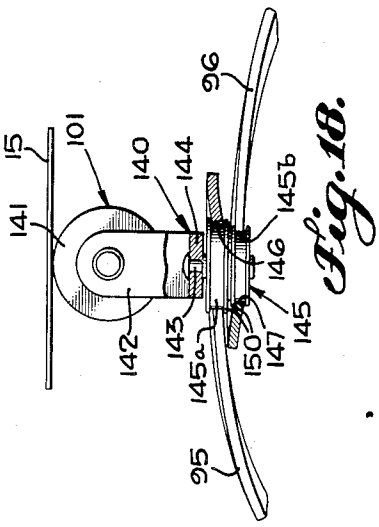


Fig. 18.

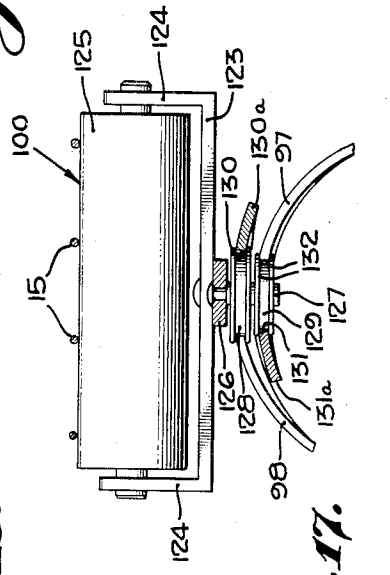


Fig. 17.

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Patented Nov. 13, 1951

2,574,881

UNITED STATES PATENT OFFICE

2,574,881

STRINGED MUSICAL INSTRUMENT

John W. McBride, Burbank, Calif., assignor to Bantar, Incorporated, Burbank, Calif., a corporation of California

Application August 15, 1949, Serial No. 110,263

20 Claims. (Cl. 84—317)

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The present invention relates to musical instruments, and more particularly to musical instruments having one or more tensioned strings adapted to be vibrated. Examples of such instruments are guitars, banjos and violins.

An object of the present invention is to provide improved stringed musical instruments embodying one or more movable frets capable of being shifted bodily along the string, preferably with a rolling motion.

Another object of the invention is to create more than a single tone on a single tensioned string at the same time by bodily moving a fret along the string, preferably with a rolling motion. In this manner, harmonics can be added to the fundamental tone.

A further object of the invention is to create more than a single tone on a single tensioned string at the same time by bodily translating a plurality of movable frets along the strings, preferably with a rolling motion.

Yet another object of the invention is to provide for the creation of a predetermined harmonic emanating from a tensioned string in relation to the fundamental tone or free vibrating length of the string.

Still a further object of the invention is to provide a musical instrument embodying a string stretcher arrangement that can be manipulated easily and conveniently by the player with the same hand as the player employs to shift a movable fret engaging the string.

A further object of the invention is to provide a musical instrument embodying a depressible bridge arrangement which maintains proper contact with the string despite changes in the free vibrating length of the string.

Another object of the invention is to provide a light, movable fret that can be shifted bodily along the string of a musical instrument, and yet be backed solidly so as to increase the duration of the tone emanating from the string.

A further object of the invention is to provide a stringed musical instrument in which a metallic fret can be shifted along an attracting guide, and in which the string or strings of the instrument are utilized to reduce, or offset partially, the attractive force of the guide upon the fret, thereby facilitating shifting of the fret along the string, while maintaining its proper engagement with the string.

Another object of the invention is to provide improved devices for shifting and guiding one or more movable frets along a tensioned string, and for maintaining the proper relationship between the one or more frets and the string.

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This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a top plan view of a musical instrument embodying the invention;

Fig. 2 is a side elevation of the instrument;

Fig. 3 is a partial longitudinal section, on an enlarged scale, taken along the line 3—3 on Fig. 1;

Fig. 4 is an enlarged cross-section taken along the line 4—4 on Fig. 1;

Fig. 5 is a top plan view, on an enlarged scale, of the depressible bridge or harmonic bar portion of the instrument;

Fig. 6 is a section taken along the line 6—6 on Fig. 7;

Fig. 7 is a section taken long the line 7—7 on Fig. 5;

Fig. 8 is a top plan view, on an enlarged scale, of the string stretcher portion of the instrument;

Fig. 9 is a section taken along the line 9—9 on Fig. 8;

Fig. 10 is a somewhat diagrammatic side elevation of a modified form of the invention;

Fig. 11 is a cross-section through a portion of another embodiment of the invention;

Fig. 12 is a partial top plan view of the instrument illustrated in Fig. 11;

Fig. 13 is a cross-section, partly in elevation, of still another form of the invention;

Fig. 14 is a partial longitudinal section through another embodiment of the invention;

Fig. 15 is a cross-section taken along the line 15—15 on Fig. 14;

Fig. 16 is a top plan view of the instrument disclosed in Fig. 14, the portion disclosed in Fig. 16 representing an extension of Fig. 14 to the right thereof;

Fig. 17 is an enlarged cross-section taken along the line 17—17 on Fig. 16;

Fig. 18 is an enlarged longitudinal section taken along the line 18—18 on Fig. 16.

The instrument disclosed in Figs. 1 to 9, inclusive, includes a body member 10 having a string anchoring portion 11 at one end, and a peg board portion 12 at its other end. Arranged transversely across the upper surface of the body mem-

ber is a bridge 13 having spaced notches 14 for the reception of tensioned strings 15, that are to be placed selectively in vibration. The strings pass through these notches 14 and through other notches 16 at the rear of the bridge to a position therebelow, the strings are suitably secured or anchored, in a well-known manner.

From the anchor end of the instrument, the strings are disposed lengthwise along the upper portion of the body member 10 toward the inclined peg board 12, the strings 15 passing through notches 17 in a pair of spaced bridges 18, 19 in the peg board, and then being secured to the usual tuning posts 20 in the latter, which may be rotated, in a known manner, by the pegs 21. Tightening of the pegs 21 will serve to stretch the strings 15 between the bridge members 13, 19, and determine the initial tension in the strings, which may be tuned as desired.

Two sets of strings are disclosed in the drawings, although it is to be understood that one or more sets can be employed, each set including one or more strings. Inasmuch as the mechanism for determining the free vibrating length of the strings is essentially the same, a detailed description of the operating mechanism for one set will suffice for all.

The free vibrating length of each string 15 is determined by shifting a roller assembly or fret 22 lengthwise along the string, the roller assembly axis being transverse, and preferably at right angles, to the direction in which the strings extend. Each roller assembly includes an intermediate string roller 23 rotatable on a shaft 24 that is fixed to guide rollers 25 on opposite ends thereof. Each guide roller has an intermediate flange 26 for precluding substantial movement of the roller assembly endwise of its axis. The string roller 23 is disposed under a set of strings 15, and engages all strings in such set, exerting an upward force thereon. The guide rollers 25 engage inclined guiding surfaces 27 that are disposed under the strings. These surfaces are preferably formed in helical fashion, and serve to feed each roller assembly 22 back and forth along the strings 15, in a manner to be described hereinafter.

The helical guide mechanism is disposed in a recess 28 in the body member 10, and extends between the anchor end 11 and peg board end 12 of the latter. A shaft or spindle is fixed to the body member 10, as by being welded or otherwise secured to a metallic plate 30 extending transversely across the body member and secured to the latter. A transverse outer end plate 31 is rotatably mounted on this spindle, as well as a transverse inner end plate 32. The outer plate 31 is secured to a helical guide 33 that extends along and under the strings 15, in the same manner as a helical thread of relatively steep pitch or lead. This outer helical guide 33 may be cut from a tubular member to provide a pair of helical guiding surfaces 27 that are substantially 180 degrees out of phase.

In a similar manner, the inner plate 32 is secured to an inner helical guide member 34 disposed within the outer guide 33 and provided with helical surfaces 27 substantially 180 degrees out of phase with respect to each other, but having the same pitch or lead. These inner helical surfaces, however, are of the opposite hand from the direction of inclination of the outer guide surfaces 27.

The outer helical guide member 33 extends toward the inclined peg board 12, where it is secured to an end plate 35 fixed to an outer or tubular shaft 36. In a similar manner, the inner helical guide member 34 is secured to an end plate 37 fixed to an inner shaft 38 extending completely through the outer shaft 36, and also through a stationary plate 39 to a location within the peg portion 12. The end of this shaft 38 is attached to a helical spring 40, the outer end of the spring being attached to the shaft supporting member 39.

The inner helical guide member 34, as noted above, is wound with an opposite hand from the outer guide member 33. That is, one of the guide members may have helical surfaces 27 equivalent to a steeply pitched left-hand helical thread, whereas the other guide member surfaces are equivalent to a steeply pitched right-hand helical thread. These helical guiding surfaces 27 engage the guide roller portions 25 of the roller assembly and cradle the latter therebetween. As an example, the guide roller 25 on one end of the roller shaft 26 will engage the outer helical surface 27 at one side of a vertical plane through the roller axis, and this same guide roller 25 will also engage the inner helical guide surface 27 on another side of such plane, providing a spaced two-point support for the guide roller on opposite sides of its vertical central plane. In like manner, the guide roller 25 on the other end of the roller shaft 26 will engage an outer guide surface and also an inner guide surface 27 on opposite sides of a central vertical plane through the roller axis. In effect, the roller is cradled by the guides 33, 34, being held by the tensioned string 15 in engagement with the helical surfaces 27, the latter surfaces reactively holding the string roller portion 23 of the assembly in firm engagement with the strings.

It has been stated that the helical guiding surfaces 27 on the outer guiding member 33 are substantially 180 degrees out of phase with respect to one another, and that this is true also of the helical surfaces 27 on the inner guide member 34. Actually, the exact extent of these surfaces being out of phase depends upon the diameter of the guide roller portions 25. The surfaces are out of phase by an angular extent which will insure the disposition of the roller assembly axis at right angles to the direction in which the tensioned strings extend.

Each roller assembly 22 is prevented from moving endwise of its axis by providing the flange 26 on each guide roller portion 25 extending between the inner and outer helical members 34, 33 (see Fig. 4). It is apparent that such flanges 26 will engage the opposed surfaces of the helical members and prevent substantial endwise movement of the roller assembly.

Each roller assembly 22 is moved along the strings 15 by simultaneously rotating the inner and outer guides 34, 33 in opposite directions and by the same angular extent. These guides are coaxial of each other, inasmuch as the axis of the fixed spindle 29 is coaxial with the axis of the inner shaft 38. As disclosed in the drawings, a pinion 41 is fixed to the inner shaft 38, which is secured to the inner end plate 37, whereas another pinion 42 is fixed to the outer shaft 36 secured to the outer end plate 35. These pinions 41, 42 are of the same diameter and are mounted adjacent one another. One pinion 41 meshes with a lower rack 43 secured to a key 44 slidably mounted in the body member 10 transversely of the shafts 36, 38, whereas the other pinion 42

meshes with an upper rack 45 suitably secured to the same key 44.

It is apparent that movement of the key 44 by a person's fingers will move the racks 43,45 longitudinally in the same direction. Since they are engaging the pinions 41, 42 on opposite sides of the common axis of the latter, the pinions will be rotated in opposite directions to correspondingly rotate the inner and outer helical guide members 34, 33 in opposite directions.

Inward movement of the key 44 by the person's fingers is resisted by the helical spring 40, so that removal of such force of movement causes the energy stored in the spring to rotate the pinion 41 fixed to the shaft 38 in the reverse direction, which correspondingly shifts the key 44 in the reverse direction, and also the pinion 42 attached to the outer shaft 36 in the reverse direction. It is, accordingly, apparent from the foregoing description that longitudinal movement of a key 44 will rotate the helical guides 33, 34 in opposite directions. As the guides are rotated, they will shift the roller assembly 22 longitudinally of the strings 15, the parts being so related that a roller assembly may be shifted to the desired longitudinal extent along the strings.

The guide rollers 25 at all times have a four-point contact with the helical guiding surfaces 27, which positively convey the assembly 22 along the strings 15, and also hold it in proper assembled relation with respect to the strings. In view of the fact that the string roller portion 23 of the assembly is rotatable on the shaft 26, movement of the assembly along the strings can occur with the string roller portion rolling under and in contact with the strings without any sliding friction, thus insuring the smooth operation of the device, with a minimum of extraneous noise.

A plurality of sets of strings 15 and roller assemblies 22, and associated mechanisms is disclosed. Each set has its rack and pinion and return spring devices, which is the same as the arrangement shown most clearly in Fig. 3. Of course, the racks 43, 44 on the keys 44 are so located and arranged thereon as to engage with only a single set of coaxial pinions 41, 42, each key being effective for accomplishing bodily translation of only a single roller assembly 22 along a set of strings.

For the purpose of introducing a harmonic into the vibrating string, a depressible bridge 48 is disposed at the key end of the instrument. A depressible bridge or harmonic bar 49 is disposed under each set of strings 15, and may be arranged either at right angles thereto, or it may be disposed obliquely with respect to the strings. Each harmonic bar 49 is threaded onto a rod 50 which is secured to an arm 51 pivotally mounted on a hinge pin 52 extending through all the depressible bridge arms 51. The pin 52 is supported by brackets 53 attached to the instrument body. A coil spring 54 is disposed around the hinge pin 52 within each arm 51, one end of the spring bearing against the body or supporting member 10, and the other end against the pivoted arm 51, for the purpose of urging the arm and the harmonic bar 49 upwardly, causing the bar to engage the strings 15 in each set in the manner of a bridge. The point of such engagement may be predetermined or varied, prior to assembly of the depressible bridge device, by suitably threading the bar 49 on the rod 50.

As the instrument is being played, and the free vibrating length of each string varied by suitable manipulation of a key 44, and rolling of each roller assembly 22 along the string 15, the spring 54 urges the depressible bridge bar 49 into proper contact with the string, maintaining such proper contact despite movements of the roller assembly 22 along the string. Because of the presence of the depressible bridge 48, harmonics are introduced into the sound emanating from the vibrating string, the particular harmonic effect being dependent on the free vibrating length of the string between the depressible bridge 48 and the particular position of the roller assembly 22 along the string 15. The setting of the string into vibration, by plucking or picking it between the roller assembly 22 and the bridge 13 at the anchor end of the instrument, will also set the string into vibration between the roller assembly 22 and the depressible bridge 48.

If desired, the tuning of the individual strings of the instrument can be changed conveniently by the operator. Also, pitch tremolo or vibrato can be imparted to the string. To accomplish these purposes, a string stretcher device 56 is disposed adjacent the keys 44. This string stretcher device includes sets of keys 57 mounted on the ends of arms 58, that are rotatable on rods 59 secured to the bottom plate 60 of the longitudinally spaced fixed bridge members 18, 19 across which the strings extend. The inner end of each arm 58 has an upwardly projecting finger 61 adapted to engage a string 15. When a key 57 is depressed, the finger 61 urges the string 15 laterally between the fixed bridge members 18, 19 and can increase its tension.

As disclosed most clearly in Figs. 8 and 9, an outer set of keys 57 is associated with two of the three strings in one set, and an inner set of keys 57*a* is associated with two of the three strings in the other set. During playing of the instrument, the person's fingers can readily depress or vibrate one or more of the keys 57, 57*a* to vary the tension in the strings 15 with which such keys are associated, thus momentarily changing the tuning of the individual string. Proper manipulation of each key 57 or 57*a* also makes it possible to impart a vibrato or pitch tremolo to the string.

As has been noted, the same hand of the person can be used to operate the keys 44 for shifting the roller assemblies 22 along the strings 15, and also for simultaneously manipulating the string stretcher device 56.

In the form of invention disclosed in Fig. 10, two roller assemblies 22, 22*a* are shifted along the helical guides 33, 34*a*, and, in addition, these guides are made with a varying pitch along their lengths. One roller assembly 22*a* is disposed under one or more tensioned strings 15, and is in engagement with the helical surfaces of the inner and outer guide members. A second roller assembly 22 is disposed ahead of the first roller assembly, and is cradled on the guides 33*a*, 34*a*, and disposed in contact with the strings 15, in essentially the same manner.

The pitch of both inner and outer helical guide members 33*a*, 34*a* decreases from one end to the other, from which it is apparent that rotation of the helical guide members in opposite directions will bodily translate the pair of rollers 22, 22*a* along the string 15, the left roller 22*a* being moved a greater distance than the right roller 22. That is, assuming the rollers 22, 22*a* to occupy the initial positions indicated in full lines in Fig. 10, and the guides rotated to shift the rollers toward the right to the dotted line positions, the rear roller 22*a* will tend to approach or catch up to

the forward roller 22. Conversely, rotation of the helical guides 33a, 34a in the opposite direction will cause the rear roller 22a to recede from the forward roller 22.

The two rollers 22, 22a are used to introduce harmonics into the vibrating string 15. Actually, the string has two free vibrating lengths, one between the forward roller 22 and the bridge 13 at the anchor end of the body, and the other the length between the rollers 22, 22a themselves. Thus, the string may be set in vibration, the frequency of vibration imparted to the string because of the free vibrating length between the rollers being substantially higher than the frequency of vibration imparted to the string due to the free vibrating length between the forward roller 22 and the bridge 13.

The thread pitch of the guides is chosen so as to decrease along the length of the latter, and two rollers may be used to obtain a set, predetermined harmonic relation to the free vibrating length of the string as the two rollers 22, 22a move along the string. It is apparent that the free vibrating length of the string between the forward roller 22 and bridge 13 is decreasing as the forward roller approaches the bridge 13. At the same time, the free vibrating length of the string between the rollers 22, 22a themselves is also decreasing. Thus, the ratio of the harmonics between the two free vibrating lengths of the string remains substantially constant. The desired ratio can be predetermined, and the pitch of the helical guides designed and varied accordingly.

In the form of invention shown in Figs. 11 and 12, a pair of spaced rollers 70, 71 is used and is shifted along the strings 15 to accomplish the same general purposes as is accomplished in the embodiment illustrated in Fig. 10. However, the rollers 70, 71 may be independently adjusted along the strings 15 so as to vary their free vibrating lengths.

As illustrated, forward and rearward rollable frets or roller assemblies 70, 71 are disclosed. The forward roller assembly 70 includes an intermediate guide roller portion 72 and end guide roller portions 73 secured to a shaft 74. String roller portions 75 are rotatably mounted on the shaft 74 between the intermediate guide roller and the end guide rollers, these string roller portions being disposed under and engaging a plurality of tensioned strings 15. Disposed below the assembly 70 is a pair of laterally spaced helical guides 76 whose marginal surfaces 77 engage the peripheries of the guide rollers 72, 73. Thus, the side edges or helical guiding surfaces 77 of one guide member 76 are in contact with the intermediate guide roller 72 and one of the end rollers 73, whereas the side edges or helical guiding surfaces of the other guide member 76 are in engagement with the intermediate guide roller 72 and the other end guide roller 73. Lateral displacement of the roller assembly along its axis is prevented by providing a central peripheral flange 78 on the intermediate guide roller 72 which may contact the opposed side edges of the helical guide members 76.

The guide members 76 have the same pitch of the same hand. They are rotated about their parallel axis simultaneously in the same direction to create bodily translation of the roller assembly 70 along the tensioned strings 15. Such rotation is accomplished by securing each guide to a pinion 79, both pinions meshing with a single rack 80 attached to a key 81. By sliding the key transversely of the strings, the pinions 79 are caused to rotate, which, in turn, rotate the helical guide members 79 and feed the roller assembly 70 along the tensioned string.

The rearward roller assembly 71 is of longer extent than the forward assembly 70. It includes a central shaft 82 on which the end guide rollers 83 are secured, and on which the intermediate string roller portion 84 is rotatable for engaging the tensioned strings 15. The end rollers 83 are disposed upon helical guides 85 of the same pitch and having guiding surfaces 86 of the same hand, which pitch may be the same or different from the pitch of the inner guide members 76. Endwise movement of the rearward roller assembly 71 along its axis is prevented by providing an inner flange 87 on each guide roller portion which is adapted to engage the side edge of an outer helical guide member 85.

The outer helical guides 85 may be rotated simultaneously about their parallel axes in a manner similar to the helical guides 76. A pinion 88 may be secured to the end of each outer guide 85, meshing with a common rack 89 fixed to a slidable key 90. Depression of the key 90 will rotate the helical guides 85 in the same direction, and feed the rearward roller 71 along the tensioned strings 15.

By suitable manipulation of the keys 81, 90, the rearward and forward rollers 71, 70 may be shifted with respect to each other and with respect to the tensioned strings 15. One roller, such as the forward roller assembly 70, can be utilized to provide the fundamental tone, whereas the other roller, such as the rearward roller 71, may be shifted with respect to and independently of the forward roller, to provide the desired harmonic or partial.

In Fig. 13, a magnetic roller assembly is disclosed which is essentially the same as the rearward roller assembly 71 shown in Figs. 11 and 12, insofar as the helical guide arrangement 85a, and the manner of rotating these guides to feed the roller assembly 71a along tensioned strings 15 is concerned. However, the magnetic roller assembly 71a shown in Fig. 13 could be constituted by a solid roller throughout its length, or it could be a divided roller, as in the other forms of the invention.

The guide portions 83a of the magnetic roller assembly engage magnetic helical guide members 85a which attract it and hold it in a downward direction against the strings 15, which may be disposed below the magnetic roller, inasmuch as the strings need not be relied upon to hold the roller 71a in proper engagement with the helical guides 85a. By suitably manipulating the key and rotating the pinions 88, the helical guides 85a are caused to rotate with assurance that the magnetic roller 71a will remain in contact therewith as it is translated bodily, with a rolling motion, along the strings 15. As indicated above, the roller 71a can be made solid, since the strings 15 are disposed on the same side of the roller as the helical guides 85a.

The disposition of the tensioned strings 15 below, or on the same side of, the roller as the helical guides 85a causes the tension in the strings 15 to reduce the attractive force of the roller 71a against the guides. As a result, it is easier to shift the roller along the guides, making the instrument operable with greater facility and dexterity by the musician.

In addition, the magnetic attraction between the guides 85a and roller 71a gives a solid backing

to the roller, and thus increases the duration of the tone emanating from the string or strings 15.

Of course, the forward roller 70 shown in Figs. 11 and 12 could also be made magnetic and engageable with magnetic guides, so as to possess the same attributes as the rearward roller 71a disclosed in Fig. 13.

In view of the attractive force between the magnetic roller 71a and the guide 85a, the roller may be made of light weight and still be held solidly and in engagement with the guides. Here again, the light weight reduces the inertia forces tending to resist rapid traverse of the roller fret 71a along the strings 15.

Another form of invention is disclosed in Figs. 14 to 18, inclusive, in which one or a plurality of rollers may be shifted selectively along one or more tensioned strings. In this form, four rotatable helical guide members 95, 96, 97, 98 are disclosed. Each guide member has a helical guiding surface 99 adapted to engage a part of a roller assembly 100 or 101.

The outermost guide member 95 is secured to an end arm 102 fixed to a shaft 103 rotatable in a supporting frame 104 and having a pinion 105 attached thereto meshing with an upper rack 106 of a key 107 slidable in a stationary guideway 108. The next helical guide member 96 is rotatable within the first guide member 95, being secured to a hollow shaft 109 rotatable within the outer shaft 103, and having a pinion 110 fixed to it adjacent the first pinion 105 and meshing with a lower rack 111 attached to the slidable key 107.

By reciprocating the key 107, the pinions 105, 110 are rotated in opposite directions to rotate the helical guides 95, 96 in opposite directions. These guides, as will be explained hereinafter, cooperate with a forward roller assembly 101, that is adapted to contact one or a plurality of tensioned strings 15.

A third helical guide 98 is mounted for rotation within the second guide 96, and is fixed to a third hollow shaft 112 rotatable within the second shaft 109. A pinion 113 is fixed to this third shaft and meshes with an upper rack 114 attached to a second key 115 slidably supported in a guideway 116. A fourth innermost helical guide 97 is rotatable within the third guide 98, and is secured to an arm 117 fastened on a shaft 118 extending through the third hollow shaft 112. A pinion 119 is secured to the innermost shaft 118 and meshes with a lower rack 120 on the second key 115.

A helical spring 121 is secured to the first pinion 105 and to the supporting frame 104 for returning the outermost helical guides 95, 96 toward their initial positions following depression of the key 107. Similarly, a helical spring 122 is secured to the innermost shaft 118 and the frame 104 for returning the two inner helical guides 97, 98 toward their initial positions following release of the depressible force on the second key 115.

By virtue of the rack and pinion arrangements, the first key 107 will rotate the two outer helical guides 95, 96 equally in opposite directions, whereas the second key 115 will rotate the inner two helical guides 97, 98 in opposite directions. The outer two guides 95, 96 are of equal pitch, although of opposite hand, which is also true of the inner two guides 97, 98.

The inner two guides 97, 98 serve to translate a roller assembly or fret 100 along the tensioned strings 15. This assembly includes a generally U-shaped supporting bracket 123, whose upwardly extending arms 124 carry a roller 125 which is in engagement with the tensioned strings 15. The base of the bracket 123 is attached to a mounting member 126 extending at right angles to the axis of the string engaging roller 125 and on opposite sides of the roller. A vertical depending shaft 127 is secured to each end of the mounting member 126, each shaft carrying an upper guide roller 128 and a lower guide roller 129, that can rotate relative to each other upon the vertical shaft 127. The upper guide roller 128, on one side of the string roller 125, engages a helical guiding surface 130 on one side of the third guide member 98, whereas the lower guide roller 129 engages the helical surface 131 of the innermost or fourth rotatable guide member 97. These rollers 128, 129 are maintained in proper relation with respect to the guides 98, 97, and are prevented from dropping with respect thereto by spaced flanges 132 on each roller engaging the top and bottom sides of the guides 98, 97.

As disclosed in Fig. 17, the rollers 128, 129 engage the third and fourth guides 97, 98 adjacent their crossing point, which will be substantially under the string roller 125. A similar forward pair of vertically arranged rollers 128a, 129a engages the third and fourth helical members 97, 98 contacting their helical guiding side edges 130a, 131a on opposite sides from the edges that are contacted by the rearward pair of rollers 128, 129 previously described. The forward rollers 128a, 129a also have the flanges 132 engaging the helical guide members, and cooperate with the flanges 132 of the other roller members 125, 129 to support the entire roller assembly 100 in proper relation with respect to the strings 15.

When the two inner helical guide members 97, 98 are rotated upon reciprocation of the second key 115, they operate upon the vertically disposed rollers 128, 129, 128a, 129a to shift the roller assembly 100 lengthwise of the strings 15. The upper and lower rollers 128, 128a and 129, 129a will rotate in opposite directions during such movement, since the companion helical guiding surfaces with which they engage effect their rotation in the manner described. During their movement along the helical guiding surfaces 130, 130a, 131, 131a, they will shift the rolling fret 100 along and in contact with the tensioned strings 15 without any sliding friction against the strings.

The forward roller assembly 101 is designed to cooperate with the two outer helical guiding members 95, 96. This roller assembly has a supporting bracket 140, with a string roller 141 rotatable in the upwardly extending bracket arms 142 and contacting the tensioned strings 15. Vertically disposed and laterally spaced shafts 143 depend from the base 144 of the bracket, each shaft carrying a roller 145 which is adapted to contact the outer helical guide portions 146, 147 of the helical guide members 95, 96. As seen in Fig. 18, the upper roller portion 145a on one side of the point of intersection of the helical guides engages the outermost guide surface 146, whereas the lower roller portion 145b engages the helical surface 146 of the second guide member 96. The other vertical roller device 145c engages the same two guides 95, 96 on the opposite side of their crossing point.

In view of the manner in which the rollers 145, 145c and the guide surfaces 146, 147 are related to one another, the roller portions 145a, 145b may be secured together for simultaneous rotation in the same direction, since the oppositely moving helical guide members 95, 96 tend to rotate the

rollers 145a, 145b in the same direction. This is true of both vertical rollers 145, 145c on opposite sides of the crossing point of the guides 95, 96.

To hold the roller assembly in proper position, each roller device 145, 145c may be provided with spaced flanges 150 engaging the upper and lower surfaces of the rotatable guide members 95, 96.

Since the outermost guide 95 has a greater radius of rotation than the inner guide 96 adjacent it, the upper roller 145a will have a larger diameter than the lower roller portion 145b so that the guides 95, 96 rotate both upper and lower roller portions 145a, 145b the same angular extent.

Movement of the first key 107 will rotate the two outer helical guides 95, 96 in opposite directions and will shift the forward roller 101 along the strings 15. The forward and rearward rollers 101, 100 may be used separately, or they may be used together, being suitably moved along the same strings by appropriate manipulation of the keys 107, 115. One roller, such as the forward roller 101, can provide the fundamental frequency, whereas the other roller, such as the rearward roller 100, can be manipulated to provide the desired harmonic or partial.

The inventor claims:

1. In a stringed musical instrument: a tensioned string; a first member in contact with said string; a rotatable member having an inclined guiding surface thereon engaging said first member to bodily translate said first member along the string upon rotation of said rotatable member; and a second movable member engaging said string intermediate its tensioned length to one side of said first member.

2. In a stringed musical instrument: a tensioned string; longitudinally spaced first and second members in contact with said string; a rotatable member disposed lengthwise of said string; said rotatable member having a helical guiding surface thereon engaging said first and second members to bodily translate said first and second members along the string upon rotation of said rotatable member.

3. In a stringed musical instrument: a tensioned string; a plurality of longitudinally spaced members in contact with said string; one or more rotatable members disposed lengthwise of said string; said one or more rotatable members having one or more inclined guiding surfaces thereon engaging said spaced members to bodily translate said spaced members along the string upon rotation of said one or more rotatable members.

4. In a stringed musical instrument: a tensioned string; a plurality of longitudinally spaced roller members in contact with said string; one or more rotatable members disposed lengthwise of said string; said one or more rotatable members having one or more inclined guiding surfaces thereon engaging said rollers to bodily translate said rollers along the string upon rotation of said one or more rotatable members.

5. In a stringed musical instrument: a tensioned string; a plurality of longitudinally spaced rollers in contact with the string; one or more rotatable members disposed lengthwise of said string; said one or more rotatable members having one or more inclined guiding surfaces thereon engaging said rollers to bodily translate said rollers along the string upon rotation of said one or more rotatable members; and means for rotating said one or more rotatable members to bodily translate said rollers simultaneously along the string.

6. In a stringed musical instrument: a tensioned string; a roller in contact with the string; means for translating said roller bodily along the string to vary the free vibrating length of the string; another member engaging said string to one side of said roller; and resilient yieldable means constantly urging said other member into engagement with said string.

7. In a stringed musical instrument: a tensioned string; a member in contact with the string; means for translating said member bodily along the string to vary the free vibrating length of the string, comprising manually manipulative instrumentalities; and means adjacent said manually manipulative instrumentalities and selectively engageable with said string for changing the tension of said string, said tension changing means being operable by the hand of a person simultaneously with engagement of such person's hand with the manually manipulative instrumentalities.

8. In a stringed musical instrument: a tensioned string; first and second longitudinally spaced members in contact with said string; a rotatable member disposed lengthwise of said string and having an inclined guiding surface thereon engaging said second member to bodily translate said second member along the string upon rotation of said another rotatable member; and means for rotating said rotatable members.

9. In a stringed musical instrument: a tensioned string; a magnetic member in contact with said string; and means in attractive relation with said magnetic member for translating said magnetic member bodily along the string to vary the free vibrating length of the string.

10. In a stringed musical instrument: a tensioned string; a magnetic roller member in contact with said string; a rotatable member disposed lengthwise of said string; said rotatable member having a helical guiding surface thereon in attractive engagement with said magnetic member to bodily translate said magnetic member along the string upon rotation of said rotatable member.

11. In a stringed musical instrument: a tensioned string; a magnetic roller member disposed above and in contact with said string; a rotatable member disposed lengthwise of said string; said rotatable member having a helical guiding surface below said magnetic member which is in attractive engagement with said magnetic member to bodily translate said magnetic member along the string upon rotation of said rotatable member.

12. In a stringed musical instrument: a tensioned string; a plurality of longitudinally spaced roller members in contact with said string; a rotatable member disposed lengthwise of said string; said rotatable member having a helical guiding surface thereon of varying pitch engaging said roller members to bodily translate said roller members simultaneously along the string upon rotation of said rotatable member.

13. In a stringed musical instrument: a tensioned string; a plurality of longitudinally spaced roller members in contact with said string; a first rotatable member; a second rotatable member located within said first member; said rotatable members having helical guiding surfaces thereon engaging said roller members, the helical surface of said first member being of the opposite hand from the helical surface of said second member, said helical surfaces of said rotatable members being of varying pitch along the length of the string; and means for rotating said rotatable

members simultaneously in opposite directions to translate said roller members bodily unequal distances along said string.

14. In a stringed musical instrument: a tensioned string; first and second longitudinally spaced members in contact with said string; a plurality of first rotatable members disposed lengthwise of said string and having helical guiding surfaces thereon engaging said first member to bodily translate said first member along the string upon rotation of said first rotatable members; a plurality of second rotatable members disposed lengthwise of said string and having helical guiding surfaces thereon engaging said second member to bodily translate said second member along the string upon rotation of said second rotatable members; and means for rotating said rotatable members.

15. In a stringed musical instrument: a tensioned string; first and second longitudinally spaced roller members in contact with said string; a plurality of rotatable inner members disposed lengthwise of said string and having helical guiding surfaces thereon engaging said first roller member to bodily translate said first roller member along the string upon rotation of said inner members; a plurality of rotatable members disposed laterally outwardly of said inner members and lengthwise of said string and having helical guiding surfaces thereon engaging said second roller member to bodily translate said second roller member along the string upon rotation of said outer rotatable member; and means for rotating said inner and outer members.

16. In a stringed musical instrument: a tensioned string; a rotatable member disposed lengthwise of said string and having a helical guiding surface thereon; a bodily translatable device, said device including a first rollable element in contact with said string, and one or more other rollable elements in engagement with said helical guiding surface to effect bodily translation of said device along said string upon rotation of said rotatable member, the axis of rotation of said one or more rollable elements being disposed at an angle to the axis of rotation of said string contacting rollable element.

17. In a stringed musical instrument: a tensioned string; first and second longitudinally spaced members in contact with said string; a pair of rotatable members disposed lengthwise of said string and having guiding surfaces thereon inclined in opposite directions and engaging said first member to bodily translate said first member along the string upon rotation of said rotatable members in opposite directions; a pair of second rotatable members disposed lengthwise of said string and having guiding surfaces thereon inclined in opposite directions and engaging said second member to bodily translate said second member along the string upon rotation of said second rotatable members in opposite directions; and means for rotating said rotatable members.

18. In a stringed musical instrument: a tensioned string secured to said instrument at both ends of said string; a movable member in contact with the string; means for translating said member bodily along the string to vary the free vibrating length of said string between said member and one end of said string; and means providing a projection movable transverse to said string selectively to engage said string on that side of said movable member remote from said one end to vary the tension thereof.

19. In a stringed musical instrument: a tensioned string; first and second longitudinally spaced movable members in contact with said string; a first pair of rotatable members having inclined guiding surfaces thereon in engagement with said first member bodily to translate said first member along said string upon rotation of said first pair of rotatable members; a second pair of rotatable members disposed within said pair of rotatable members and having inclined guiding surfaces thereon in engagement with said second member bodily to translate said second member along said string upon rotation of said second pair of rotatable members; means for rotating said first pair of rotatable members; and means for rotating said second pair of rotatable members.

20. In a stringed musical instrument: a tensioned string; a plurality of string contacting members movable longitudinally of said string; a movable member having guiding surfaces thereon engaging said string contacting members bodily to translate said string contacting members along said string upon movement thereof; and means for moving said movable member.

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