

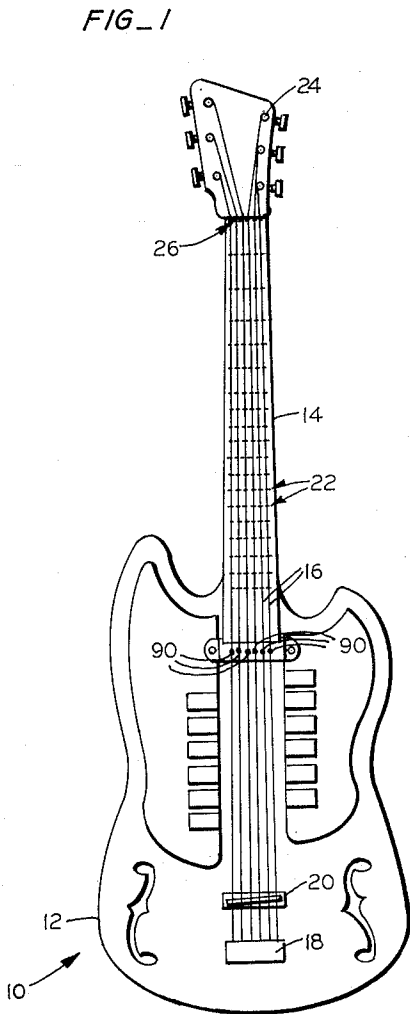
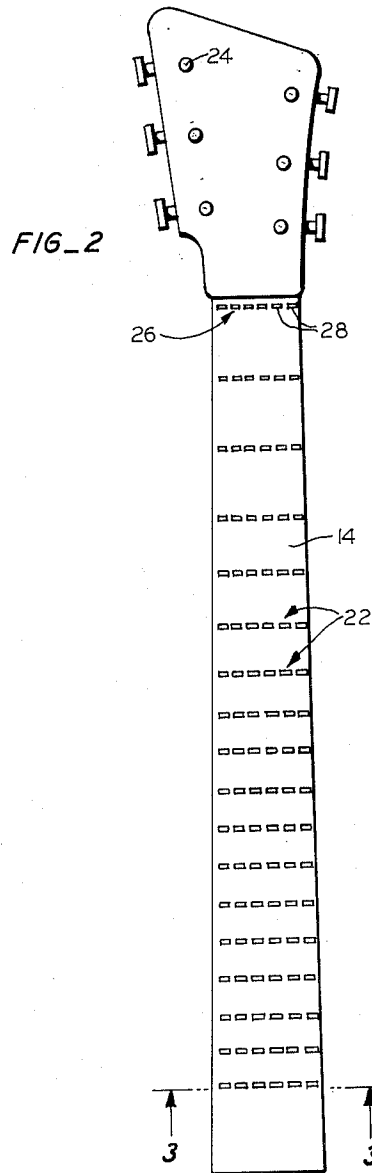
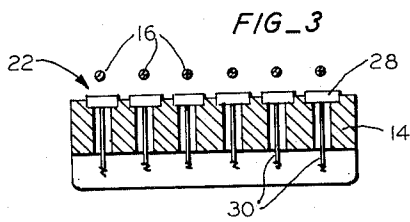
Dec. 31, 1963

L. KREBS
MUSICAL INSTRUMENT

3,116,357

Filed June 26, 1961

2 Sheets-Sheet 1



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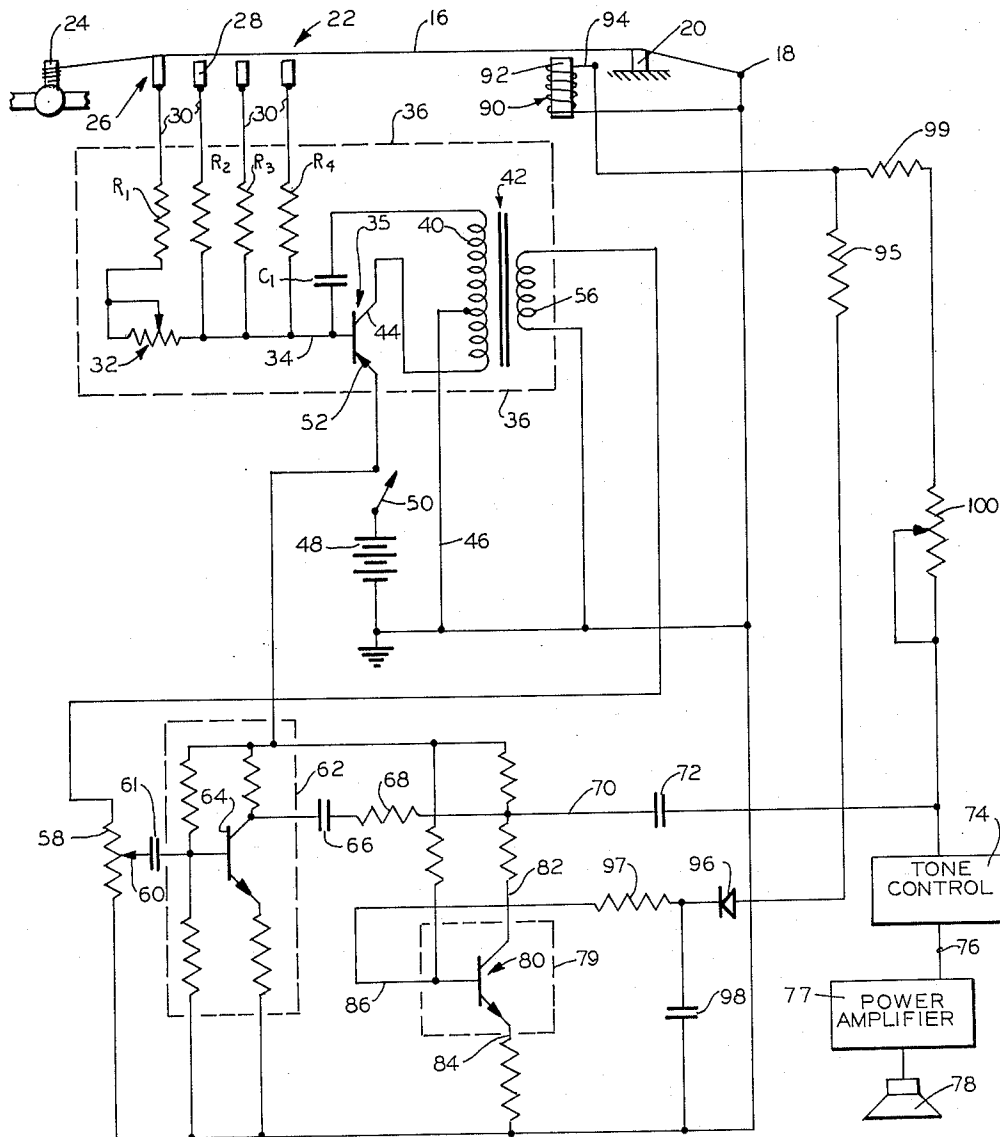
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FIG. 4



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MUSICAL INSTRUMENT

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This invention relates to musical instruments, and more particularly to an electrical finger board for musical instruments such as a guitar, banjo, mandolin, ukelele, or zither.

In many of the previously available electrical musical instruments, much of the player's artistic touch is lost because the sound of each note of the prior instruments tends to be more or less uniform regardless of who is playing the instrument.

This invention provides an electrical instrument which combines the advantages of both electronic and natural playing because it incorporates the player's individual touch into the final output of the instrument.

Briefly, the invention contemplates an elongated finger board with a plurality of longitudinally spaced frets mounted on the board. At least one electrically conductive wire is disposed over the frets and adapted to be pressed into electrical contact with them. An oscillator having a variable frequency output is connected to the frets so that the frequency output of the oscillator is determined by the fret contacted by the wire. An electronic gate has its input connected to the output of the oscillator, and a pickup element is disposed adjacent the wire to generate a control signal in response to the vibration of the wire. Means are provided to couple the control signal to the gate to regulate the oscillator output flowing through the gate.

Thus, to play the instrument, the wire is pressed into contact with a fret to cause the oscillator to have an output of the desired frequency. The amount of the oscillator output passing through the gate is controlled by causing the string to vibrate adjacent the pickup. Preferably, the oscillator output flowing through the gate is proportional to the control signal, which in turn is proportional to the amplitude of the vibrations of the string so that the player or artist controls the output of the oscillator by the force with which he plucks the string. In this way, the skill and dexterity of a musician is not masked by the electronic circuitry of the instrument, and feeling and character introduced by the musician's individual touch is not lost.

In the presently preferred form, the instrument includes means for mixing the oscillator output from the gate with the natural output from the vibrating string so a musician can get unlimited sounds and tones from the instrument. Moreover, with an instrument such as a guitar, which includes six strings, each fret is formed of insulated segments so there are six sets of collinearly aligned segments. Each set of segments is under a respective wire, and each wire is connected to a separate oscillator to provide for individual output from each string in accordance with which segment is contacted by the wire.

These and other aspects of the invention will be more fully understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a plan view of a guitar constructed in accordance with the invention;

FIG. 2 is an enlarged top plan view of the finger board showing the segmented frets;

FIG. 3 is a view taken on line 3-3 of FIG. 2, with the individual strings disposed over respective segments in the frets; and

FIG. 4 is a schematic diagram of a circuit for one of the strings of the instrument.

Referring to FIG. 1, a guitar 10 includes a body 12 and

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the usual finger board 14. Six guitar strings or wires 16 are connected at one end to a tail piece 18 on the guitar body, and extend over a conventional bridge 20, a series of transverse frets 22 on the finger board, and are secured at their opposite ends to anchor bolts 24 mounted on the end of the finger board remote from the guitar body. The fret 26 farthest from the guitar body is slightly higher than the remaining frets and is always in contact with the wires. As shown best in FIGS. 2 and 3, each fret is divided into six separate segments 28, each insulated from the other and each disposed under a respective string 16 to form six collinear sets of segments.

A separate enamel-insulated wire 30 is connected to each fret and in an electrical circuit as shown in detail in FIG. 4 and as described below.

The circuit shown in FIG. 4 is typical for each of the strings and is shown for only one of the strings to simplify the illustration of the invention. Referring to FIG. 4, a typical string 16 extends over longitudinally and collinearly aligned segments 28 of the frets 22 so that the string can be pressed down into contact with any selected segment of a fret. Each of the frets corresponds to a musical note such as A, D, G, C, E, etc., the closer the fret segment to the bridge 20, the higher the frequency of note to which the segment corresponds. The segment 28 in the fret 26 nearest the end of the wire remote from the tail piece is slightly higher than the segments in the other frets, and therefore is in constant contact with the wire. A conductor 30 connects segment 28 through a resistor R_1 and a rheostat 32 to the base 34 of a transistor 35, which is part of an oscillator 36. A capacitor C_1 is connected to the oscillator input at one end to the base 34 and at the other end to one end of a primary winding 40 of a transformer 42. The other end of the winding 40 is connected to the collector 44 of the oscillator transistor. The primary winding 40 is center tapped to ground through a lead 46. The negative end of a power supply battery 48 is connected to ground, and the positive end of the battery is adapted to be connected through a switch 50 to the emitter 52 of the oscillator transistor.

Each of the other fret segments is connected through leads 30 and respective resistors R_2 , R_3 , R_4 , etc. to the oscillator transistor base. The resistors R_1 , R_2 , R_3 , R_4 , etc. the rheostat, and the capacitor C_1 form the tank circuit for the oscillator, so that when the string 16 is pressed down into contact with the different segments, a different RC constant is established for the oscillator to cause it to oscillate at different frequencies. The oscillator is tuned by the rheostat 32 to the string fundamental or a harmonic of the fundamental, i.e., the natural vibration of the string in the open position shown in FIG. 4. The values of the resistors R_2 , R_3 , R_4 , etc. are selected to provide a decreasing RC constant for the oscillator so that the frequency output of the oscillator increases with decreasing distance of the segments from the bridge 20.

The output of the oscillator is a secondary winding 56 of the transformer 42. One end of the secondary winding is grounded, and the other end is connected to the input of a potentiometer resistor 58, the other end of which is grounded. A movable tap 60 is adapted to slide along the potentiometer resistor 58 to control the "volume" of the oscillator output, which is connected through a coupling capacitor 61 to the input of preamplifier 62, which includes a second transistor 64. The output of the preamplifier is coupled through a capacitor 66, a resistor 68, a lead 70, and a capacitor 72 to the input of a tone control 74 having an output 76 which goes to conventional power amplifier 77 and a speaker 78.

An electronic gate 79 includes a transistor 80, an input 82, an output 84, and a control terminal 86. The gate is connected as shown in FIG. 4 so the input 82 and output 84 connect the lead 70 to short to ground a por-

tion of the preamplifier output. The amount shorted by the gate depends on the conductive state of the gate, which in turn is controlled by the signal applied to the control terminal 86 from a pickup 90, that includes a core 92 of magnetic material and a coil of wire 94 disposed around the core. The pickup is disposed adjacent the wire 16 so that as the wire vibrates, the magnetic flux surrounding the coil 94 is changed to generate an electric signal in the coil 94. One end of the coil is connected to ground and the other end is connected through a resistor 95, a diode 96, and a resistor 97 to the control terminal 86 of the gate. A capacitor 98 is connected to ground and between resistor 97 and diode 96 so those three components rectify the A.C. output of coil 94 to supply a D.C. control signal to the transistor 80 in gate 79. The output of coil 94 is also connected through a resistor 99 and a rheostat 100 to the input of the tone control so that the natural output of the vibrating string can be mixed with the output of the oscillator depending on the setting of the rheostat 100. As shown in FIG. 1, a separate pick-up 90 is disposed under each string 16.

In playing the instrument shown in the drawings, the musician presses the string or strings down into contact with a segment or segments to establish the desired frequency outputs for each of the oscillators. The string is then caused to vibrate, say by plucking it with a guitar pick, so that each pickup 90 generates an electric control signal in proportion to the vibration of the string. The gate 78 is normally fully conducting so that all of the signal from the oscillator is shorted to ground until a control signal from the pickup is applied to the control terminal of the gate, which becomes less conducting with increasing control signal strength from the pickup. Thus, if the string is picked relatively hard, the gate is substantially closed so that the full power from the oscillator and preamplifier is fed through the tone control to the power amplifier to produce a relatively loud sound at the frequency determined by the oscillator output. On the other hand, if the signal from the pickup is relatively weak, the output from the oscillator and preamplifier is correspondingly reduced. Depending on the setting of the rheostat 100, the natural vibrations of the string 16 are mixed with the output of the oscillator at the option of the musician so he can obtain an infinite variety of sounds and tones from the instrument, which depend not only on the setting of the various electrical components, but also on the artistic touch of the musician as well.

The various electrical components shown in FIG. 4 are located in the body of the guitar. The transistor design of the oscillator is preferred because of the reduced size and power requirements. But even more important, the transistorized circuits are of low impedance and present no hum problems due to stray hum fields around partly unshielded circuits in the neck or due to hand capacitance or other phenomena that tend to create hum or noise in high impedance circuits of the type using vacuum tubes.

The gate is amplitude sensitive so that when the string is picked softly, a soft tone or small portion of the oscillator output is passed through the gate. Conversely, when the string is picked hard, the gate closes further to short less of the oscillator output and more power from the oscillator is passed to the power amplifier. The gate control can be achieved by several methods, one being by taking advantage of the small emitter current characteristics of a transistor. Another is to have a photo cell in the base-emitter circuit. The resistance of the photo cell changes in accordance with how much light is applied to it from light bulb (not shown) in the pickup signal circuit so that it is lighted to an intensity proportional to the pickup signal. In another embodiment the transistor is biased to saturation as shown in FIG. 4 to appear as a short to ground in the output of the oscillator circuit. When a portion of the pickup voltage is fed to the base of the transistor, the internal

resistance of the transistor increases, thereby allowing oscillator output to pass through to the output amplifier.

I claim:

1. A musical instrument comprising an elongated finger board, a plurality of longitudinally spaced frets mounted on the board, at least one electrically conductive wire disposed over the frets and adapted to be pressed into electrical contact with the frets, an oscillator having a variable frequency output, means for changing the output of the oscillator in response to the fret contacted by the wire, and electronic gate having an input, an output, and a control terminal, means connecting the oscillator output to the gate input, a pick-up element disposed adjacent the wire to generate a control signal in response to vibration of the wire, and means coupling the control signal to the gate control terminal to regulate the oscillator output flowing through the gate.

2. A musical instrument comprising an elongated finger board, a plurality of longitudinally spaced frets mounted on the board, an electrically conductive wire disposed over the frets and adapted to be pressed into electrical contact with the frets, an oscillator having a variable frequency output, means for changing the output of the oscillator in response to the fret contacted by the wire, an amplitude electronic gate having an input, an output, and a control terminal, means connecting the oscillator output to the gate input, a pick-up element disposed adjacent the wire to generate a control signal in response to vibration of the wire, and means coupling the control signal to the gate control terminal to regulate the amplitude of oscillator output flowing through the gate in proportion to the amplitude of the control signal.

3. A musical instrument comprising an elongated finger board, a plurality of longitudinally spaced frets mounted on the board, an electrically conductive wire disposed over the frets and adapted to be pressed into electrical contact with the frets, an oscillator having a variable frequency output, means for changing the output of the oscillator in response to the fret contacted by the wire, an electronic gate having an input, an output, and a control terminal, means connecting the oscillator output to the gate input, a pick-up element disposed adjacent the wire to generate a control signal in response to vibration of the wire, means coupling the control signal to the gate control terminal to regulate the oscillator output flowing through the gate, and means for mixing the output of the pick-up element with the output of the gate.

4. Apparatus according to claim 3 which includes means for varying the amount of output from pick-up element mixed with the output of the gate.

5. A musical instrument comprising an elongated finger board, a plurality of longitudinally spaced frets mounted on the board, an electrically conductive wire disposed over the frets and adapted to be pressed into electrical contact with the frets, an oscillator having a variable tank circuit to produce a variable frequency output, means for changing the resonant frequency of the tank circuit and output of the oscillator in response to the fret contacted by the wire, an electronic gate having an input, an output, and a control terminal, means connecting the oscillator output to the gate input, a pick-up element disposed adjacent the wire to generate a control signal in response to vibration of the wire, and means coupling the control signal to the gate control terminal to regulate the oscillator output flowing through the gate.

6. A musical instrument comprising an elongated finger board, a plurality of longitudinally spaced frets mounted on the board, each fret including segments electrical insulated from each other, the segments in each fret being located to form collinearly aligned sets with segments in adjacent frets, a separate electrically conductive wire disposed over each collinearly aligned set of segments and adapted to be pressed into electrical contact with the segments underlying it, a separate oscillator connected to

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each wire, each oscillator having a variable frequency output, means for changing the frequency output of each oscillator in response to the segment contacted by the respective wire for each oscillator, a separate electronic gate for each oscillator, each gate having an input, an output, and a control terminal, means connecting each oscillator output to a respective gate input, a separate pick-up element disposed adjacent each wire to generate a control signal in response to vibration of each respective wire, and means coupling the control signal of each

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pick-up to a respective gate control terminal to regulate the oscillator output flowing through the gate.

References Cited in the file of this patent

UNITED STATES PATENTS

2,792,738	Donahue	May 21, 1957
2,817,261	Fender	Dec. 24, 1957
2,909,092	De Armond	Oct. 20, 1959
2,968,204	Fender	Jan. 17, 1961
2,976,755	Fender	Mar. 28, 1961