United States Patent [19]

Barkan

[11] **3,742,114**

[45] **June 26, 1973**

[54] **GUITAR-LIKE ELECTRONIC MUSICAL INSTRUMENT USING RESISTOR STRIPS AND POTENTIOMETER MEANS TO ACTIVATE TONE GENERATORS**

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[21] Appl. No.: **165,213**

[52] **U.S. Cl.** **84/1.16,** 84/1.17, 84/1.25

[51] **Int. Cl.** **G10h 1/02,** G10h 5/04

[58] **Field of Search** ..... 84/1.01, 1.16, 1.17, 84/1.24, 1.25, DIG. 30

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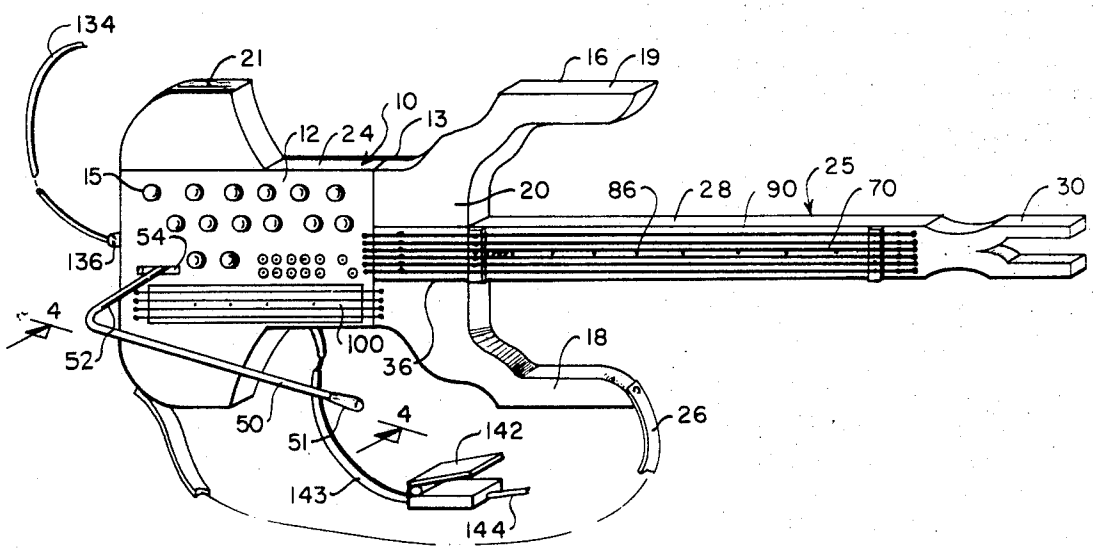
[57] **ABSTRACT**

An electronic guitar-like musical instrument comprises a central flat hollow box-like body with contoured forms extending laterally. A neck extends outwardly of one end of the body. On the neck is a fingerboard formed by a plurality of electrical resistance strips over which are suspended wire strings. On the box-like body is a control panel provided with controls for the instrument. A short fingerboard is also provided on the control panel and is formed by short electrical resistance strips over which are suspended other wire strings. Tone generators in the box-like body are electrically connected in circuit with the strings, resistance strips and controls on the panel. Potentiometers on the panel control separate tone generators. A vibrato bar extends outwardly of the body for varying pitch of generated tones. Picked notes and chords, sustained and continuously varied notes and chords can be generated by the instrument.

11 Claims, 16 Drawing Figures



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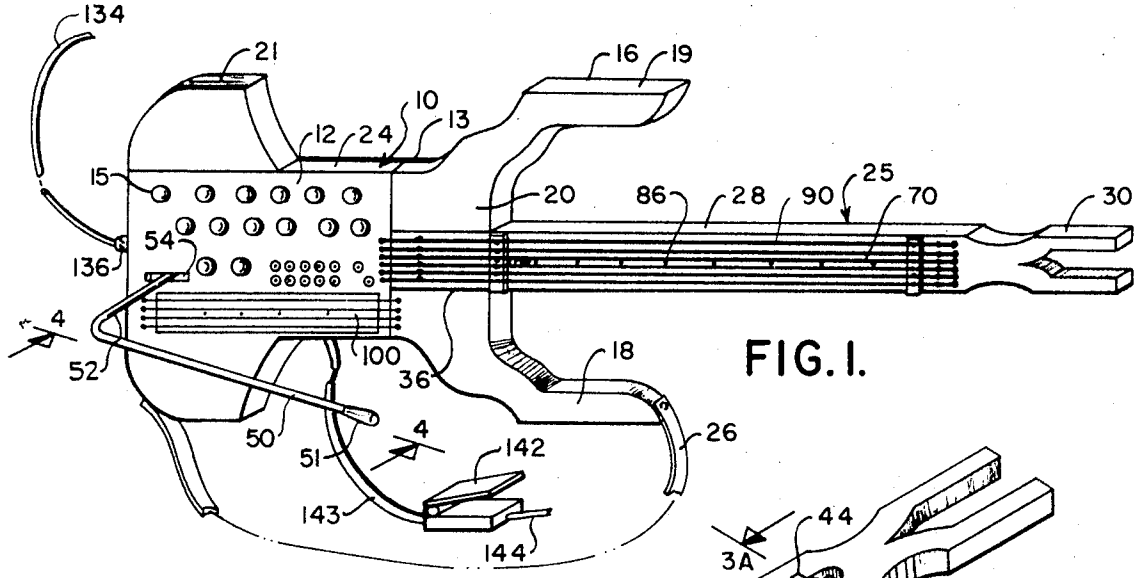

FIG. 1.

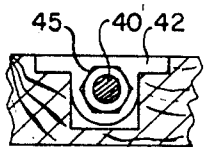

FIG. 3A.

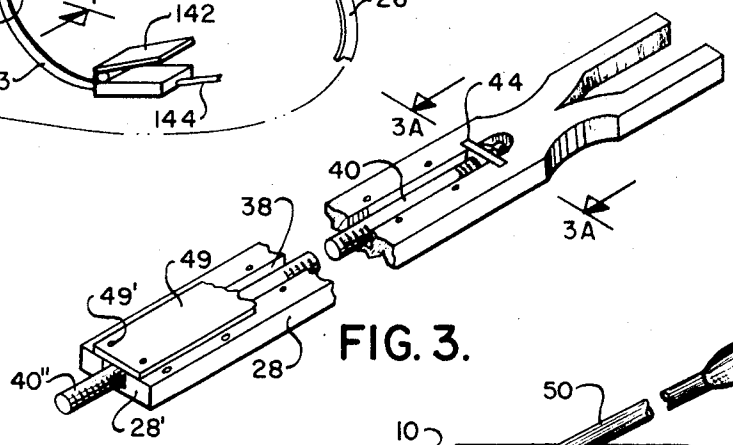

FIG. 3.

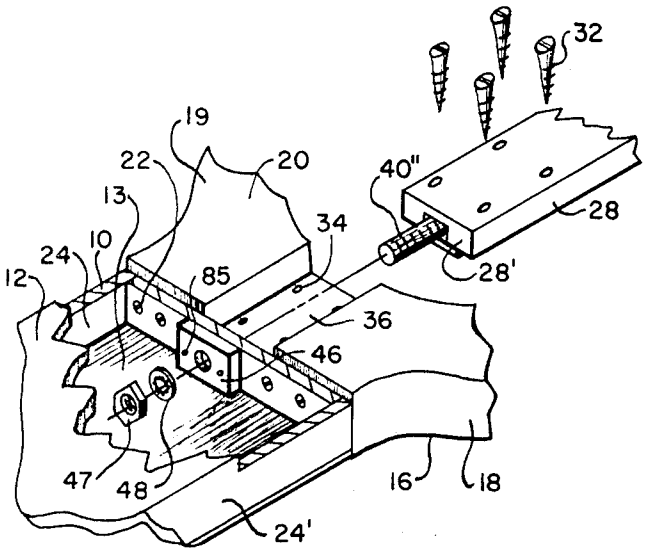

FIG. 2.

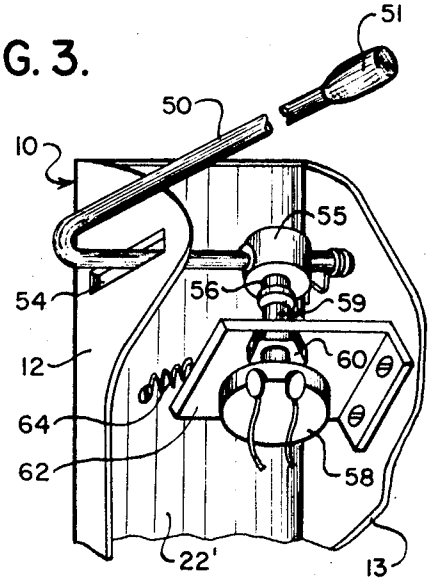

FIG. 4.

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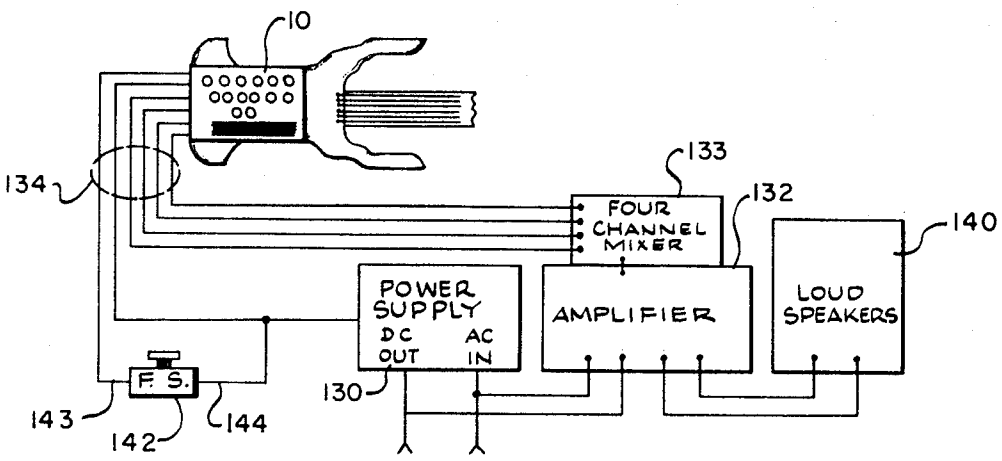

FIG. 13.

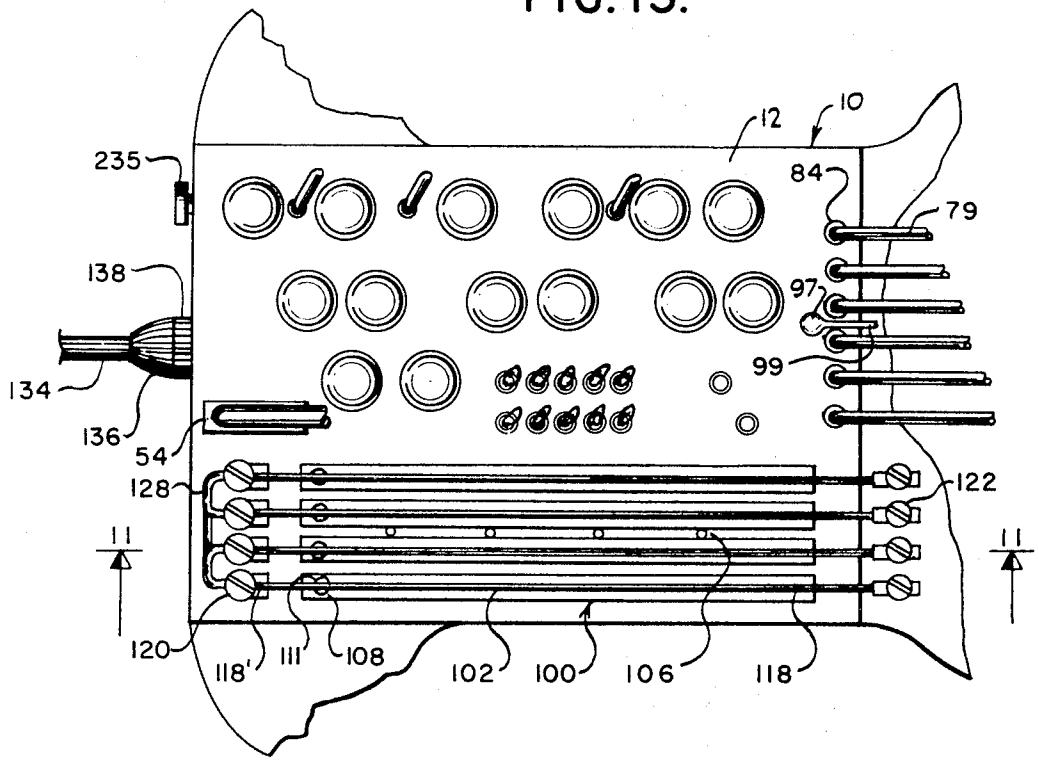

FIG. 5.

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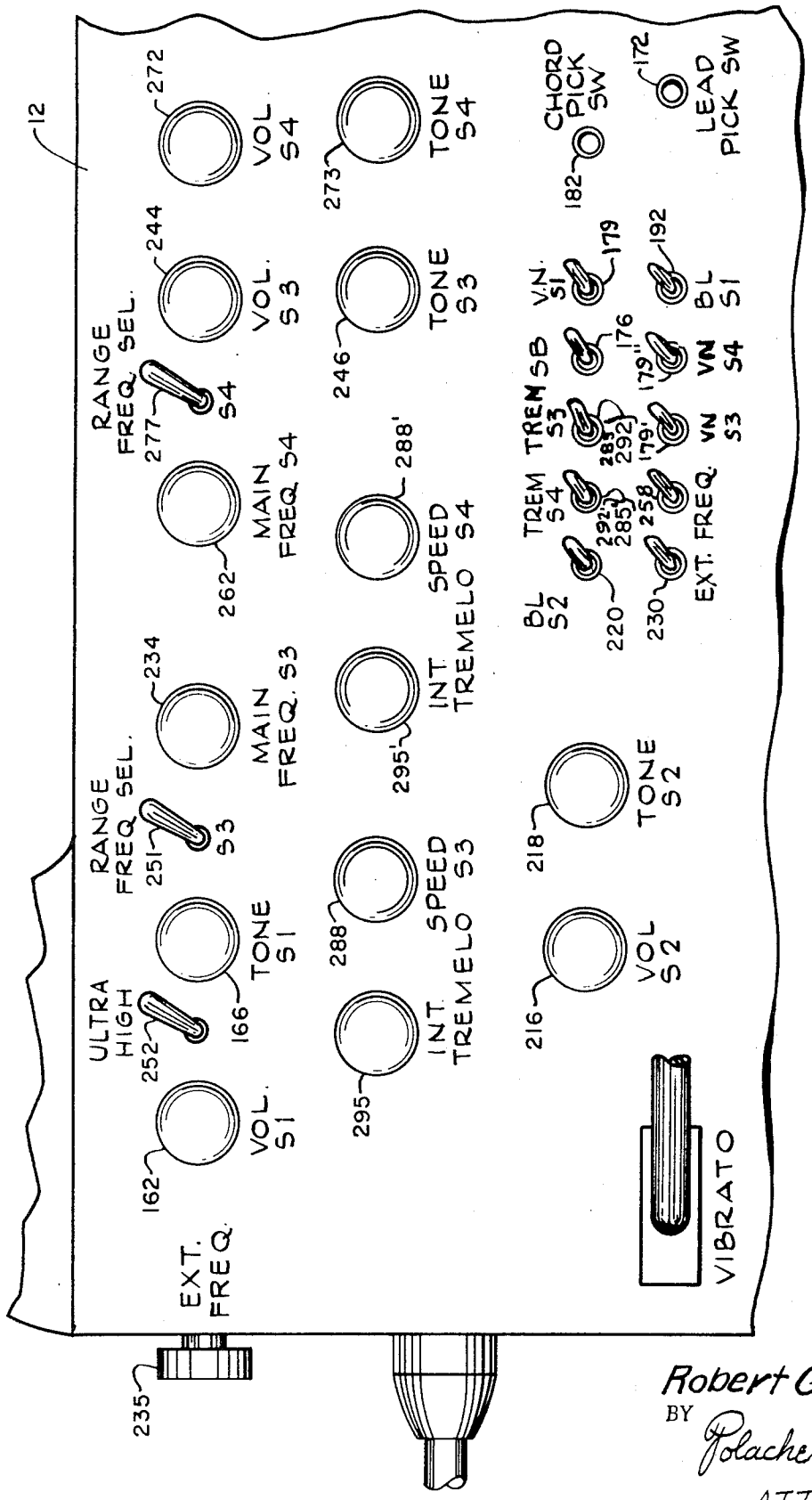

FIG. 5A.

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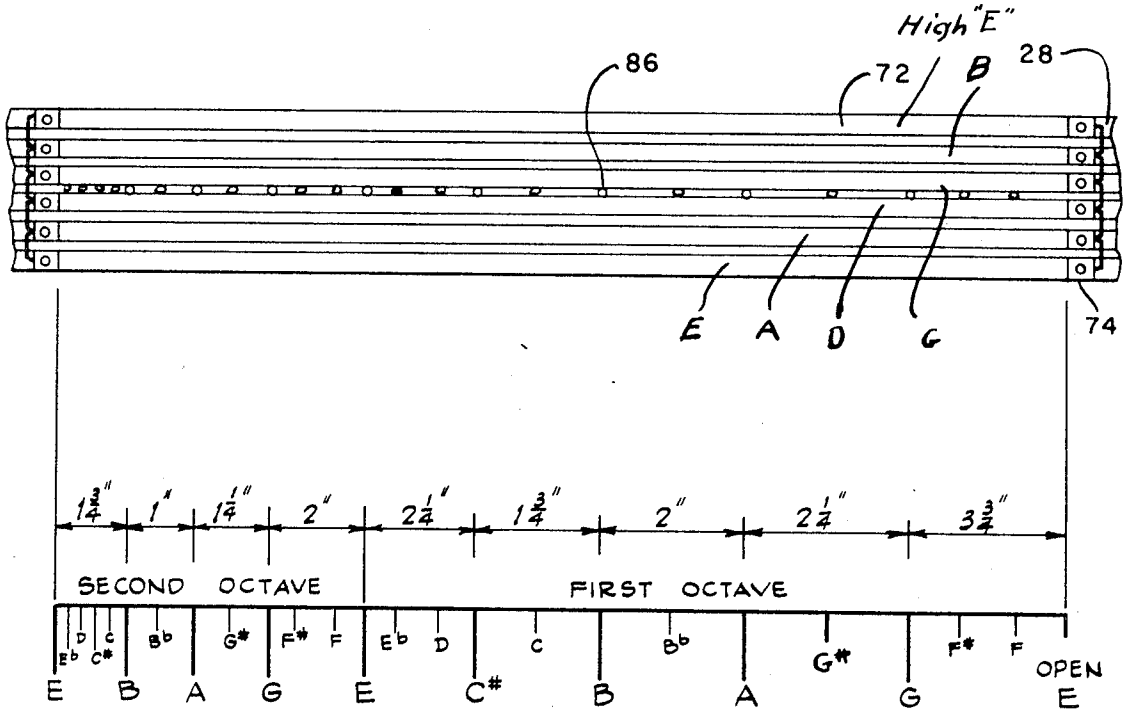

FIG. 6.

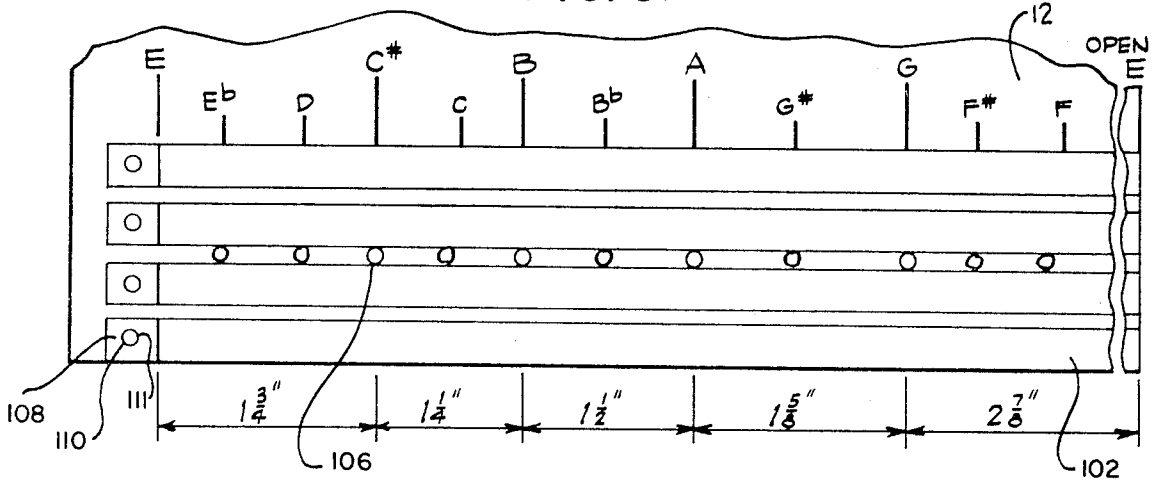

FIG. 7.

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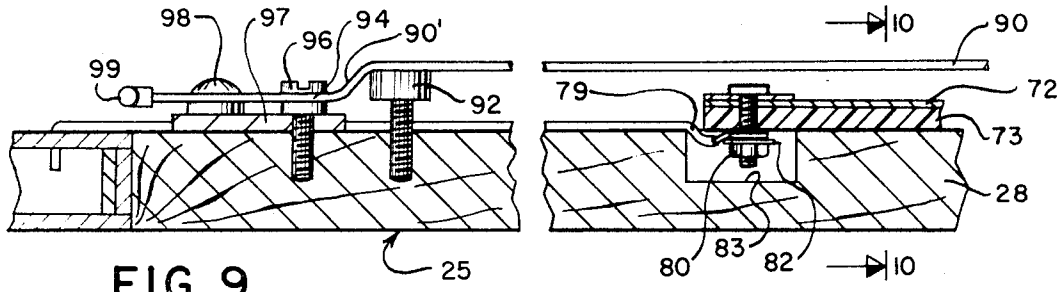


FIG. 9.

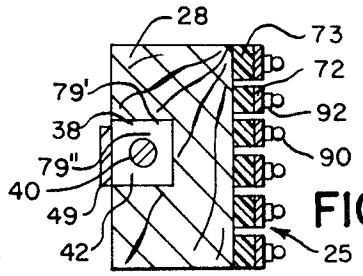
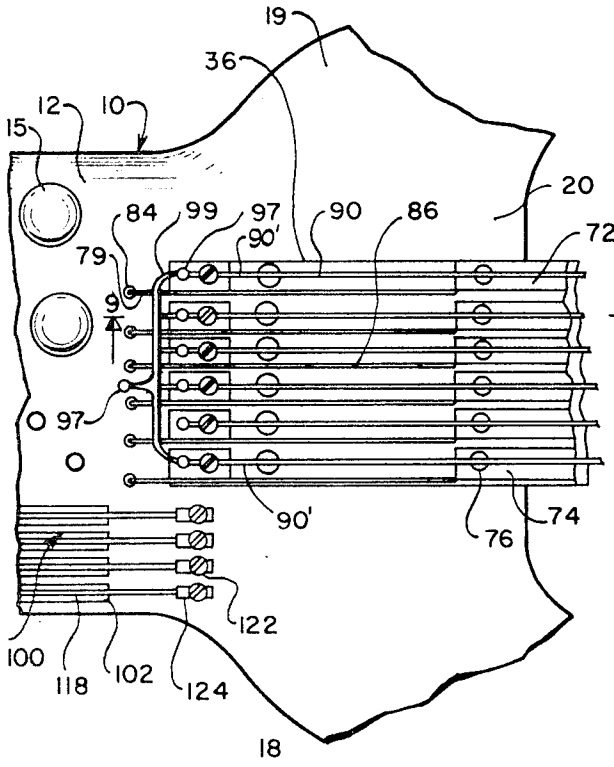


FIG. 10.



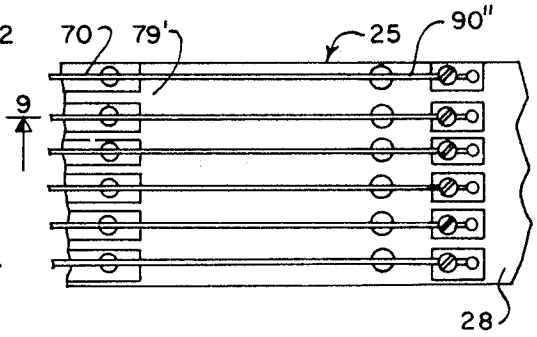


FIG. 8.

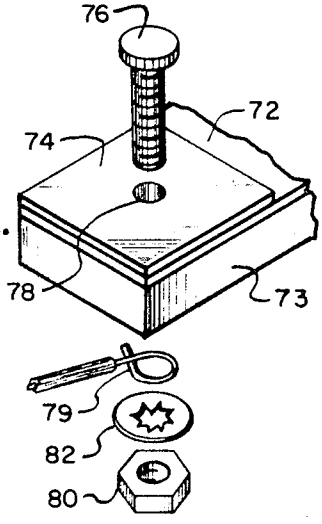


FIG. 12.

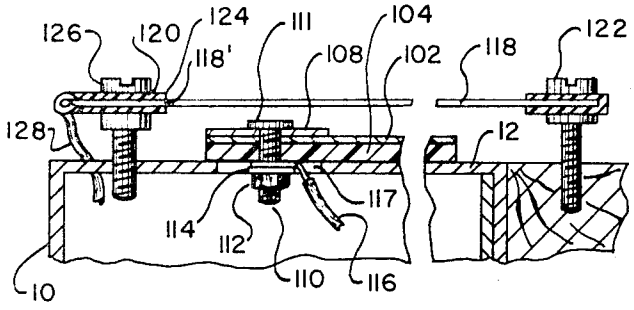


FIG. 11.

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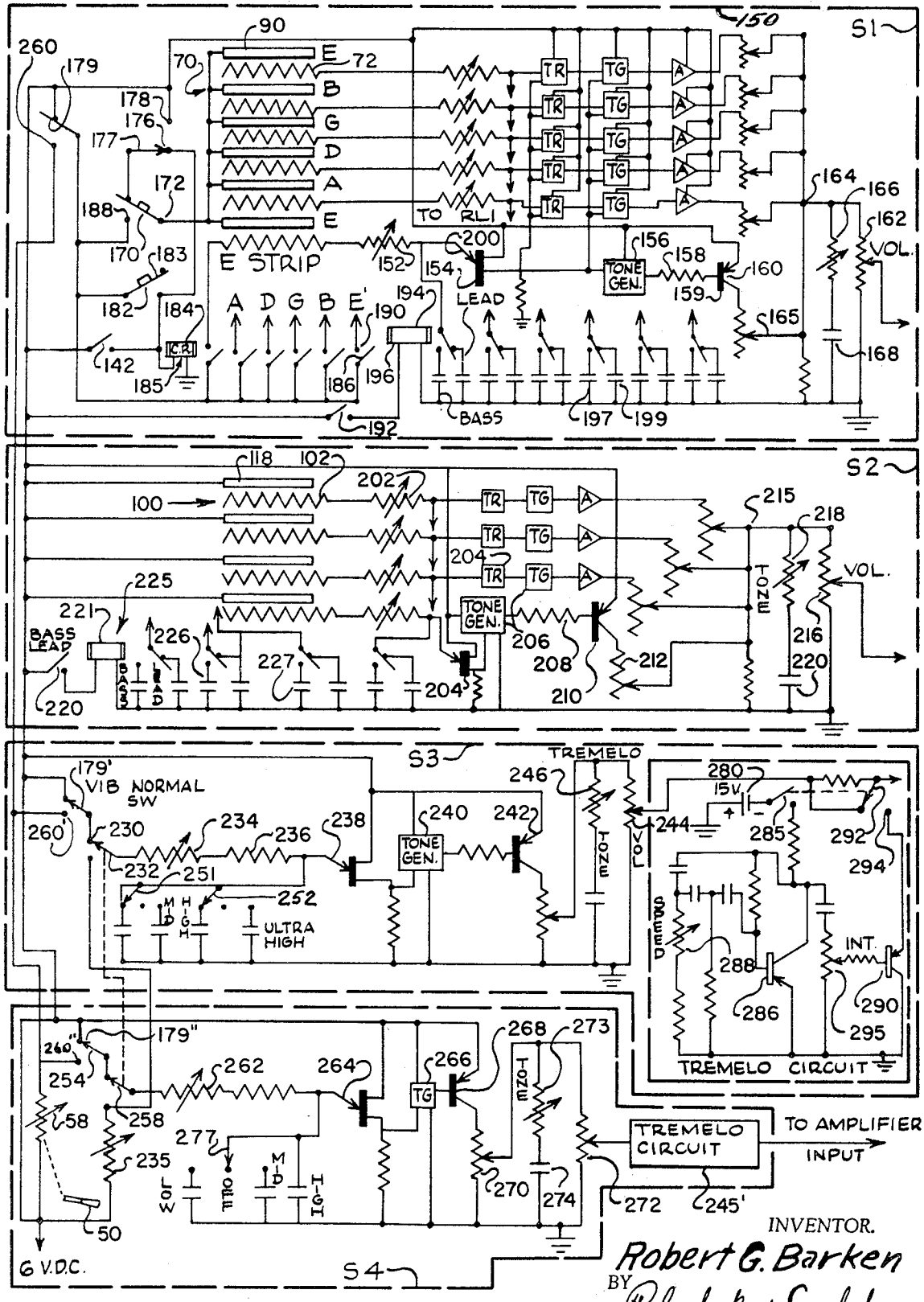

FIG. 14.

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GUITAR-LIKE ELECTRONIC MUSICAL INSTRUMENT USING RESISTOR STRIPS AND POTENTIOMETER MEANS TO ACTIVATE TONE GENERATORS

This invention involves an electronic musical instrument capable of playing electronically generated musical tones in a manner familiar to a guitarist.

The instrument is electrically connected to an audio amplifier and loudspeaker system to produce audible music. According to the invention, the instrument has a hollow central box-like body containing components of electronic circuitry which controllably generate audio frequency tones. Extending laterally from the body are contoured forms used to support the body. The electronic circuitry has four sections. An elongated neck secured to one of the forms carries a neck fingerboard. This fingerboard forms part of a first one of the circuit sections. It has six wire strings suspended over flat resistor strips each connected in a circuit with its own audio frequency tone generator in the central body. By depressing any string against its resistor strip at any point an electronic audio frequency signal is generated corresponding to the particular string pressed and the point at which it contacts the resistance strip. By depressing the strings at marked points corresponding to the fret spacing of a conventional guitar, musical tones are produced corresponding in pitch to those produced by a guitar.

Tones are produced analagous to picked tones by pressing a "pick" switch on the control panel. Picked chords can be produced by pressing two or more strings and simultaneously pressing a "chord pick" switch on the control panel. A foot operated switch is provided for chord picking to free the player's hand which operates the pick switches for other operations. A bypass switch on the control panel permits production of picked or continuous tones with one hand alone, freeing the player's other hand to perform other operations. Tone and volume controls are provided on the control panel of the central body for the neck fingerboards.

A second section includes a small fingerboard on the control panel of the central body. This body fingerboard has four suspended strings and underlying resistance strips. This fingerboard is connected in circuit with four individual tone generators and produces tones covering slightly more than three octaves. It can be played alone or it can be played in conjunction with the neck fingerboard which covers five octaves so that the two fingerboards together provide a range of five octaves. Tone and volume controls are provided for the second section.

On the control panel are provided potentiometers of third and fourth sections which control aduio frequencies produced by two other separate tone generators. The frequency range controled by each potentiometer ranges from 1 hertz to 2,640 hertz section three having an extra setting allowing it to reach 12,000 hertz. Individual tremolo circuits are provided for the third and fourth sections. A vibrato bar for producing vibrato effects is provided for the first, third and fourth circuit sections. By rocking the vibrato bar, an associated potentiometer is varied to cause an increase or decrease in pitch of tone or tones being played. A remote power supply connected to the instrument provides D.C. voltage for operating all components.

The invention provides a musician with means for producing a wide range of electronically generated music. The musician can play individual pieces on the neck fingerboard or if desired, can accompany the pieces played on the neck fingerboard with tones generated by use of the body fingerboard or the potentiometer controls of the third and fourth sections. All four sections can be operated interchangeably to provide accompaniment. This provides the musician with means for performing with several instrumental sections at once. For example, he may play a melody on the neck fingerboard accompanied by a tonal or percussion rhythm section and a bass section.

Tones produced by all sections may be continuously varied or sustained. The instrument thus provides a guitar-like instrument with features of an electronic organ as well as features of a guitar.

Other and further features, objects and advantages of the invention will become apparent from the following detailed description taken together with drawings, wherein:

FIG. 1 is a perspective view of an electronic musical instrument embodying the invention.

FIG. 2 is an exploded fragmentary perspective view of parts of the instrument showing how the neck is assembled with the body.

FIG. 3 is a perspective view of the neck per se in an inverted position, parts being broken away.

FIG. 3*a* is a cross-section along lines 3A–3A of FIG. 3.

FIG. 4 is a horizontal fragmentary, enlarged perspective view taken on line 4—4 of FIG. 1 showing the assembly of vibraor bar and potentiometer.

FIG. 5 is a front view similar to part of FIG. 1 showing the control panel and body fingerboard on a scale enlarged over that of FIG. 1.

FIG. 5A discloses in detail the panel 12 of FIG. 5.

FIG. 6 is a front view of part of the neck with strings removed showing simulated frets and musical tone locations.

FIG. 7 is a front view of the body fingerboard with strings removed showing simulated frets and musical tone locations.

FIG. 8 is a further inlarged front view of the neck fingerboard and parts of the body, portions being broken away.

FIG. 9 is a magnified fragmentary sectional view taken on line 9—9 of FIG. 8, parts being broken away.

FIG. 10 is a cross sectional view taken on line 10—10 of FIG. 9.

FIG. 11 is a magnified partial longitudinal sectional view of the body fingerboard taken on line 11—11 of FIG. 5, parts being broken away.

FIG. 12 is an exploded perspective view on a magnified scale showing one end of a resistor strip and electrical connector assembly.

FIG. 13 is a diagram showing the wiring hookup of the instrument with a power supply, audio amplifier and loudspeaker assembly.

FIG. 14 is a schematic diagram of the electronic system of the instrument.

Referring first to FIG. 1, there is shown an electronic musical instrument embodying the invention. The instrument has a body formed by a rectangular circuit box 10 provided with an integral front panel 12 and a removable back or bottom cover plate 13. On the panel are manually operable controls 15 described in detail

below. At one end of box **10** is secured a generally U-shaped form **16** having contoured arms **18** and **19** which serve for support of the instrument. The bight **20** of form **16** is secured to end wall **21'** of box **10**; see FIG. **2**. Further forms **21,22** secured to side walls **24, 24'** of box **10** provide an hour-glass shape to theinstrument. A strap **26** is secured at opposite ends to form **21** and the end of one arm **19**. This strap can be engaged around the shoulder of the player holding the instrument.

The instrument has an elongated neck **25** formed by a flat wood or plastic bar **28**. This bar terminates at its outer free end in spaced fingers **30**. The inner end **28'** of bar **28** is secured by screws **32** engaged in holes **34** provided in a cutout or recess **36** formed in the bight **20** of form **16**; see FIG. **2**. The bottom or rear side of bar **28** is formed with a groove **38** through which extends a rod **40** threaded throughout or at least at opposite ends; see FIGS. **3** and **10**. One end **40'**(FIG. **3***a*) of rod **40** is engaged with a plate **42** set in grooves **44** extending laterally of one end of groove **38** and is held by a nut **45**. The other end **40''** of rod **40** extends outwardly of the other end of groove **38** and is engaged in end wall **22** of box **10** and in a reinforcement plate **46** secured to end wall **22**; see FIG. **2**. A nut **47** and washer **48** engage this end of rod **40**. The nut **47** can be tightened to tension bar **28** for straightening it or for holding it straight in the event it tends to bend forwardly toward the front of the instrument. A cover plate or strip **49** is provided to cover groove **38** and rod **40** and is held by screws **49'**; see FIG. **3**. Neck bar **28** fits snugly in recess **36** and is securely held there. If desired the joint can further be reinforced by gluing the end **28'** of bar **28** in recess **36**.

A vibrato control bar **50** has a handle **51** at its outer end which can be manually grasped and moved up or down for controlling vibrato tones. Bar **50** is L-shaped as best shown in FIGS. **1** and **4**. Its shorter arm **52** extends through a slot or hole **54** in panel **12** and is secured radially to a knob **55**. Knob **55** is mounted at one end of a rotatable shaft **56** used to adjust variable resistor **58** mounted by a threaded sleeve **59** and nut **60** on a support plate or bracket **62** on bottom plate **13** of the circuit box. A coil spring **64** is secured at opposite ends to the side of knob **55** opposite from arm **52** to end wall **22'** of the circuit box **10**. Bar **50** can be arranged to be rotated on arm **52** as an axis downwardly out of the way of the player.

The neck **25** has a neck fingerboard **70** formed by six thin electrical resistance strips **72** bonded to insulative plastic strips **73**. These strips are in turn cemented to the front or upper side of neck bar **28**; see FIGS. **6, 8, 9** and **10** and **12**. The resistance strips are spaced apart laterally and disposed parallel to each other in coplanar disposition on neck bar **28**. Opposite ends of strip **72** are coated with films **74** of silver paint or other highly conductive liquid to serve as electrical terminals. Flathead bolts **76** extend through holes **78** in the films **74**, strips **72** and **73** for engaging looped ends of insulated wires **79** and **79'**; see FIGS. **8, 9, 10** and **12**. The bolts are secured by nuts **80** and lockwashers **82**. The nuts **80** and lock-washers seat in recesses **83** formed in the neck under strips **73**; see FIG. **9**. Wires **79** extend along the top of bar **28** to circuit box **10** where they enter the circuit box through the holes **84** in panel **12**; see FIGS. **5** and **8**. Wires **79'** are collected in a cable **79''** and run through groove **38** to the circuit box **10**; see FIG. **10**. Registering holes **85** can be provided in end wall **22** and plate in the circuit box for passing cable **79''**; see FIG. **2**. On neck bar **28** are screws or pins **86** spaced apart longitudinally of the neck centrally thereon between adjacent resistor strips; see FIGS. **1, 6** and **8**. These pins serve as simulated fret marks. The pins are spaced apart varying distances corresponding to notes "G", "A", "B", "C #", "E", and the like of a first musical octave, and notes "G", "A", "B", and the like of a second musical octave. These are fret locations familiar to guitar players so that the provision of these fret markers on neck bar **28** facilitates playing of the instrument.

Playing of the instrument is made possible by electrically conductive wire strings **90** disposed parallel with the resistive strips and supported above them by elevating bolts **92** near opposite ends of the strings. The ends **90'**, **90''** of the strings are engaged in passages **94** formed in mounting bolts **96** through which the ends of the strings extend. The string ends are soldered to lugs **97** by solder joints **98**. String ends **90'** are joined to a common wire **99** which enters circuit box through hole **97**; see FIGS. **5, 8** and **9**. By pressing strings **90** against resistive strips **72** at selected points along the neck fingerboard, different notes are sounded by the instrument. Some of these notes are indicated in FIG. **6**. If a player runs his finger along any string pressing each point of the string in succession against a strip **72**, a continuously varying tone will be produced by the instrument. The way this is accomplished is explained further in connection with the circuitry of the instrument shown in FIGS. **13** and **14**.

A supplemental body fingerboard **100** is further provided on panel **12** of the circuit box **10**. Here four parallel electrical resistance strips **102** bonded to plastic strips **104** are disposed in laterally spaced coplanar disposition longitudinally of panel **12**; see FIGS. **1, 5, 7, 8** and **11**. Fret locations at notes "G", "A", "B", "C # ", and the like are indicated by pins or screw **106** located centrally of the fingerboard. One end of each resistance strip has a silver film **108**. Electrically conductive bolt **110** has a flat head **111** overlaying this film. Attached to bolt **110** by nut **112** and lockwasher **114** is a wire **116** extending through hole **117** in panel **12** to the circuitry in circuit box **10**; see FIG. **11**.

Over each resistance strip is a flexible, electrically conductive wire string **118** supported at opposite ends by elevating bolts **120,122**. Opposite ends of the springs are clad in insulative tubing **124** engaged in passages **126** in the bolts. Ends **118'** of the strings are connected to common wire **128** which passes into the circuit box through a hole in panel **12**. Fingerboard **100** is played like fingerboard **70**. Individual or continuously variable tones are producible.

The instrument is connected to a direct current power supply **130** and amplifier **132** via a cable **134** terminating in a plug **136** engaged in a socket **138** at one end of the circuit box **10**; see FIGS. **1, 5** and **13**. Amplifier **132** drives loudspeaker assembly **140** in conventional manner. A four-channel mixer **133** of conventional type can be interposed between the instrument and amplifier **132**. A footswitch **142** is connected to the circuit box and power supply via wires **143, 144**. Operation of this footswitch is described in connection with the circuitry **150** shown in FIG. **14** to which reference is now made.

Circuit **150** has four sections S1–S4. Section S1 includes the neck fingerboard **70** comprising six strings

90 and resistance strips 72. Section S2 includes the body fingerboard 100 comprising four strings 118 and resistance strips 102. Sections S3 and S4 include means for producing tremolo and vibrato effects. Power is supplied to the circuit at 6 volts D.C.

In Section S1 each of resistance strips 72 is connected in series circuit with a variable trimmer resistor 152, a transistor 154 and audio frequency wave or tone generator 156. The output of tone generator 156 is in series with base resistor 158, and base 159 of amplifying transistor 160. The outputs of all transistors 160 are applied to junction point 164. The combined outputs are fed to the mixer-amplifier 133, 132 via variable resistor 162 which serves as a volume control. Variable resistor 166 in series with capacitor 168 serves as a tone control. Volume and tone controls 162, 166 are shown on panel 12 in FIG. 5A over indicia reading VOL-S1 and TONE-S1. The tone generators 156 may be conventional audio oscillators or signal generators variable in output frequency by change of input resistance and input current. The variable resistance is provided by each string 90 in association with a resistance strip 72. By pressing any string to contact a strip 72 at any point a greater or lesser amount of resistance of ths strip 72 is placed in series with the tone generator. The 6 volts power supply is applied to each string 90 either continuously or momentarily. Momentary application of d.c. voltage is effected via pole 170 of LEAD PICK switch 172. This pole is connected to all strings 90. Swtich 172 is a single pole double throw pushbutton type of switch. When the switch button is pressed, the d.c. voltage is applied through fixed switch contact 188 and pole 170 to all strings 90. The d.c. voltage can be applied continuously to the strings via LEAD PICK BYPASS switch 176. This is a toggle switch which can be thrown to close pole 177 with switch contact 178 for applying d.c. voltage to the strings and cutting out or bypassing switch 172.

Vibrato normal switch (VN1) 179 is connected to LEAD PICK switch 172 and a CHORD PICK switch 182. Pole 183 of switch 182 is connected in series with coil 184 of a six-pole chord control relay 185 for energizing this relay momentarily when the CHORD PICK switch is closed. Switch 182 is a pushbutton switch. The locations of switches 172, 176, VN 179, VN 179', VN 179'', on panel 12 are shown in FIG. 5A. Foot switch 142 is connected between the 6 volts d.c. power supply and relay coil 184 for energizing this relay by pedal action of a player of the instrument. The movable contacts 186 of relay 185 are all connected to pole 179 along with the pole 183 of switch 182 and contact 188 of switch 172. The fixed contacts 190 of relay 185 are connected respectively to the resistance strips 72. A BASS-LEAD toggle switch 192 is connected between the power supply and coil 194 of relay 196. This is a six-pole relay whose poles 198 selectively connect either a bass control capacitor 197 or a lead (treble) control capacitor 199 between emitter 200 of transistor 154 and ground. The location of BASS-LEAD switch 192 is shown on panel 12 in FIG. 5A.

In circuit section S2, each resistance strip 102 is connected in series circuit with trimmer resistor 202, transistor 204 and audio tone generator frequency wave or tone generator 206. The outputs of each of the four tone generators 206 is applied via load resistor 208 to transistor amplifier 210. The output of each amplifier 210 is applied via trimmer resistor 212 to junction point 215. Junction point 215 is connected via volume control 216 to one of the mixer-amplifier inputs. The volume control is a variable resistor. Tone control 218 is a variable resistor which is in series with capacitor 220 and is connected across the volume control. The volume control 216 and tone control 218 of section S2 are shown on panel 12 in FIG. 5A. The tone generators 206 are conventional variable frequency audio oscillators. BASS-LEAD switch 220 of section S2 is connected between the power supply and coil 221 of relay 225. This relay has four poles arranged to select either bass or lead capacitors 226, 227 for connection across the inputs of transistors 204. Swtich 220 is shown on panel 12 in FIG. 5A.

In section S3, switch 179' is connected to contact 230 of EXTENDED FREQUENCY switch 232. Switch 232 has a contact 233 connected to EXTENDED FREQUENCY control 235. Switch 232 is connected in series with MAIN FREQUENCY CONTROL 234, fixed resistor 236, and transistor 238 to audio frequency wave or tone generator 240 which is audio oscillator having a range of 1 hertz to at least 12,000 hertz. The output of the tone generator 240 is connected to transistor amplifier 242. The output of this amplifier is applied via volume control 244 to a tremolo circuit 245 described below. The output of the tremolo circuit is applied to one input of the mixer-amplifier 133, 132. Tone control 246 in series with capacitor 248 is connected across the volume control. Frequency selector switches 251, 252 selectively connect capacitors of different values across the input of transistor 238. The locations of switches 232, 251, 252, and controls 234 235, 244, 246 on panel 12 are shown in FIG. 5A. Control 235 is mounted at the end of circut box 10.

In section S4, variable resistor 58 is adjusted by vibrato bar 50. This resistor is connected to contact 260'' of VIBRATO NORMAL switch 179'. VN switch 179'' is connected to !EXTENDED FREQUENCY switch 258. In normal position of the VN switches, the vibrato bar is bypassed. When each of switches 179, 179' and 179'' close with contacts 260, 260' and 260'', the operation of the vibrato bar is possible since resistor 58 is then effectively connected in circuit with the tone generators of sections S1, S3 and S4. MAIN FREQUENCY CONTROL switch 262 of section S4 is connected in series with switch 258, transistor 264 and sudio frequency wave or a tone generator 266. The tone generator has a range of 1 hertz to at least 2,640 hertz. It is connected to transistor amplifier 268. The output of amplifier 268 is applied via a trimmer resistor 270 and volume control 272 to tremolo circuit 245'. A tone control 273 in series with capacitor 274 is connected across the volume control. Frequency selector switch 277 and capacitors 279 are connected between the input of transistor 264 and ground. The switches and controls 258, 262, 273 and 272, 277 of section S4 are shown on panel 12 in FIG. 5A.

The tremolo control circuits 245 and 245' are identical. Each circuit includes a d.c. voltage source 280 connected via a switch 285 to transistor 286. Variable resistor 288 connected across the transistor in a resistance-capacitance circuit serves as a SPEED CONTROL. The audio frequency output of sections S3 or S4 is applied to transistor 290 via a switch 292 when thrown to contact 294. Transistor 286 drives transistor 290 via INTENSITY control 295. The tremolo circuits 245 and 245' have separate SPEED and INTENSITY

controls 288, 295 and 288' and 295' in the two sections S3, S4; see FIG. 5A. Joint switches 285, 292, and 285' and 292' are also shown in FIG. 5A. The output of transistor 290 is applied to one of the mixer-amplifier inputs.

In operation of the instrument including circuit 150, any one of the six tone generators oscillates instantly when any string 90 contacts a resistance strip 72 at any point if d.c. voltage is applied to the pressed string. Voltage is applied to the strings momentarily if the LEAD PICK switch 172 is pressed or voltage is applied continuously if the LEAD PICK BYPASS switch 176 is closed. The desired bass or lead (treble) range is selected by operation of the BASS-LEAD switch 192 which energizes relay 196. Notes are "picked" operating the LEAD PICK switch 172 to control the interval of time voltage is applied to the strings selectively pressed. A plurality of tones constituting a chord are "picked" by momentary operation of the CHORD PICK switch 182 while two or more strings are pressed against the resistance strips. The chord can be sustained by holding switch 182 depressed. An open string chord of all six strings can be produced by pressing the CHORD PICK switch 182 without pressing any string. The variable frequency tone generators have relative frequencies corresponding to note intervals of the tempered scale as used on a conventional guitar. Thus indicated in FIG. 14, full open string notes correspond to standard low E, A, D, G, B and high guitar E strings. When either PICK switch 172 or 182 is closed, pressing any string against a resistance strip has the effect of reducing resistance in the input to transistor 154 resulting in a rise in frequency increase the pitch of tone produced. During string"picking" two hands are used, one at strings 90 and the other at the desired PICK switch. If one hand playing of individual notes is desired, LEAD PICK BYPASS switch 176 will be closed to apply d.c. voltage to all strings continuously. One hand playing of chords can be done by closing the foot switch 142 which energizes the relay 184 continuously to apply voltage to all resistance strips. Barred chords can be produced in normal manner without any need to use the CHORD PICK switch.

By operating the VIBRATO NORMAL switches 179, 179' and 179'', and vibrato bar 50, notes or chords can be modulated to increase or decrease slightly in pitch. Moving the bar in one direction the pitch is increased and moving the bar in opposite direction, the pitch is decreased. Normally the potentiometer or resistor 58 has certain resistance when bar 50 is at rest in neutral position. Moving the vibrato bar up or down varies the resistance applied in circuit with the resitance strips to vary the frequencies of the tone generators activated by pressing the strings against resistance strips.

The combined outputs of the tone generators after amplification by transistors 160 all controlled in volume by VOLUME control 162. The tone control 160 serves as a treble frequency bypass to vary the outputs of all tone generators 156 simultaneously. The outputs of section S1 are applied to audio amplifier 132 and loudspeakers 140 via four-channel mixer circuit 132. This mixer can be operated in known manner to produce various special sound effects.

The neck fingerboard provides for five octaves of notes ranging from low bass E to treble ranging from low bass E to treble E; tuning of the E string of S1 and S2 is indicated in FIGS. 6 and 7. The resistance lengths of strips 72 are selected and calculated so that the normal string tuning of the neck fingerboard at their highest points is as follows corresponding to the six bass guitar or the six string standard guitar:

	Bass	Lead
Low E	164.8 hz	329.6 hz
A	220 hz	440 hz
D	293.6 hz	587.3 hz
G	391.9 hz	783.9 hz
B	493.8 hz	987.7 hz
High E	659.2 hz	1318.5 hz

Body fingerboard 100 is operated by pressing strings 118 with the hand which is not operating the neck fingerboard. Relay 225 is energized when the BASS-LEAD switch 220 is closed. Normally the relay contacts are set at the LEAD position but are thrown to BASS position when the relay is energized. Voltage is applied continuously to strings 118. Tones are produced by depressing the strings at selected points against resistance strips 102. The tuning corresponds to the four string bass guitar or the first four strings of a standard guitar as follows:

	Bass	Lead
Low E	82.4 hz	164.8 hz
A	110 hz	220 hz
D	146.8 hz	293.6 hz
G	195.9 hz	391.9 hz

It will be noted that some overlap is provided at the high end of the bass range and the low end of the lead range. Chords are produced by finger pressing desired strings.

In sections S3 and S4, both tone generators are constantly energized and oscillating. They are silenced by turning down the volume controls 244 and 272. The MAIN FREQUENCY controls 234 and 262 each covers a range of three octaves. By use of the FREQUENCY SELECTOR switches 251, 252 and 277 a desired tonal range can be produced as follows:

Low	5 to 40 hz
Mid-range	40 to 330 hz
High	330 to 2640 hz
Ultra-high	1500 to 12,000 hz — section three only.

Sections S3 and S4 can be used in conjunction with vibrato bar 50 by operating the VIBRATO NORMAL switch 199' and 179'' either separately or simultaneously with the neck fingerboard 70.

By operating the EXTENDED FREQUENCY switches 232 and 258 either tone generator 240 or 266 can be used in conjunction with the EXTENDED FREQUENCY control 235 to further lower the frequency range of the tone generators. When switch 252 in section S3 is at ULTRA-HIGH selection, control 235 can be set at a high resistance point. This applies high resistance to transistor 238 in section S3 and causes a white noise, "volcano" or "avalanche sound efffect which can be varied by tone control 246 for further enhancement of a deep rumbling noise effect. If the resistance of extended frequency control 235 is increased still further, it has the effect that if various tones on the remaining sections S1, S2 and S4 are produced, section S3 will accompany these tones with an additional tone one octave lower in frequency than the original tones, causing a pleasing musical effect found on conventional 12-string guitars. If the tones produced by sections S1, S2, or S4 are silenced by turning down volume

controls **162, 216,** or **272,** respectively, only the accompanying tones are heard. This effectively lowers the frequency range of tones produced by either section S1 or S2 to as low as **20** hz, even though this lower frequency range is an output of tone generator **240** in section S3. These lower tones can be further effected by the tone control **246** of section S3. The player can produce various frequency modulation effects through the combined use of all three frequency controls **234, 235** and **262.** As an example an oscillating siren effect can be produced. The tremolo circuits **245** and **245'** provide amplitude modulation of the tones generated by generators **240** and **266** respectively. They are actuated by operating the tremolo switches **285, 292** and **285'** and **292'.** Speed and intensity controls **288, 288'** and **295, 295'** permit adjustment of tremolo effects.

On the panel **12** of FIG. **5A,** except for lead pick switch **172** and chord pick switch **182** which are normally pushbutton switches, remaining other switches are toggle type switches.

Since the contacts of the strings and resistance strips are continuously variable from end to end of the strings, an umlimited variety of musical scales and tonal fluidity is attainable. The fret markings **86** and **106** locate exact points where specified notes can be produced.

The instrument can be regarded as covering five continuous octaves when fingerboards **70** and **100** are played together. In addition three additional octaves are covered by each of sections S3 and S4 when all range selections are used.

In its preferred form the neck fingerboard is eighteen inches long and the body fingerboard is nine inches long as indicated in FIGS. **6** and **7.** However other lengths to suit the needs of players can be used.

A prior art U.S. Pat. No. 3,223,771 covers a musical device superficially similar to the above-described invention; however, there are major significant differences such as the patented device: does not have nor disclose a combination of several electrical circuits of respectively several musical sections; does not disclose nor suggest resistor "strips", does not disclose nor suggest a plurality of strings each with its own generator circuit, i.e. the patent uses one generator for a plurality of strings for a single generator — thereby preventing playing concurrently on more than one string; the patent cumbersomely includes the amplifier and speaker built-in; and the like.

While a preferred embodiment of the invention has been described, it will be apparent that many modifications and variations are possible without departing from the spirit of the invention.

What is claimed is:

1. An electronic musical instrument comprising a central, flat hollow body; contoured forms extending outwardly of sides and one end of the body for supporting the same; a neck extending outwardly of one of the forms at said one end of the central body; a first section including a first fingerboard on said neck comprising a plurality of flat, laterally spaced coplanar electrical resistance strips, and a plurality of electrically conductive wire strings suspended over said strips respectively; and electronic circuitry in said central body including a plurality of audio-frequency electronic wave tone generators electrically connected in circuit with said strings and strips for producing different tones when said strings are selectively pressed against the strips, said tones depending in pitch on the particular string pressed and the particular point at which the pressed string contacts an underlaying resistance strip; said central body has a control panel, and tone and volume controls mounted on said panel and connected in circuit with said generators for respectively adjusting tone and volume of pitch produced by operation of said fingerboard; and further comprising a plurality of potentiometers on said control panel; said electronic circuitry further comprising a plurality of further audio frequency wave generators connected in circuit with said potentiometers respectively for generating tones extending in frequency over a prescribed frequency range for accompanying tones produced by operation of the fingerboard; further comprising third section tremolo generating means connected in circuit with said further wave generators for controllably producing tremolo effects when said further generators are active; further comprising a fourth section including a vibrato bar and another potentiometer in said central body connected in circuit with the first named wave generators and said further wave generators for varying pitch of tones produced thereby and said vibrato bar movably mounted on said control panel and connected to said other potentiometer for producing vibrato effects when said vibrato bar is moved while the first named and other wave generators are producing tones of selected pitches.

2. An electronic musical instrument as defined in claim **1,** wherein said fingerboard has spaced markers thereon designating predetermined musical intervals corresponding to those of a conventional stringed guitar.

3. An electronic musical instrument of claim **1,** in which in series circuit with said third section tremolo generator means is a third-section volume control means receivable of output of said third section tremolo generator means, and in which a third-section tone control is connected across said volume control and in which in said fourth section connected in series circuit with said vibrato bar is a switch, a transistor and said tone generator receivable of signals through said switch through said transistor, a trimmer resistor fed by the fourth section generator, and a fourth-section volume control fed by said trimmer resistor, said fourth-section volume control being connected to feed its output to said third section tremolo generator.

4. An electronic musical instrument comprising a central, flat hollow body; contoured forms extending outwardly of sides and one end of the body for supporting the same; a neck extending outwardly of one of the forms at said one end of the central body; a first fingerboard on said neck comprising a plurality of flat, laterally spaced coplanar electrical resistance strips, and a plurality of electrically conductive wire strings suspended over said strips respectively; and electronic circuitry in said central body including a plurality of audio frequency electronic wave generators electrically connected in circuit with said strings and strips for producing different tones when said strings both separately and jointly are selectively pressed against the strips, said tones depending in pitch on the particular string pressed and the particular point at which the pressed string contacts an underlaying resistance strip; said central body has a control panel, and tone and volume controls mounted on said panel and connected in circuit with said generators for respectively adjusting tone

and volume of pitch produced by operation of said fingerboard; a second fingerboard on said control panel comprising a plurality of other flat, laterally spaced coplanar electrically conductive resistance strips, and a plurality of other electrically conductive wire strings suspended over said other strips respectively; said electronic circuitry further including a plurality of other audio frequency waves generators electrically connected in circuit with said other strips and strings for producing still other tones when said other strings are selectively pressed against the other strips, said other tones depending in pitch on the particular other string of the second fingerboard pressed and the particular point at which the pressed other string contacts an underlaying resistance strip, said first and second fingerboards being operable for producing all of said tones simultaneously.

5. An electronic musical instrument as defined in claim **4,** further comprising other tone and volume controls mounted on said panel and connected in circuit with said other generators for respectively adjusting tone and volume of pitches produced by operation of said second fingerboard.

6. An electronic musical instrument as defined in claim **4,** further comprising a plurality of potentiometers on said control panel; said electronic circuitry further comprising a plurality of further audio frequency wave generators connected in circuit with said potentiometers respectively for generating tones extending in frequency over a prescribed frequency range for accompanying tones produced by operation of the fingerboard.

7. An electronic musical instrument as defined in claim **6,** further comprising tremolo generating means connected in circuit with said further wave generators for controllably producing tremolo effects when said further generators are active.

8. An electronic musical instrument as defined in claim **5,** further comprising a plurality of potentiometers on said control panel; said electronic circuitry further comprising a plurality of further audio frequency wave generators connected in circuit with said potentiometers respectively for generating further tones extending in frequency over a prescribed frequency range for accompanying tones produced by operation of the first and second fingerboards.

9. An electronic musical instrument as defined in claim **6,** further comprising another potentiometer in said central body connected in circuit with the first named wave generators and said further wave generators for varying pitch of tones produced thereby; and a vibrato bar movably mounted on said control panel and connected to said other potentiometer for producing vibrato effects when said vibrato bar is moved while the first named and other wave generators are producing tones of selected pitches.

10. An electronic musical instrument as defined in claim **4,** wherein said circuitry further comprises switch means connected in circuit with the first named and other wave generators for controlling time intervals during which said fingerboards are operable to produce tones.

11. An electronic musical instrument as defined in claim **4,** wherein said circuitry further comprises switch means for shifting the frequency ranges of tones produced by operation of the fingerboards.

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