Nov. 29, 1949 J. W. McBRIDE 2,489,657

MUSICAL INSTRUMENT WITH TENSIONED STRINGS

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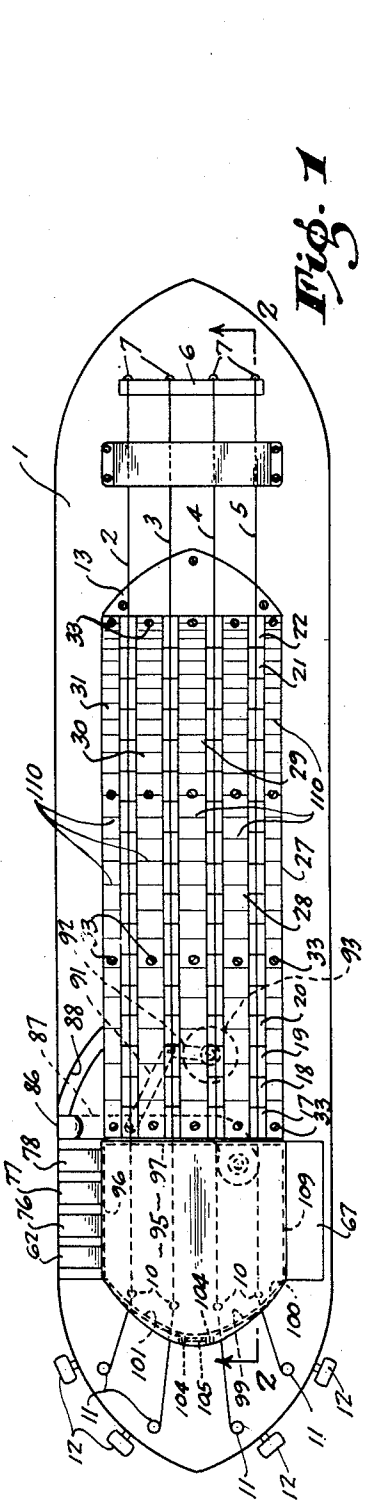

Fig. 1

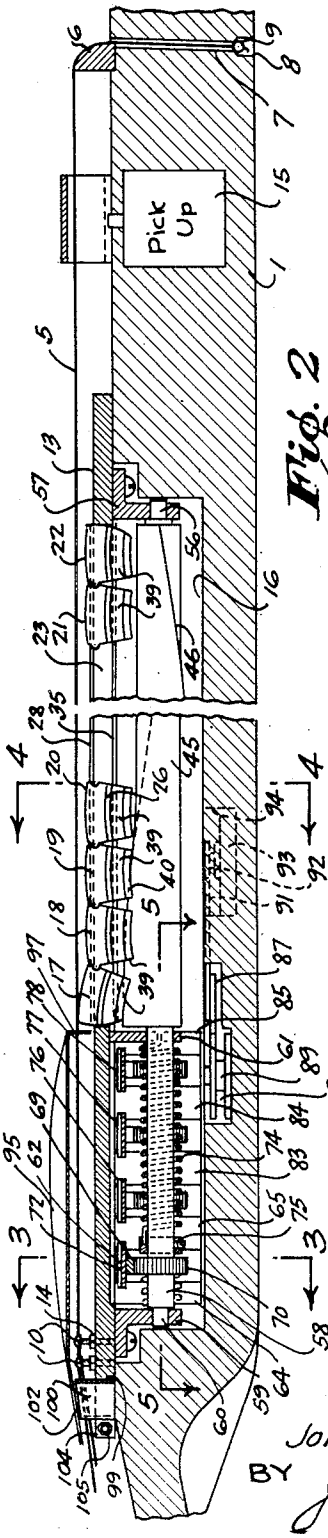

Fig. 2

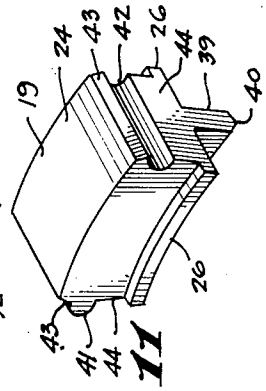

Fig. 11

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Fig. 3

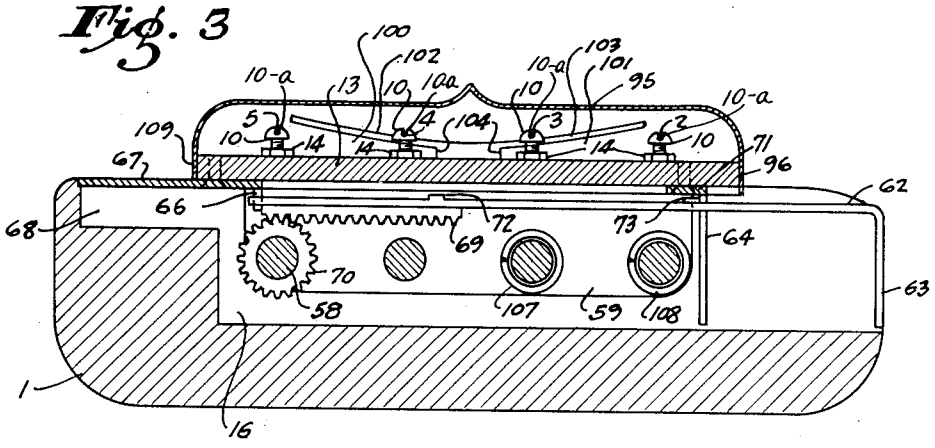
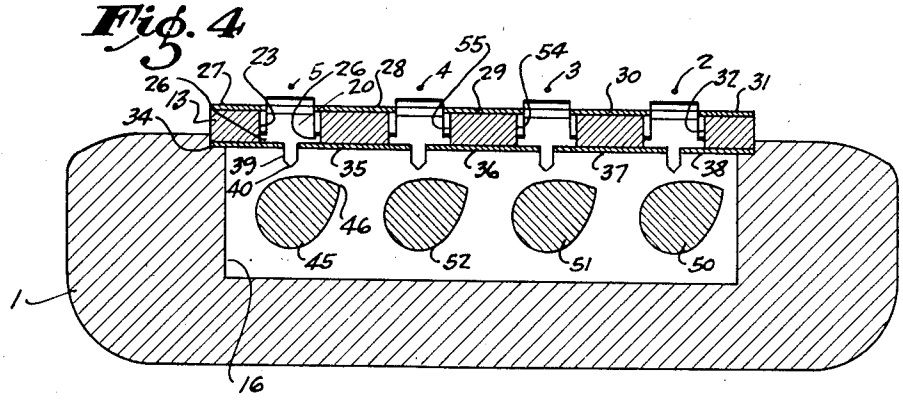


Fig. 4



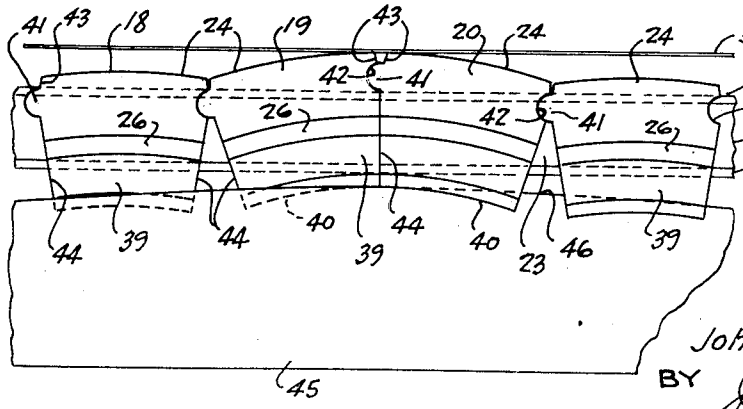


Fig. 6

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Fig. 10

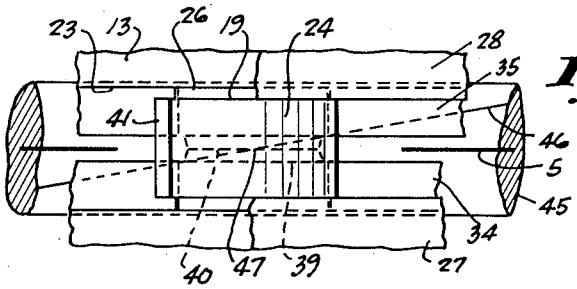


Fig. 7

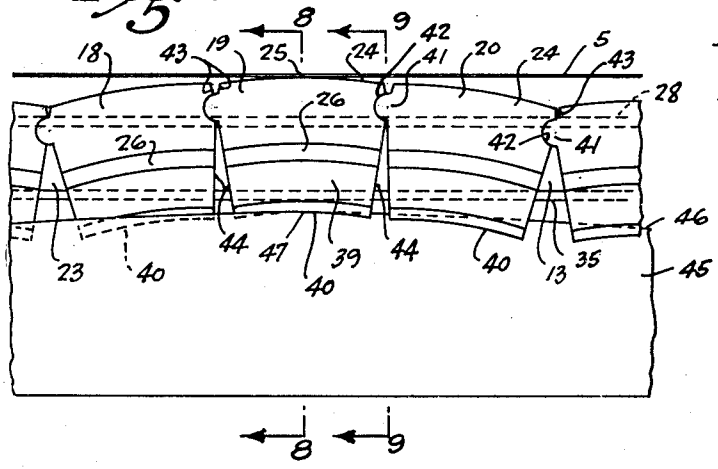


Fig. 8

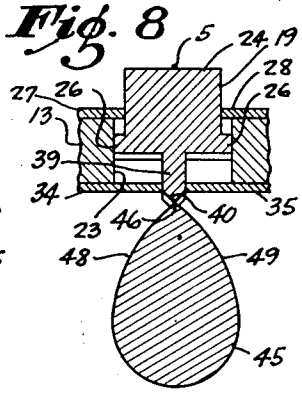


Fig. 5

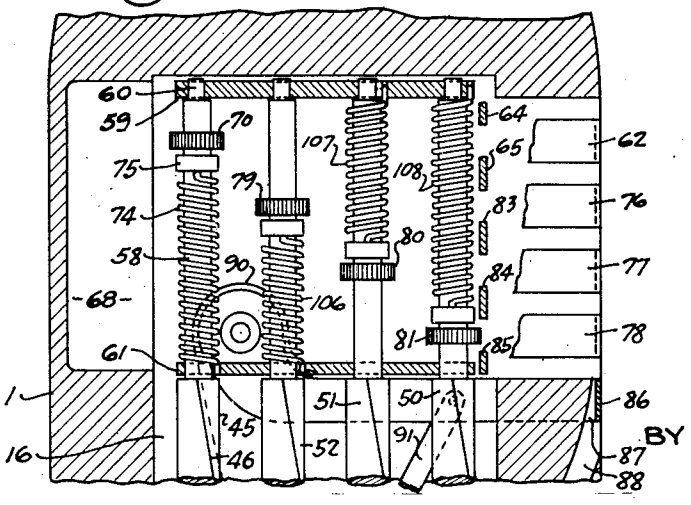
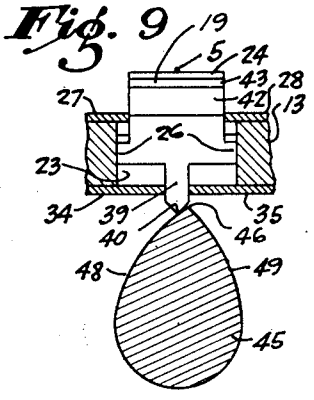


Fig. 9



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Patented Nov. 29, 1949

2,489,657

UNITED STATES PATENT OFFICE

2,489,657

MUSICAL INSTRUMENT WITH TENSIONED STRINGS

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Application June 17, 1944, Serial No. 540,794

22 Claims. (Cl. 84—317)

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This invention relates to musical instruments, and particularly those with tensioned strings.

In a conventional instrument of this kind, such as a violin, guitar, banjo, or mandolin, the pitch is determined by operation of the fingers on the strings, to determine the free vibrating lengths.

A mechanism for effecting "stopping" of the strings by mechanical means is described and claimed in an application filed on March 16, 1942, under Serial No. 434,855, in the name of John W. McBride and entitled: Stringed musical instrument, now Patent No. 2,368,256 issued January 30, 1945. In that application, the adjustment in the free vibrating length is accomplished by the aid of movable frets, any one of which may be urged upwardly into contact with the corresponding string. The frets for each string are operated by a cam device, or the like.

It is a consequence resulting from the use of such a device as described in said prior application, that the string can be "stopped" only at a series of predetermined, spaced points. It may however be desirable continuously to vary the point where the string is stopped, as for example, when playing the Hawaiian steel guitar. In this way, the pitch produced by the string is correspondingly varied through a continuous series of values.

It is one of the objects of this invention to make it possible to operate a series of movable frets so as to vary in a continuous manner the point of contact of the frets with the corresponding string.

To effect this result, that surface of the fret which is intended to contact the string is arched, and the fret is so operated as to bring different parts of that surface into contact by an action similar to a rolling action.

It is another object of this invention to make it possible to produce this rolling action, and especially by the aid of simple and inexpensive structures.

It is still another object of this invention to ensure that frets, as they become successively active, produce an undulating or rolling effect, the string being contacted by a wave-like motion of the frets. Thus, substantially smooth continuity of operation is assured between maximum and minimum free string lengths, as the frets are operated in succession.

It is still another object of this invention to provide generally an improved musical instrument of the character above specified.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one

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embodiment of the invention. For this purpose there is shown a form in the drawings accompanying and forming part of the present specification. The form 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 this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a top plan view of an instrument incorporating the invention;

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

Figs. 3 and 4 are sectional views, still further enlarged, taken respectively along planes 3—3 and 4—4 of Fig. 2;

Fig. 5 is a sectional view, taken along plane 5—5 of Fig. 2;

Fig. 6 is an enlarged fragmentary view, corresponding to a portion of Fig. 2, illustrating the manner in which the frets may be operated;

Fig. 7 is a view similar to Fig. 6, but illustrating another phase of operation of the device;

Figs. 8 and 9 are sectional views, taken respectively along planes 8—8 and 9—9 of Fig. 7;

Fig. 10 is a plan view, partly in section, of that portion of the structure illustrated in Fig. 7, some of the frets being removed for clarity; and

Fig. 11 is a pictorial view of one of the frets utilized in the instrument.

As shown most clearly in Figs. 1 and 2, a body 1 is provided that serves as a convenient support for all of the parts of the instrument. This body may be made of wood; and, since electrical pick-up devices are utilized for responding to the string vibrations, it is not necessary that this body have resonant qualities.

Stretched along the length of the body 1 are a number of strings 2, 3, 4 and 5. The right-hand ends of these strings (Figs. 1 and 2) are disposed over a stationary bridge 6. These ends extend downwardly through appropriate apertures 7. The ends of the strings are shown as knotted, as indicated at 9. Each of the knots 9 is accommodated in a corresponding enlarged recess 8, which forms a shoulder around the aperture 7 to provide a seat for the knot.

The left-hand portion of each string is likewise supported upon a bridge structure. In the present instance, a post 10 is provided for each string (see also Fig. 3). Each post may be in the form of a round head screw, providing a slot

10—*a* in which the corresponding string may rest. The height of the posts is adjustable, as by being threaded into the top of the metallic supporting plate 13. Lock nuts 14 may be used to maintain the adjustment.

After the string passes through the slot formed in the head of the corresponding post, it is then wound around a pin, such as 11, illustrated in Fig. 1. The pin 11 may be turned in the well understood manner, as by the aid of a tuning peg 12.

By providing an adjustable post 10 for each of the strings, their position relative to the body 1 may be accurately determined.

An electric pick-up device 15 of any well-known type may be arranged adjacent the bridge 6 for transmitting electrical vibrations in accordance with the string vibrations.

The mechanism for adjusting the free vibrating length of any of the strings as desired by the player is located mainly in the recess 16 formed in the body 1. Since the mechanisms for all of the strings are substantially identical, it is necessary merely to describe in detail the mechanism associated with one of these strings, such as string 5.

Arranged in regular order below each of the strings are a series of movable frets. Some of the frets associated with string 5, are shown in Fig. 2, and are indicated by reference characters 17 to 22 inclusive. These frets are confined within a longitudinal slot 23 in the plate 13 underneath the corresponding string (see especially Figs. 4, 8 and 9). Each of the frets has a convex string engaging surface 24 (Figs. 6, 7 and 8). The string 5, when the frets are moved upwardly, thus touches the convex surface 24 at a point such as 25 (Fig. 7). The frets are furthermore arranged to be rocked in succession in such manner that the point of contact 25 of the string 5 with the convex string engaging surface 24 can move in a continuous manner from one end of the convex surface to the other. Thence a succeeding fret comes into contact with the string, and the process is repeated. Thus from the position of Fig. 7, fret 19 can rock to the position of Fig. 6; and now the succeeding fret 20 is in position to be contacted by string 5. This fret 20 may now be rocked to move the point of contact from left to right along the convex surface 24 of fret 20. This gliding or undulating motion of the frets simulates quite closely the effect obtained in the playing of the Hawaiian guitar by moving a steel rod along the string.

The manner in which the undulating motion of the series of frets 17, etc. is obtained will now be described.

Each of the frets associated with string 5 is restrained for movement transversely of the guide slot 23 by having its side flanges 26 (Figs. 6, 7, 8, and 11) in sliding contact with the sides of the slot 23. Overhanging the flanges 26 are the plates 27 and 28, shown to best advantage in Fig. 4. Supplemental plates 29, 30, and 31 cooperate with the frets that are disposed beneath the other strings, 4, 3, and 2. The end plates 27 and 31 are associated with the end slots 23 and 32. The intermediate plates 28, 29, and 30 have their opposite edges extending over adjacent slots. All of the plates 27, 28, 29, 30, and 31 are shown in Figs. 1 as being attached to the supporting plate 13 by the aid of the metallic flat head screws 33. These plates 27, 28, 29, 30, and 31 are each provided with transverse markings 110 spaced in such manner that their position

indicates the tone obtained when a string is stopped at a point corresponding to the position of one of the markings.

The plates 27, 28, 29, 30, and 31 effectively restrict upward movement of all of the frets. Downward movement is restrained by corresponding plates 34, 35, 36, 37, and 38. These plates are spaced apart sufficiently to guide the narrow extensions 39 projecting beneath each of the frets, and shown most clearly in Figs. 4, 8, 9, and 11.

The flange 26 and the lower pointed edge 40 of the projection 39 are arcuate, and concentric with the string contacting surface 24 of the fret. Furthermore, the frets are jointed or hinged as by the aid of cylindrical projections 41 extending from their left-hand faces, and near the top of the frets. These projections fit into corresponding cylindrical sockets 42 in the adjacent fret. As shown most clearly in Figs. 6 and 7, the converging sides 44 of the frets permit freedom of relative angular motion at the hinges. Above the hinges the sides of the fret are spaced apart, as indicated by the boundary planes 43. In this way, a complete articulation about the hinge axis is permitted.

Normally, when the instrument is inactive, the extreme left-hand fret 17 for each string is in the elevated position indicated in Fig. 2. The left-hand side of this fret is curved to move smoothly with respect to the end wall of the slot in which the fret is accommodated. For like reasons, the right-hand end fret 22 is also provided with a curved right-hand side. The slot 23 in the supporting plate 13 is just long enough to permit the undulating motion to take place with inappreciable clearance between the hinge elements.

Operation of the frets to raise and rock them in succession is provided by a cam-like member 45 (Figs. 2, and 4 to 10 inclusive). This cam-like member 45 may most conveniently be in the form of a rod having a helical-like crest 46, and having an axis of rotation substantially parallel with the length of string 5. Crest 46 extends in a helical manner about the axis of the rod, making about three-quarters of a revolution. As the rod 45 is rotated about its axis, the helical-like crest 46 contacts the lower edges 40 of the frets in succession. As the rotation continues, an undulating motion is provided where the crest 46 is in contact with an edge 40. This undulating motion may be best explained in connection with Figs. 6, 7, 8, 9, and 10.

In the position of Figs. 7 and 10, the helical-like crest 46 is in contact with the center of the lower edge 40 associated with the fret 19. In this position, the center of the convex surface 24 contacts the string 5. The point of contact between crest 45 and the edge 40 is illustrated by reference character 47 in Fig. 7. The crest 46 crosses the lower edge 40 at point 47, as illustrated most clearly in Fig. 10. Thus, toward the right of the point 47, the crest 46 is back of the edge 40 (see also Fig. 9). Toward the left of the point 47, the crest 46 is in front of the edge 40. The sides 48 and 49 (Figs. 8 and 9) of the member 45 can be so shaped that the edge 40 stays in substantial contact with these sides while the crest 46 is in operative relation with the fret. Contact between the side 48 and the lower edge 40 is indicated in Fig. 9.

Now, as the rod 45 is rotated in one or the other direction from that illustrated in Fig. 7, the fret 19 is rocked and the hinges between the

frets are moved in a direction transverse to string 5. Accordingly, the contact point 25 moves either to the right or left.

Thus, as indicated in Fig. 6, if the rod 45 is moved from the position of Fig. 7 angularly about its axis so that the crest 46 just touches the right-hand edge of the fret 19, then this fret has been correspondingly rocked or rotated in a counter-clockwise direction about the hinge formed between the fret 19 and fret 20. At the same time, the hinge between these frets has been raised, and fret 20 has been rotated in a clockwise direction about the hinge. Continued movement of the crest 46 toward the right, as viewed in Fig. 6, will cause the point of contact with the string 5 to occur on fret 20; and it will continue on fret 20 until the crest 46 reaches the lower right-hand corner of fret 20.

The successive rocking of the crests with corresponding raising and lowering of the hinges is characteristic of the motion imparted to the frets by rotation of the rod 45. Since the lower edge 40 contacts the sides 48, 49 that join to form the crest 46, the rocking or undulating motion of the crest is accomplished by positive contact of a substantial portion of the crest with the hinges.

Crested rods 50, 51, and 52, parallel with rod 45, are disposed underneath the slots 32, 54, and 55 that accommodate the frets cooperating with strings 2, 3, 4, and 5 (see especially Fig. 4). These rods operate the respective frets in a manner described in connection with rod 45. Rod 45 is shown as rotatably supported at its right-hand end by the aid of the stub shaft 56 that is journalled in a bracket 57. This bracket 57 extends transversely to the recess 16, and is supported beneath the supporting plate 13. In this way, the bracket 57 can serve to support rotatably all of the rods 45, 50, 51, and 52.

At its left-hand end the rod 45 is provided with a cylindrical extension 58 (Figs. 2, 3, and 5). A bracket 59, similar to bracket 56, rotatably supports the stub shaft 60 projecting from the left-hand end of the cylindrical portion 58. Adjacent the right-hand end of the cylindrical portion 58, as viewed in Fig. 2, another bracket 61 is provided in which the cylindrical extension 58 is journalled. Both brackets 59 and 61 are wide enough to accommodate all of the other rods 50, 51, and 52.

Manual operation of the rods is obtained by keys 62, 76, 77, and 78, arranged side by side. Since the key mechanisms are similar, a description of the mechanism associated with rod 45 will serve as descriptive of all of them.

Operation of rod 45 is obtained by the aid of a rack and pinion mechanism. The rack 69 is carried by a key 62 (Figs. 1, 2, 3, and 5). This rack meshes with a pinion 70 carried by cylindrical extension 58.

Key 62 has a flat operating portion extending transversely of the axis of rod 45, and has a downwardly extending portion 63 capable of being manipulated by one of the fingers of the player. The key is guided at its side edges by the aid of guide bars 64 and 65 located at the right of the device, as shown in Fig. 2, and by the corresponding guide bars 66 (Fig. 3) at the left-hand end of the key 62. Guide bars 64 and 65 may be found integral with a flange 71, fastened to the bottom of plate 13. Guide bars 66 are likewise formed integrally with a flange 67 that is extended to form a cover for the space 68. This space is a transverse extension of space 16 to accommodate the ends of the operating keys

when they are urged toward the left, as viewed in Fig. 3. Similarly, space 16 is extended to the right-hand edge of the instrument, as viewed in Fig. 3, where the operating ends 63 of the keys are located to permit inward motion of the keys. By moving the key 62 inwardly, or toward the left, as viewed in Fig. 3, counter-clockwise rotation is imparted to the rod 45, due to rotation of pinion 70 by rack 69. The extent of movement determines the angular position of the helical-like crest 46, and the corresponding point where the crest is in contact with one of the series of frets.

The upper surface of the key 62 may carry the stops 72 and 73 to limit the linear movement of the rack 69. These co-operate with the guide plates 64, 65, and 66. Furthermore, a resilient means is provided for urging the rack 69 and the key 62 toward the right, corresponding to the starting position where stop 73 is in contact with plates 64, 65. In this position, the extreme left-hand fret 17 is the one that is raised, as indicated in Fig. 2.

The resilient means comprises a coil spring 74 (Figs. 2 and 5) disposed over extension 58. One end of this coil spring is anchored in the bracket 61, and the other end is anchored in a collar 75 mounted on the cylindrical extension 58. The force of the spring may be adjusted by appropriate angular adjustment of the collar 75. This force is in such a direction as to tend to move the rod 45 in clockwise direction, as viewed in Fig. 3.

Similarly, keys 76, 77, and 78 (Figs. 1 and 5) are utilized to operate the rods 52, 51, and 50 respectively. Each of these keys is guided similarly to key 62 by downwardly extending guide plates 65, 83, 84, and 85 joined to flange 71, and guide plates (not shown) similar to guide plate 66, joined to flange 67.

These plates, as shown most clearly in Figs. 2, 3, and 5, extend downwardly substantially to the bottom of recess 16 to form an enclosure for the key operated mechanism.

Each of the rods 52, 51, and 50 carries a pinion indicated by reference characters 79, 80, and 81 in Fig. 5. These pinions are axially spaced to correspond to the spacing of the corresponding keys 76, 77, and 78. Springs 105, 107, and 108 are utilized to urge the rods 52, 51, and 50 toward the starting position. One end of the spring 106 is shown as anchored in the bracket 61. However, in order to maintain the length of the springs 107 and 108 at a practical value, the ends of these springs are anchored in the bracket 59, as shown most clearly in Fig. 5.

By appropriate manipulation of the keys 62, 76, 77, and 78, any one or more of the crested rods 45, 50, 51, and 52 may be manipulated to cause the desired undulating motion of the corresponding frets associated with the tensioned strings.

In order to adjust the operation of the electrical pick-up device 15, an adjustable lever mechanism is indicated in Figs. 1, 2, and 5. Thus, adjacent the key 78 is a lever 86. This lever has a horizontal portion 87, as seen in Fig. 2. Its vertical portion can move with respect to the body 1 in a slot 88 formed in the body 1. Lever 86 is pivoted on a boss 89 mounted in the recess 90 communicating with the recess 16. At an intermediate point of the horizontal portion 87, a link 91 is pivoted. This link, in turn, is joined to a crank arm 92 that serves to operate a control

rheostat 93, or the like, disposed in a recess 94 of the body 1.

A sheet metal cover 95 (Figs. 1, 2, and 3) is provided at the left-hand end of the instrument for covering the mechanism at that end. The cover is detachably supported in a manner now to be described.

Thus, the cover 95 includes a pair of side flanges 96 and 109 that contact the sides of the main supporting plate 13. The right-hand end of the cover is also provided with a flange 97, formed integrally with flanges 96 and 109, and projecting downwardly to near the top surface of the plate 13.

The left-hand edge 99 of the plate 13 is arcuate, as indicated in Figs. 1 and 2. Flanges 96 and 109 have portions 101 and 100, respectively, which extend over the left-hand edge of plate 13. By the aid of slots 102 and 103 (Fig. 3) cut below the top of the cover member 95, these extensions 100 and 101 form virtually a strap-like clamp over the left-hand end of plate 13. To provide a clamping effect, these extensions 100 and 101 may be formed with ears 104 for the accommodation of a clamping screw 105. By tightening the screw 105, the flange members 96, 109, 100, and 101 are closely clamped to the side edges of the support 13. The cover member 95 may be readily removed, if desired, by loosening screw 105.

The inventor claims:

1. In a musical instrument having a tensioned string, a plurality of frets movable relative to each other, each fret having an arched surface engageably mounted with said tensioned string and means for moving the frets to cause said surfaces to contact the string progressively along said surfaces.

2. In a musical instrument having a tensioned string, a plurality of frets movable relative to each other in a direction transverse to the string and mounted for engagement with said string, and means for so moving the frets that the contact point between the frets and the string moves in a continuous manner along the length of the string.

3. In a musical instrument having a tensioned string, a plurality of frets movable relative to each other so as to contact said string, said frets each having an arched contacting surface, and means for rocking the frets to alter continuously the point of contact between the surfaces and the string along the length of the string.

4. In a musical instrument having a tensioned string, a plurality of frets movable relative to each other, each fret having an arched surface, said surfaces engageably mounted with said tensioned string, and an operating member having a cam portion for moving the frets to produce a rolling contact between the fret surface and the string.

5. In a musical instrument having a tensioned string, a plurality of frets movable relative to each other, each fret having an arched surface engageably mounted with said tensioned string means for guiding the movement of the frets toward and away from the string, and a mechanism for imparting a rolling motion to the fret surface upon the string.

6. In a musical instrument having a tensioned string, a movable fret having an arched surface, means for guiding the movement of the fret toward and away from the string, and a mechanism for imparting a rolling motion to the fret surface upon the string, said mechanism including a rotary rod having a helical-like crest that cooperates with a portion of the fret.

7. In a musical instrument having a tensioned string, a fret having a convex string engaging surface, means forming a guide for the fret, means for moving the fret to cause contact between the surface and the string, and means providing an axis of motion for the fret transverse to the string.

8. In a musical instrument having a tensioned string, a fret having a convex string engaging surface, means forming a guide for the fret, means for moving the fret to cause contact between the surface and the string, and means providing a shifting axis for the fret, transverse to the string, and shifted toward the string as the fret is operated by the fret moving means.

9. In a musical instrument having a tensioned string, a fret having a convex string engaging surface, means forming a shifting axis for the fret, transverse to the string, and means for imparting an angular motion, as well as a motion of translation, to the fret for urging the fret toward the string and for varying the point of contact between the string and the surface.

10. In a musical instrument having a tensioned string, a fret having a convex string engaging surface, means forming a shifting axis for the fret, transverse to the string, and means for imparting an angular motion, as well as a motion of translation, to the fret for urging the fret toward the string and for varying the point of contact between the string and the surface, comprising a crested rod engaging the fret on a surface disposed opposite the convex surface.

11. In a musical instrument having a tensioned string, a fret having a convex string engaging surface, means forming a shifting axis for the fret, transverse to the string, and means for imparting an angular motion, as well as a motion of translation, to the fret for urging the fret toward the string and for varying the point of contact between the string and the surface, comprising a rotatable rod having a crest contacting a concave surface of the fret.

12. In a musical instrument having a tensioned string, a fret having a convex string engaging surface, means forming a shifting axis for the fret, transverse to the string, and means for imparting an angular motion, as well as a motion of translation, to the fret for urging the fret toward the string and for varying the point of contact between the string and the surface, said fret having a concave surface adapted to be contacted by said motion imparting means.

13. In a musical instrument having a tensioned string, a fret having a convex string engaging surface, means forming a shifting axis for the fret, transverse to the string, and means for imparting an angular motion, as well as a motion of translation, to the fret for urging the fret toward the string and for varying the point of contact between the string and the surface, comprising a movable member having a cam-like crest, said crest having side surfaces, a point of the crest contacting a concave surface of the fret, said concave surface crossing the crest at said point and having portions conforming to the sides of the crest, motion of the rotatable member causing the point of contact between the crest and the concave surface.

14. In a musical instrument having a tensioned string, a guide member, a series of frets guided therein and extending in a direction lengthwise of the string, adjacent frets being jointed to-

gether, each of the frets having a convex string engaging surface, and means for rocking any of the frets to cause the string to contact a surface in a progressively continuous manner.

15. In a musical instrument having a tensioned string, a guide member, a series of frets guided therein and extending in a direction lengthwise of the string, adjacent frets being jointed together, each of the frets having a convex string engaging surface, and means for successively operating the frets to cause them to engage the string at a point that progresses along said surface.

16. In a musical instrument having a tensioned string, a guide member, a series of frets guided therein and extending in a direction lengthwise of the string, adjacent frets being jointed together, each of the frets having a convex string engaging surface, and means for rocking the frets successively.

17. In a musical instrument having a tensioned string, a guide member, a series of frets guided therein and extending in a direction lengthwise of the string, adjacent frets being jointed together, each of the frets having a convex string engaging surface, and means for rocking any of the frets to cause the string to contact a surface in a progressively continuous manner, comprising a rotatable rod having an axis of rotation substantially parallel to the string and having a raised crest for successively operating the frets.

18. In a musical instrument having a tensioned string, a guide member, a series of frets guided therein and extending in a direction lengthwise of the string, adjacent frets being jointed together, each of the frets having a convex string engaging surface, and means for rocking any of the frets to cause the string to contact a surface in a progressively continuous manner, comprising a rotatable rod having a helical-like crest that successively operates the frets.

19. In a musical instrument having a tensioned string, a guide member, a series of frets guided therein and extending in a direction lengthwise of the string, adjacent frets being jointed together, each of the frets having a convex string

engaging surface, and means for rocking any of the frets to cause the string to contact a surface in a progressively continuous manner, each fret having a concave surface that is intersected by the crest during operation of the fret, the concave surface contacting the sides of the crest.

20. In a musical instrument having a tensioned string, a plurality of frets, means supporting said frets for movement relative to each other into and out of engagement with said string, and means for moving said frets successively into engagement with said string so that the contact point between the frets and string moves in a continuous manner along the length of the string.

21. In a musical instrument having a tensioned string, a plurality of frets arranged generally in a common central plane, means supporting said frets for movement relative to each other into and out of engagement with said string, and means for moving said frets successively into engagement with said string so that the contact point between the frets and string moves in a continuous manner along the length of the string.

22. In a musical instrument having a tensioned string, a movable fret having an arched surface, means for guiding the fret for movement toward and away from the string, and a mechanism for imparting a rolling motion to the fret surface upon the string, said mechanism including a rotary rod movable relative to said fret and having a helical-like crest that cooperates with a portion of the fret.

JOHN W. McBRIDE.

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