Dec. 12, 1944. J. W. McBRIDE 2,364,861

STRINGED MUSICAL INSTRUMENT

Filed July 11, 1942 5 Sheets-Sheet 1

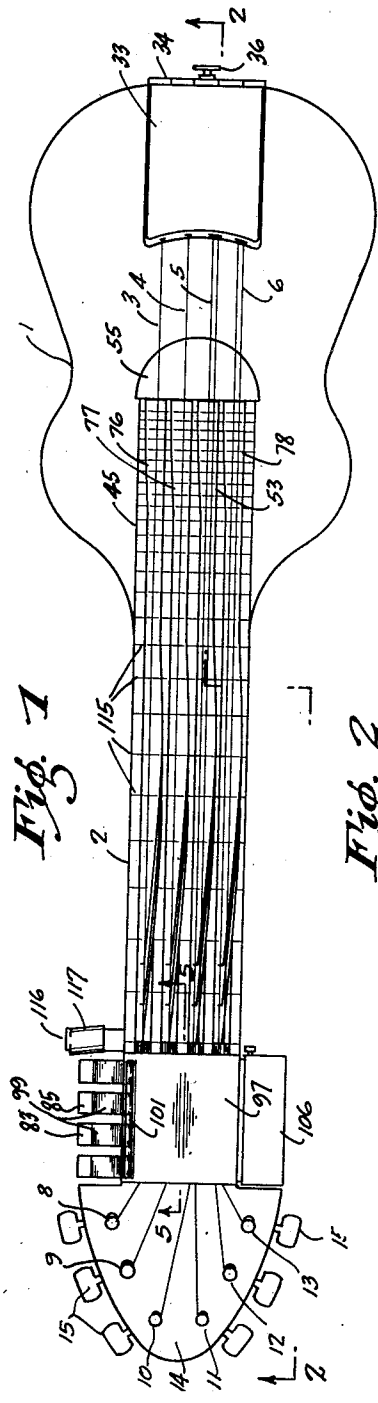


Fig. 1

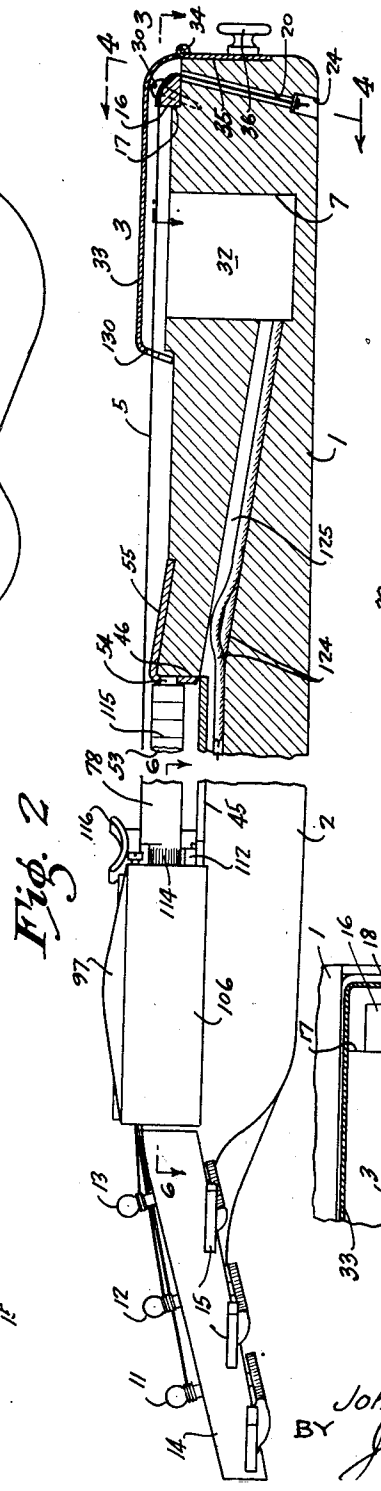


Fig. 2

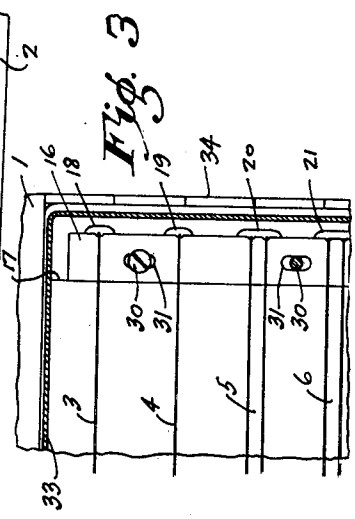


Fig. 3

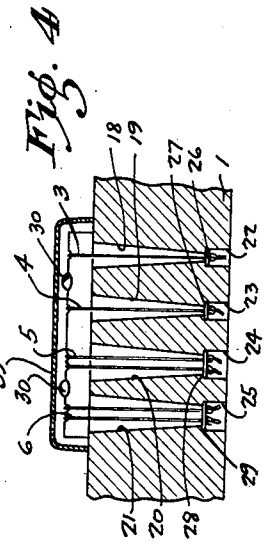


Fig. 4

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Dec. 12, 1944. J. W. McBRIDE 2,364,861

STRINGED MUSICAL INSTRUMENT

Filed July 11, 1942 5 Sheets-Sheet 2

Fig. 5

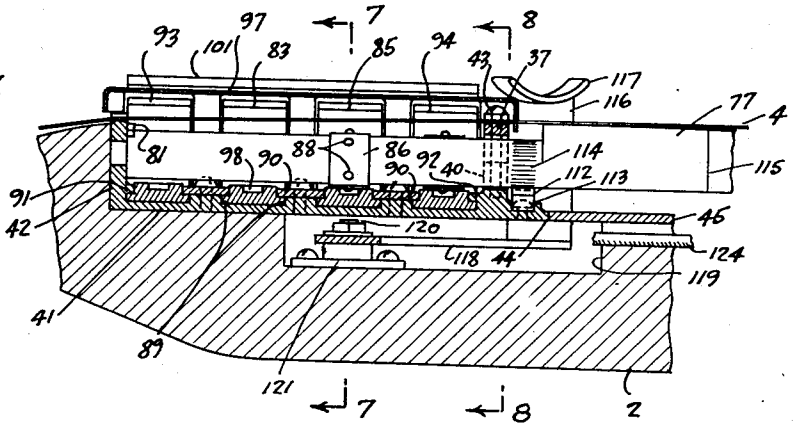
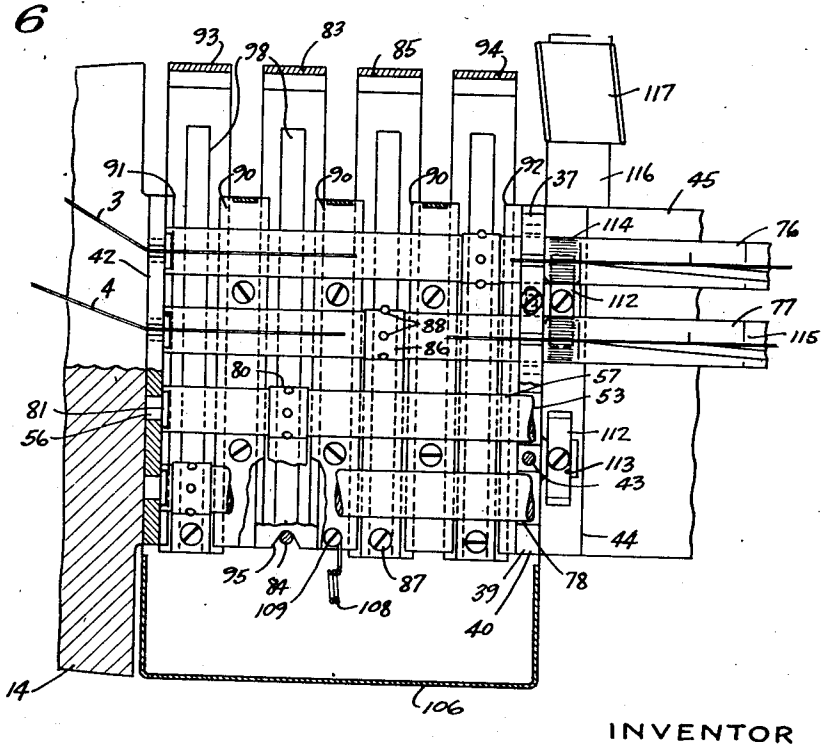


Fig. 6



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Dec. 12, 1944. J. W. McBRIDE 2,364,861

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Filed July 11, 1942 5 Sheets-Sheet 3

Fig. 7

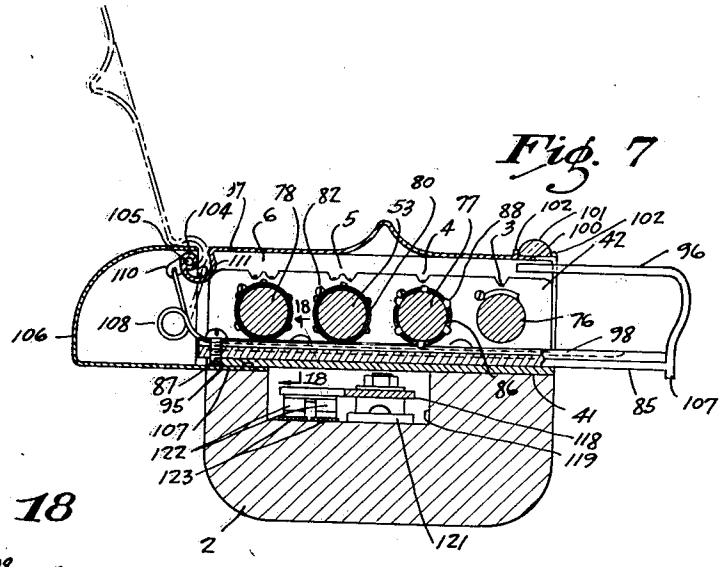


Fig. 18

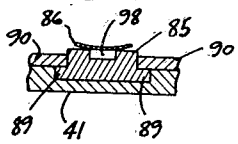


Fig. 8

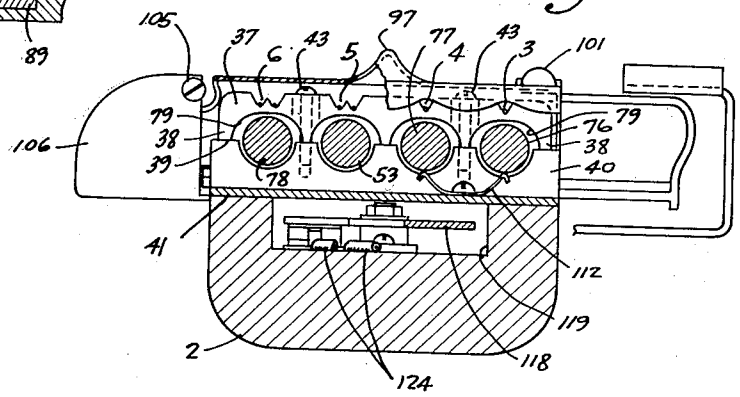
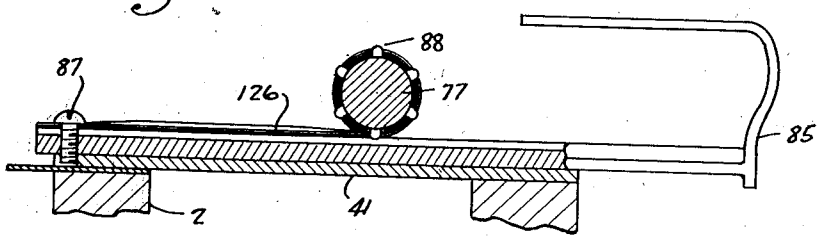


Fig. 9



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Dec. 12, 1944. J. W. McBRIDE 2,364,861

STRINGED MUSICAL INSTRUMENT

Filed July 11, 1942 5 Sheets-Sheet 4

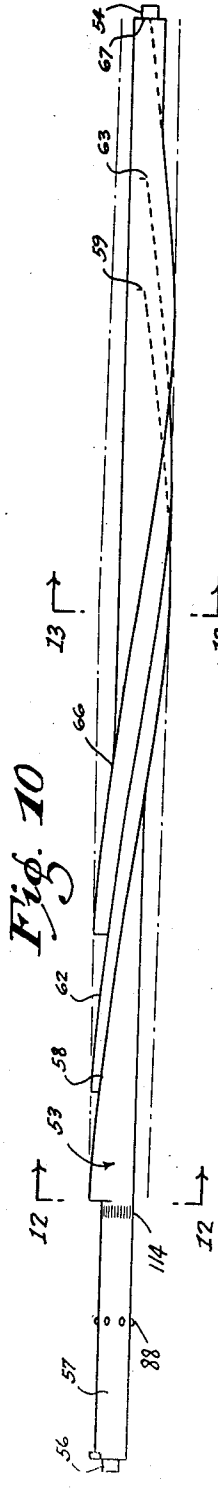


Fig. 10

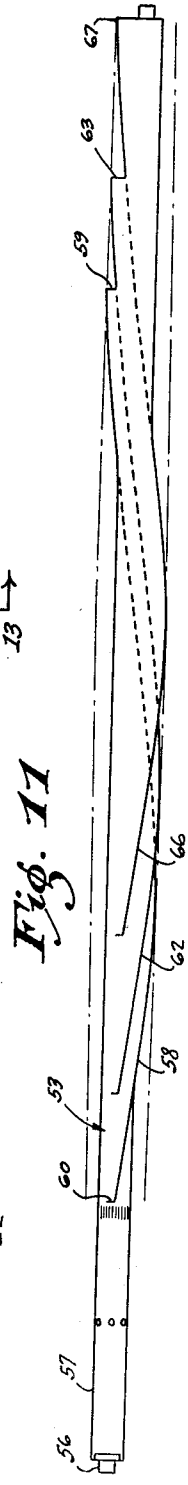


Fig. 11

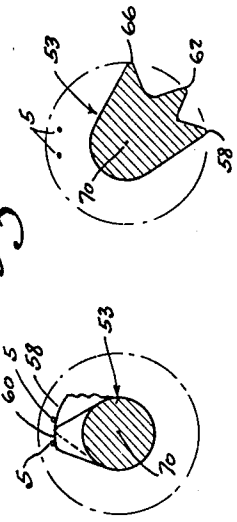


Fig. 13

Fig. 12

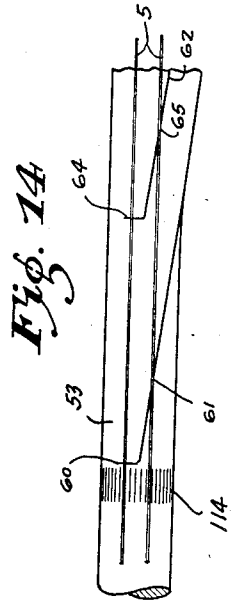


Fig. 14

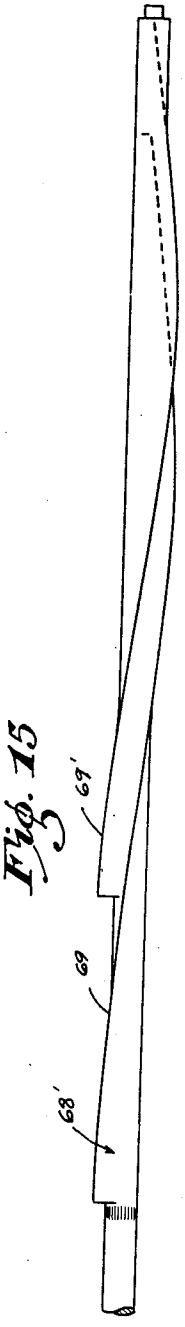


Fig. 15

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Dec. 12, 1944. J. W. McBRIDE 2,364,861

STRINGED MUSICAL INSTRUMENT

Filed July 11, 1942 5 Sheets-Sheet 5

Fig. 16

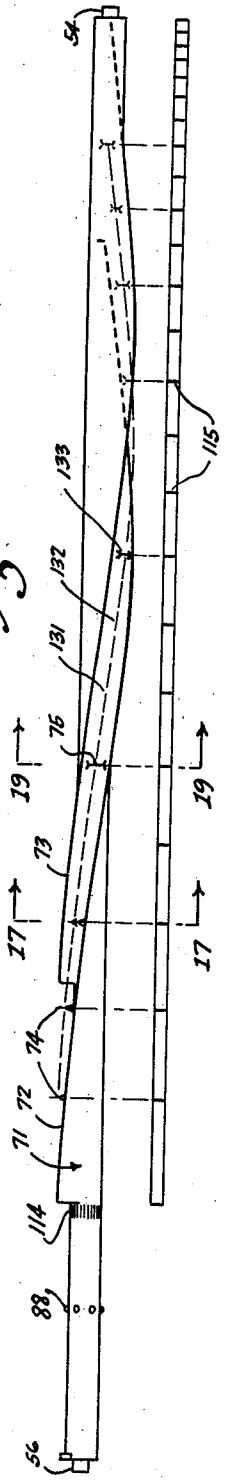


Fig. 19

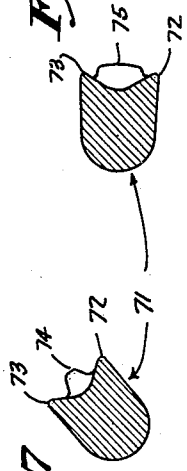


Fig. 17

Fig. 20



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Patented Dec. 12, 1944

2,364,861

UNITED STATES PATENT OFFICE

2,364,861

STRINGED MUSICAL INSTRUMENT

John W. McBride, Burbank, Calif.

Application July 11, 1942, Serial No. 450,515

18 Claims. (Cl. 84—1.15)

This invention relates to a stringed musical instrument. More particularly it relates to the type of instrument in which the pitch is determined by the free length of a vibrating string, and in which this free length is determined by the player.

This application is a continuation in part of several prior applications filed in the name of John W. McBride, and identified as follows: Serial No. 388,379, filed April 14, 1941, for a "Stringed musical instrument," which has matured into Patent No. 2,316,799, granted April 20, 1943; Serial No. 410,813, filed September 15, 1941, "Stringed musical instrument," which has matured into Patent No. 2,316,800, granted April 20, 1943; Serial No. 434,855, filed March 16, 1942, for a "Stringed musical instrument."

In some of these prior applications, there is disclosed a rotatable rod having a helical-like crest, located below the string to be controlled, and the angular position of the rod determines the point of the crest that contacts with the string, thus determining its free vibrating length. The means utilized for rotating the rods, illustrated in these prior applications, are of the rack and pinion type, the rack being operated by finger keys; or else of the type in which a coil spring is wrapped around the rod, and anchored thereto, the other end being operable by a key mechanism.

It is one of the objects of this invention to improve in general upon the apparatus disclosed in these prior applications.

In the use of the helical crested rod such as described in some of these prior applications, for any specific angular position of the rod, there is but one point where the string is stopped. By the aid of the present invention, the rod can be made to stop or contact the string at a plurality of points, whereby the player has a larger choice of free vibrating lengths for each position of the rod. This effect is obtained by the provision of a plurality of crests (interrupted or uninterrupted as desired) for each rod. By appropriate design of the crests, the relationship of the free lengths can be predetermined to obtain definite chords or other musical effects.

It is still another object of this invention so to arrange the crests on the rods that the pressure exerted upon the strings by the crests will be substantially equal for any angular position of the rod.

It is still another object of this invention to provide a fine adjustment for determining the exact points of contact of the crest with the string; and more particularly, by making it possible to adjust the angle of the string with respect to the axis of the corresponding rod.

In rotating the crested rod by a pulling force on one end of a wrap-around spring, this spring provides a restoring force as soon as the manual force is removed. If this force is too suddenly removed, the spring has a tendency to bind between the turns. It is still another object of this invention to ensure that such a spring device will function satisfactorily even when the pulling force is abruptly removed, to return the rod promptly and smoothly to its starting position.

It is still another object of this invention to make it possible for the operator of the instrument to sense when any rod has been adjusted to a desired position.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown a few forms 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 this 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 plan view of an instrument incorporating the invention;

Fig. 2 is an enlarged sectional view, taken along the plane 2—2 of Fig. 1, a part of the instrument being broken away in order to reduce the size of the figure;

Figs. 3, 4 and 6 are sectional views taken along correspondingly numbered planes of Fig. 2;

Fig. 5 is an enlarged sectional view taken along the plane 5—5 of Fig. 1;

Figs. 7 and 8 are sectional views taken along correspondingly numbered planes of Fig. 5;

Fig. 9 is an enlarged fragmentary sectional view similar to Fig. 7, of a modified form of the invention;

Fig. 10 is a side elevation of a rotary rod having a plurality of helical-like crests, and illustrating one form of the invention;

Fig. 11 is a top plan view of the rod illustrated in Fig. 10;

Figs. 12 and 13 are sectional views taken along the correspondingly numbered planes of Fig. 10, and showing a string structure in association with the rotatable rod;

Fig. 14 is a fragmentary enlarged view similar

to Fig. 11, illustrating the cooperation between the string structure and the crests of the rod;

Fig. 15 is a view similar to Fig. 10, of a modified form of the invention;

Fig. 16 is a view similar to Fig. 10 but illustrating a crested rod in which one of the crests is in the form of a series of interrupted projections;

Figs. 17 and 19 are sectional views taken along correspondingly numbered planes of Fig. 16;

Fig. 18 is a sectional view taken along plane 18—18 of Fig. 7; and

Fig. 20 is a diagrammatic view showing the action of the crests in connection with a string.

The instrument includes a body portion 1 having a neck portion 2 extending therefrom (Figs. 1, 2, 5, 6, 7, 8). Since the instrument in this instance is illustrated as one which picks up the vibrations of the strings and translates them into electrical impulses, the body 1 is shown as substantially solid and made of such material as wood or the like. It is shown as provided with the four string structures 3, 4, 5 and 6 (Figs. 1, 3, 4, 7, 8). While the string structures 5 and 6 are shown as formed of a pair of individual strings, the word "string" as used hereinafter applies to either the single or double string structure.

The strings are stretched over the electrical pickup device 32 located in the cavity or recess 7, (Fig. 2) in the body 1. The manner in which the electrical amplifying system associated with device 32, may be controlled will be explained hereinafter.

Tensioning of the strings 3, 4, 5 and 6 may be accomplished by the aid of tuning pegs 8, 9, 10, 11, 12, 13 (Figs. 1 and 2) accommodated within the peg board 14. This peg board 14 forms an extension from the neck portion 2. The strings 3, 4, 5 and 6 are wound around the pegs, and these pegs may be turned to adjust the applied tension, as by the aid of the keys 15.

The right hand ends of the individual strings are anchored in a manner shown most clearly in Figs. 2, 3 and 4. Thus each string passes over a bridge 16. This bridge has an arcuate surface with notches appropriately formed therein for the strings. The bridge is arranged so that its left hand face is in contact with a vertical shoulder 17 formed on the top of the body 1. The strings pass over the bridge 16 and into the apertures 18, 19, 20 and 21. These apertures, as shown most clearly in Fig. 4, taper downwardly, and are provided with straight counterbores 22, 23, 24 and 25. Into the counterbores extend the anchoring washers 26, 27, 28 and 29. The strings extend through these washers and are knotted on the bottom side thereof.

The bridge 16 is shown as attached to the body 1 by the aid of a pair of screws 30. These screws pass through elongated slots 31, making it possible to adjust the bridge 16 laterally with respect to the body 1. The purpose of this adjustment will be explained hereinafter.

A housing or covering extending over the bridge and the electrical pick-up 32 is formed by the aid of a sheet metal member 33. This sheet metel member 33 is hinged at 34 to a plate 35 attached to the end wall of the body 1. Accordingly this cover member 33 may be swung upwardly to expose the right hand ends of the strings 3, 4, 5 and 6 if desired. Furthermore, a button 36 may be provided for the accommodation of a loop for the suspension of the instrument in a convenient manner on the body of the player. The front flange 130 of the cover 33 is slotted to permit free passage of the strings beneath the cover 33.

The left hand ends of the strings 3, 4, 5 and 6 pass over a bridge 37 (Figs. 6 and 8). This bridge 37 is provided at its upper edge with a series of notches for the accommodation of the individual strings forming the string structures 3, 4, 5 and 6. The bridge 37 has feet such as 38 resting upon the top surface 39 of a foot member or wall 40. This foot member 40 is shown as a substantially vertical wall formed integrally with a metallic supporting frame 41. This frame 41, as will be explained hereinafter, provides the main support for the operating mechanism for adjusting the free lengths of the strings. This frame 41 is attached to the left hand extremity of the neck 2. The left hand vertical wall 42 (Figs. 5 and 7) abuts against a vertical shoulder formed between the peg board 14 and the neck 2. This left hand wall 42 may be provided with notches similar to the notches in the bridge 37 for the accommodation of the strings 3, 4, 5 and 6.

The bridge 37 as shown most clearly in Figs. 6 and 8, is attached to the vertical wall 40 as by the aid of the screws 43, passing through elongated slots in the bridge 37. Accordingly the position of the bridge 37 may likewise be adjusted in a direction lateral to the strings.

The frame 41 may be attached permanently to the neck 2 by any appropriate means. Its right hand edge 44 (Figs. 5 and 6) is shown as abutting a plate 45 that extends over the neck portion of the instrument, and lines its upper edge to form a fret board. This plate 45 is also illustrated in Fig. 2. Its right hand edge extends to the vertical wall 46 formed on the top of the body 1.

The control of the length of the strings 3, 4, 5 and 6 is accomplished by the aid of rotatable rods having helical-like crests. Such rods have been described in the prior applications hereinabove identified. In the rods illustrated in these prior applications, each string to be controlled is disposed over a rod having an axis of rotation substantially parallel with the string. By angular adjustment of the rod, the position where the helical-like crest contacts the string may be determined.

In said prior applications the effective length of the vibrating strings between the bridge of the instrument and the place where the helical-like crest contacts the string, is determined by rotating the rod to a definite angular position. By the aid of the present invention, the tensioned string may be contacted at several spaced points by crests carried by the rod, so as to divide the string into a series of different lengths, each capable of being set into free vibration. For example, a string 47 in Fig. 20 is diagrammatically illustrated as stretched between the bridges 48 and 49. A plurality of crests 50, 51 and 52 are shown as contacting the string 47. Now by plucking the string between the crest 52 and bridge 48, a definite musical note will be produced. Musical notes of higher pitch, however, can be obtained by plucking the string between the crests 52 and 51, or between the crests 51 and 50. Agitation of all of the string sections may occur simultaneously if desired; and of course the vibrations can be obtained by rapid rotation or oscillation of the crested rod. All of the vibrations thus obtained are effectively transmitted by the aid of the string to affect the pickup 32; or else the vibrations may if desired be arranged to

produce audible sounds by other means, such as a resonating body.

The crests **50**, **51** and **52** may be in the form of helical-like crests that are angularly spaced from each other along the rod that carries the crests, much in the manner of the individual helical threads of a multi-thread screw. Although three crests are indicated, any suitable number may be used. These crests may all have the same pitch; the two outside crests being spaced from the middle crest about the rod by equi-angular distances, or they may have the same or different pitches and may be unequally spaced about the rod with respect to the middle crest. By appropriate design, the relationship of the three vibrating string sections formed by the aid of the triple crest can be made such as to produce desired harmonious chords when any group of the string sections are set into vibration.

A triple-crested rod is utilized in connection with each of the strings **3**, **4**, **5** and **6**. As shown in Fig. 10, these rods are substantially identical and each has three crests, of equal pitch; the center crest being midway between the outer crests. However, for purposes of illustration a rod having three crests of equal pitch but unequally spaced with respect to the center crest will be shown and described in detail. Since all of these rods are of substantially identical structure, that rod **53** which is associated with string structure **5** will be described. The structure of the rod can be best explained in connection with Figs. 10, 11, 12, 13 and 14.

At the right hand end of rod **53** a stub shaft **54** is provided. This stub shaft **54** is shown in Fig. 2 as rotatably mounted in one leg of a bracket **55** disposed on the top of the head **1** and extending over the vertical wall **46**.

At its left hand end a similar stub shaft **56** is provided. This stub shaft **56** is journaled in the vertical wall **42** of the frame **41**.

Adjacent the left hand stub shaft **56** is a cylindrical portion **57** cooperating with other parts of the mechanism for rotating the rod **53** to any desired angular position.

The first helical crest **58** of rod **53** begins adjacent the right hand end of the cylindrical portion **57**. This crest **58** ends after making three-quarters of a turn at the point **59** (Figs. 10 and 11). A narrow lateral extension **60** is provided for the crest **58** at its left hand extremity. This extension ensures that the string **5** will be contacted by the crest even at the limit of its angular movement, as well as throughout the entire range of angular movement of the rod **53**. The beginning position of the rod **53** is illustrated in Fig. 14; that is, a position in which the left hand extension **60** of the crest **58** is in contact with the string. Since string **5** happens to be a double string, the upper string only is contacted by the lateral extension **60**. The lower string is contacted at a point **61** disposed to the right of the crest **60**.

The second crest **62** also makes three-quarters of a revolution and ends at the point **63**. It too has a lateral extension **64** contacting the upper length of the string **5**. The lower length of the string **5** is contacted by this crest **62** at a point **65** (Fig. 14).

The third crest **66** likewise extends for three quarters of a revolution and ends at the point **67**. Crest **66** is also provided with a lateral extension **68**.

The rotation of rod **53** is limited to three-quarters of a revolution. All three of the crests **58**, **62** and **66** contact the string structure **5**, forming vibratible string lengths as explained in connection with the diagram of Fig. 20. By adjusting the angular position of the rod **53** it is possible to vary the points of contact **50**, **51** and **52** of the crests with respect to the string. Of course in the case of a string such as **5**, employing two individual lengths, the two lengths of the string structure are stopped at different relative positions. This does not occur for string structures formed of a single length such as the strings **3** and **4**.

If it be assumed that the left hand portions of the crests **58**, **62** and **66** are in contact with the string, these points of contact are close to the place where the string is confined by the bridge **37** (Fig. 8). Accordingly even a relatively small lifting of the string by the corresponding crest will be sufficient to maintain the string in firm contact with the crest. Therefore to hold the crest thus firmly against the string, it is not necessary to raise the string so much as when the string is contacted at the central portion. Since the bridges are quite far away from this central contacting point, the string must be raised by the crest to a greater extent in order to obtain a sufficiently firm pressure between the crest and the string.

In order to obtain this effect, the radial distance of the crests from the axis of the rod **53** is increased at the center of the rod. Thus as shown in a sectional view of Fig. 13, the distance from the axis **70** to the crests **58**, **62** and **66** is considerably greater than the distance from the axis **70** to the crests at the right hand end and the left hand end of the rod **53** (see Fig. 12). In other words, the envelope of all of the crests is a conical surface, having a maximum diameter at the center section **13—13** and tapered toward each end of the rod.

By the aid of the laterally adjustable bridges **16** and **37** (Figs. 2, 3, 4, 6 and 8), it is furthermore possible to shift the strings in opposite directions respectively at their opposite ends so that the equalization of string pressures can be even further refined. By proper direction of adjustment the ends of the strings can be caused to be contacted by crest portions having lesser radii than before the adjustment.

In the form of the rod illustrated in Figs. 10, 11, 12 and 13, three crests are indicated. However, it is possible if desired to vary the number of crests that are formed upon the rod. For example, in Fig. 15 the rod **68'** is shown as provided with only two crests, **69** and **69'**. These two crests each extend, in the present instance, for three-quarters of a revolution, but have different pitches.

In still another form of the invention illustrated in Figs. 16, 17 and 19, a rod **71** is illustrated having three crests, which are shown by way of illustration as each extending three-quarters of the way around the rod, but each having a different pitch. The two outside crests **72** and **73** are continuous and conform in general to the outside crests **58** and **66** of the form illustrated in Fig. 10. The intermediate crest is interrupted and is formed by a series of projections such as **74**. These projections **74** extend transversely to the axis of the rod **71**. These lateral portions may vary in width; for example, in Fig. 19, showing a projection **75**, the lateral extent of that projection

is quite large. Furthermore, the longitudinal spacing of these projections **74** may be made to conform to definite fret positions, determined by the harmonic tones desired to be produced. It is noted that the projections at the left hand end are farther apart than the projections at the right hand end, which is nearer the main bridge **16**. The particular spacing of the projections is determined by the tone to be produced by a string stopped by the projections; and each projection thus has a definite relative position along the axis of the rod **71**. It is possible to omit one or more of the series of projections; as for example at the points **131**, **132**. In such a case the lateral extent of the projections **75** and **133** (which define the ends of the projectionless portion) are made angularly wide. Thus it is possible materially to vary the string length between the stops of the other crests **72** and **73**, while maintaining the same positions of contact on one of the projections **75** or **133**. This large angular extent of some of the projections **75**, **133**, is sometimes desirable for obtaining definite harmonic effects.

The mechanism for controlling the angular position of the crested rods can be described in connection with Figs. 5, 6, 7 and 8. The crested rod **53** is but an example of all the other crested rods **76**, **77** and **78**. All of these crested rods are rotatably mounted at their left hand end in the vertical wall **42** and in their right hand end in the bracket **55** (Fig. 2). The cylindrical portions of each of them, as illustrated most clearly in Fig. 8, passes under appropriate recesses, such as **79**, formed in the bottom of the bridge **37**.

The rod **53** has coiled around it a spiral spring **80**, formed of flat stock. The inner end of the spring may be anchored to the cylindrical portion **57** of the rod **53**. The spring is so arranged that it urges the rod **53**, as viewed in Fig. 7, to rotate in a counterclockwise direction. When free to exert this torque, the rod **53** is positioned at such an angle that the lateral crest **60** is at the top of the rod. The rod **53** is stopped in this angular position by the aid of an arcuate stop **81** attached near the left hand end of the cylindrical portion **57**. This stop abuts against a stationary screw **82** attached to the inner side of the vertical wall **42**. Similar stops are provided for each of the crested rods.

Similarly the arcuate stop **81** is of such angular extent that the crested rod is stopped by the other end of the stop **81**, after the rod has an angular motion of three-quarters of a complete revolution from the beginning position illustrated in Fig. 7.

The rotation of the rod **53** in a clockwise direction from the beginning position of Fig. 7 is accomplished by the aid of a key **83** illustrated in Figs. 5 and 6. To this key **83** is attached the outer extremity of the spring **80**, as by the aid of a screw **84** (shown in section in the lower portion of Fig. 6). The movement of the key **83** in a downward direction as viewed in Fig. 6 causes the spring **80** to unwind against its inherent resistance to such unwinding, and causes a corresponding rotation of rod **53**.

Since in Figs. 7 and 18 a key mechanism is illustrated in connection with crested rod **77**, a description of this key mechanism will constitute a description of the key mechanism for rod **53**, as well as the other rod operating mechanisms.

Thus in this case the key **85** (Figs. 7 and 18) is shown as cooperating with the end of the spring **86** wrapped around the rod **77**. The left hand extremity of the spring **86** (Fig. 7) is attached to the left hand extremity of key **85** by the aid of a screw **87** corresponding to the screw **84** for key **83** (Fig. 6). The spring **86**, as well as all of the other springs utilized in connection with the crested rods, is shown as having a bowed or arcuate section (Fig. 18). This arcuate section is used to stiffen the spring. Furthermore, in order to ensure that the winding and unwinding of the spring will cause a synchronized angular movement of the corresponding crested rod, the spring is apertured to accommodate the pins **88** attached to the corresponding crested rod and extending radially therefrom. These pins **88** (Figs. 7 and 16) are equi-angularly spaced and are long enough to engage the perforations in the spring **86**. The upper surface of each of the keys is provided with a slot such as **98** (Figs. 5, 6 and 18) to accommodate the pin extremities as the key is operated.

The key **85** is guided for linear movement by the aid of its flanges **89**. Thus the frame **41** is recessed laterally to accommodate the lower portion of the key **85**. Overlying the flanges **89** are the retainer plates **90** (see particularly Figs. 5 and 18). These retainer plates **90** extend between adjacent keys. The vertical wall **42** and the vertical wall **40** have inwardly directed flanges **91** and **92** to cooperate with the outer flanges of the end keys **93** and **94**.

The screw **87**, which serves to attach the outer end of the wrap-around spring **86**, may also serve as a stop to limit the outward movement of the key **85**. For this purpose the screw **87** extends below the lower surface of the key **85**, so as to cooperate with a notch formed in the left hand edge of the frame **41**. Such a notch **95** is illustrated in Fig. 6, cooperating with the screw **84**.

Inward movement of the key **85** is stopped by downwardly directed projection **107** formed on the key. This projection is adapted to cooperate with the right hand edge of the frame **41**.

Each of the keys is provided with an upper portion **96** (Fig. 7) that is intended to project underneath a cover member **97**. This cover member as will be explained hereinafter, may be lifted up to expose the key mechanism. It is sufficient for the present to note that the flat portions **96** carry scale marks **99** (Fig. 1) cooperating with an edge **100** (Fig. 7) defining the ends of slots in the right hand flange **103** of the cover member **97**. In order to magnify the scale marks, a cylindrical lens **101** extending transversely of all of the keys can be provided. It may be held in place by appropriate struck-up portions **102** formed on the cover member **97**.

At the left hand edge of cover **97**, it is provided with bearing bosses **104**. These bearing bosses are adapted to cooperate with the pivot pins **105** (Figs. 1 and 8) disposed in the end walls of the stationary casing member **106**. This casing member **106**, as shown most clearly in Fig. 7, has a projection **107** disposed beneath the frame **41** and held in place by the fastening means that holds the frame **41** in place.

In order to hold the cover member **97** either in the closed full line position of Fig. 7, or in the alternative open dot-and-dash line position, use is made of a hairpin spring **108** (Figs. 6 and 7). One end is anchored as by the aid of a screw **109** to one of the retainer plates **90**. The other end is attached to the arm **110** fastened to the bearing boss **104**. The hairpin spring **108** in the full line position of Fig. 7, urges the cover member **97** in a

clockwise direction. As the cover member 97 is lifted to the dot-and-dash position the direction of the torque exerted by the hair spring is reversed and its force now urges the cover 97 in a counterclockwise direction. In order to ensure that the cover member 97 may be moved between its two positions without interference with the adjacent edge of the stationary housing member 106, the bearing boss 104 is joined to the main portion of the cover member 97 by an arcuate portion 111.

The player of the instrument should be able to sense when any of the crested rods is moved to a desired angular position. In order that there be some indication of these angular positions, these rods are restrained at definite angular points, so as to provide a minor resisting force against movement from the restrained position. This may be accomplished for example by the aid of a pair of spring arms 112 (Figs. 5, 6 and 8). These spring arms are fastened in the bottom of grooves 113 formed adjacent the right hand portion of the frame 41. Each of the springs 112 has oppositely directed arms contacting the peripheral surface of adjacent rods 76, 77 and 53, 78 respectively. The upper ends of these springs are adapted to cooperate with serrations 114 formed on the cylindrical surface of each of the crested rods. These serrations 114 (Fig. 10) occur at the right hand extremity of the cylindrical extension 57 of the crest rod 53.

Furthermore, in order further to assist the player in appropriately positioning the crested rod to the desired angle, the rods as well as the neck 2 of the instrument may be marked with fret marks. Such fret marks are indicated by the marks 115 of Figs. 1 and 2. The arrangement of the fret marks is also indicated in the lower portion of Fig. 16, showing a gradual convergence as the effective length of the corresponding string is shortened. These marks are drawn accurately both upon the plate 45 as well as upon the crested rods.

Volume control of the amplification of the impulses picked up by the electrical pickup device 32 (Figs. 1 and 2) is obtained by the aid of a lever 116 (Figs. 1, 2, 5 and 6). This lever is adapted to be manipulated by the thumb of the player. To facilitate manipulation, a thumb receiving piece 117 is fastened to the top of the lever 116. The lever 116 is shown as having an arm 118 (Figs. 5, 7 and 8) that extends into the cavity 119 of the neck 2. This lever is shown as pivoted on a vertical axis by the aid of a pivot screw 120 fastened in a bearing standard 121. The arm 118 carries the contact brushes 122 sweeping over corresponding stationary contact plates 123. These contacts may be utilized in a well known manner for varying the constants of the electrical circuits. To make this possible, conductors 124 (Figs. 2 and 8) are connected between the pickup 32 and contact mechanism. These leads extend through appropriate passageways such as 125 formed in the instrument.

While it is ordinarily sufficient to utilize a spring 86 of the character illustrated for the control of the crested rods, it may sometimes be advisable to provide a stiffer spring arrangement. Such an arrangement is illustrated in Fig. 9. Here the key 85 as before is adapted to cooperate with the crested rod 77. The spring 126 is formed of two parts, both of the parts having an arcuate cross section of the character illustrated in Fig. 18. By the provision of the double layer spring, a stronger torque is provided.

What is claimed is:

1. In a stringed instrument, a rotatable rod having a plurality of helical-like crests, and a string with which the crests cooperate for simultaneously stopping the string at a plurality of points.

2. In a stringed instrument, a rotatable rod having a plurality of helical-like crests, at least one of said crests being interrupted, and a string with which the crests cooperate for simultaneously stopping the string at a plurality of points.

3. In a stringed instument, a rotatable rod having a helical-like crest, and a string adapted to be contacted by the crest, the point of contact being determined by the position of the rod, the radius of the crest measured normal to the axis of rotation of the rod having a maximum at an intermediate point along the length of the crest.

4. In a stringed instrument, a rotatable rod having a plurality of helical-like crests, and a string adapted to be contacted by the crests, the points of contact being determined by the position of the rod, the radius of each crest measured normal to the axis of rotation of the rod having a maximum at an intermediate position along the string, and diminishing from that maximum toward the opposite ends of the rods.

5. In a stringed instrument, a rotatable rod having a helical-like crest, a string adapted to be contacted by the crest, the point of contact being determined by the position of the rod, means for tensioning said string, and means for ajusting the position of the string with respect to the rod axis.

6. In a stringed instrument, a rotatable rod having a helical-like crest, a string adapted to be contacted by the crest, the point of contact being determined by the position of the rod, means for tensioning said string, and means for adjusting the position of the string with respect to the rod axis, comprising a member laterally adjustable with respect to the rod, over which member the string is tensioned.

7. In a stringed musical instrument having a tensioned string, the combination therewith of a rotatable crested rod adapted to contact the string at a point or points corresponding to the angular position of the rod, and mechanism for controlling the angular position of the rod, comprising a spring wrapped around the rod, the inner end being anchored to the rod, said spring having apertures, and pins carried by the rod and engaging the apertures.

8. In a stringed musical instrument having a tensioned string, the combination therewith of a rotatable crested rod adapted to contact the string at a point or points corresponding to the angular position of the rod, and mechanism for controlling the angular position of the rod, comprising a spring wrapped around the rod, the inner end being anchored to the rod, said spring having a bowed cross section, in a direction lateral to its length.

9. In a stringed musical instrument having a tensioned string, the combination therewith of a rotatable crested rod adapted to contact the string at a point or points corresponding to the angular position of the rod, and mechanism for controlling the angular position of the rod, comprising a spring wrapped around the rod, the inner end being anchored to the rod, said spring having multiple plies.

10. In a stringed musical instrument having a tensioned string, the combination therewith of a rotatable crested rod adapted to contact the string at a point or points corresponding to the angular position of the rod, and mechanism for controlling the angular position of the rod, comprising a spring wrapped around the rod, the inner end being anchored to the rod, said spring having multiple plies, and having apertures, and pins carried by the rod and engaging the apertures.

11. In a stringed instrument, a rotatable rod having a helical-like crest, a string adapted to be contacted by the crest, said rod having serrations on a part of its exterior surface, and a spring finger cooperating with the serrations to provide a resistance to movement of the rod.

12. In a stringed instrument, a plurality of rotatable crested rods, a plurality of strings respectively associated with said rods, said rods having substantially parallel axes of rotation, key mechanisms for operating said rods, a hinged cover member disposed over those parts of the rods that are mechanically connected with the key mechanism, and spring means for the cover member adapted to maintain said cover member either in open or closed position.

13. In a stringed instrument, a plurality of rotatable crested rods, a plurality of strings respectively associated with said rods, said rods having substantially parallel axes of rotation, key mechanisms for operating said rods, a hinged cover member disposed over those parts of the rods that are mechanically connected with the key mechanisms, each of said key mechanisms carrying a scale, and a magnifying lens carried by the cover member and overlying the scales.

14. In a stringed instrument, a rotatable rod having a helical-like crest, and a tensioned string adapted to be contacted by the crest, the point of contact being determined by the position of the rod, said rod having markings laterally of the crest, and related to the pitch corresponding to the contacting positions of the crest.

15. In a stringed instrument, a rotatable rod having a plurality of helical-like crests, and a tensioned string with which the crests are adapted to contact, the points of contact being determined by the position of the rod, one of said crests being interrupted, some of the elements of said interrupted crest having greater angular extent than others.

16. In a stringed instrument, a rotatable rod having a plurality of helical-like crests, and a tensioned string with which the crests are adapted to contact, the points of contact being determined by the position of the rod, one of said crests being interrupted, some of the elements of said interrupted crest having greater angular extent than others, the axial spacing along the rod from said some of the crests to the adjacent crests being greater than the spacing between the other crests.

17. In a stringed instrument, a rotatable rod having a plurality of helical-like crests, and a tensioned string with which the crests are adapted to contact, the points of contact being determined by the position of the rod, the pitches of the crests being non-uniform.

18. In a stringed musical instrument, a member having a plurality of crests, a tensioned string, and means for moving said member with respect to the string to cause the crests simultaneously to stop the string at a plurality of points determined by the position of the member.

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