Sept. 22, 1970 R. L. WHEELER ET AL 3,530,226

STRINGED GUITAR WITH ELECTRONIC ORGAN TONE GENERATORS ACTUATED WITH FINGERBOARD SWITCHES

Filed April 10, 1968

2 Sheets-Sheet 1

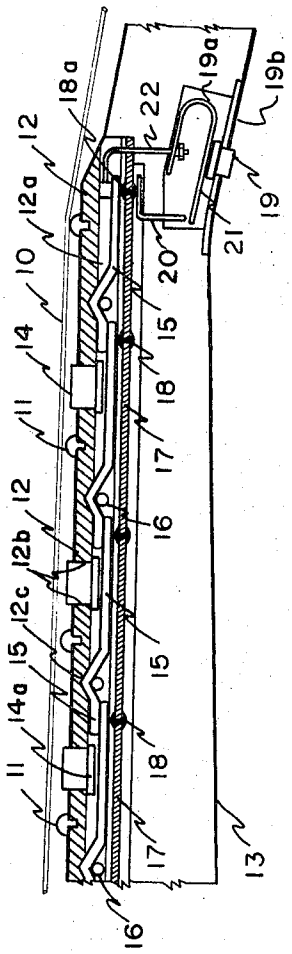


FIGURE 1

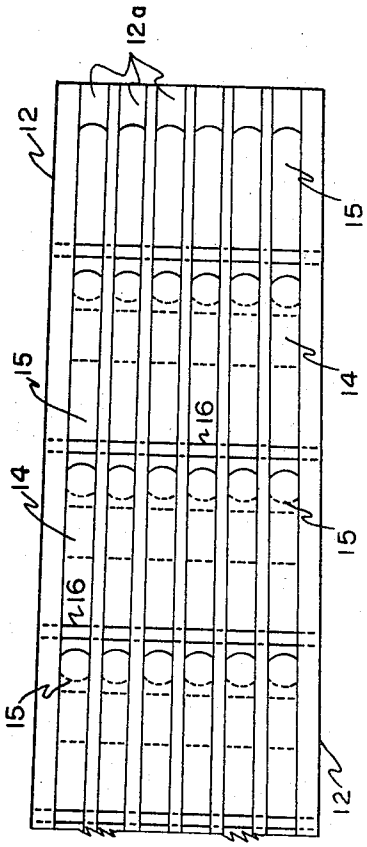


FIGURE 3

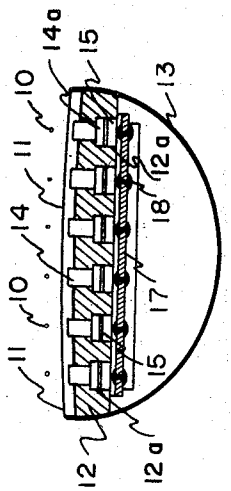


FIGURE 2

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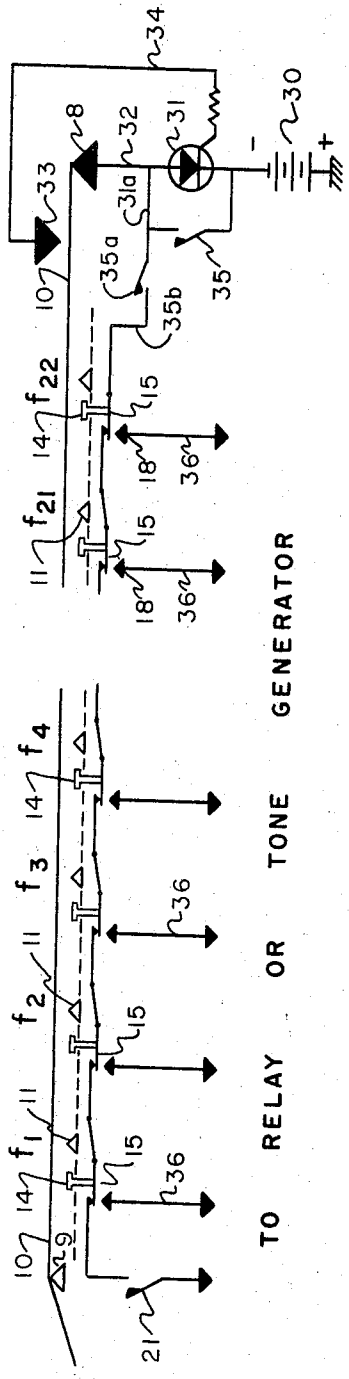


FIGURE 4

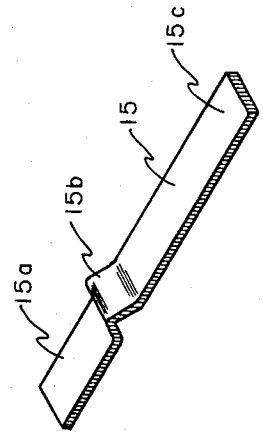


FIGURE 6

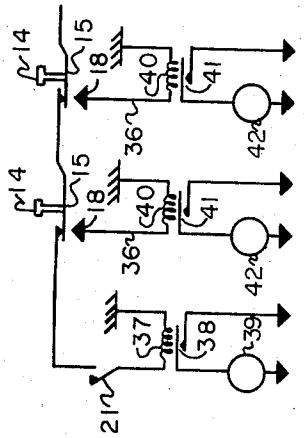


FIGURE 5

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STRINGED GUITAR WITH ELECTRONIC ORGAN TONE GENERATORS ACTUATED WITH FINGERBOARD SWITCHES

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U.S. Cl. 84—1.16 10 Claims

ABSTRACT OF THE DISCLOSURE

A stringed guitar with electronic organ tone generators selectively actuated with fingerboard switches and including a silicon controlled rectifier between strings and a battery. The fingerboard supports spaced divided frets against which the strings may be engaged by finger pressure in the normal manner. The under side of the fingerboard is grooved to provide a groove beneath each string. Switch blades are supported in overlapping relation in each groove, the blades being held in place by transversely extending retaining pins. A push button is supported above each switch blade. When the string is pressed against a fret, the corresponding push button is depressed. The switch blades are normally in contact, and current is supplied to each row of switch blades. A circuit board is positioned below the finger board and includes contacts connected to corresponding tone generators. When a push button is depressed the corresponding blade is flexed out of engagement with the next adjacent switch blade and into engagement with a tone generator contact.

This invention relates to an improvement in electronic guitar or similar instrument, and deals particularly with a string instrument which may be connected to a series of tone generators capable of producing tones like or unlike the tone produced by the instrument itself. In other words, the tones produced may be similar to those produced by an electronic organ or other such instrument.

Various types of devices have been produced for electric amplifiers for amplifying the tones produced by the playing of a string instrument such as a guitar. In some instances, the fingering of the strings of the instrument has served to actuate tone generators of one type or another to produce a tone which may be quite dissimilar to that produced by the instrument itself. One of the obstacles to the production of instruments of the type described lies in the high cost of production. Instruments produced for musicians who have established a reputation are not critical as to cost, as high cost of production has little effect upon the sales to a musician who is well known in a certain field. However, in order to make the instrument available to musicians who are less skilled, a low cost of production is an extremely important factor.

It is an object of the present invention to provide a stringed instrument including a finger board and cooperable circuit board which may be produced at an extremely low cost and which accordingly lends itself to the field of musicians of ordinary means. The finger board and circuit board may be used in place of the fretted board usually provided on such instruments and may be produced and sold for a cost much less than the cost of comparable electronic instruments capable of accomplishing somewhat similar results.

A feature of the present invention resides in the provision of a stringed instrument having a finger board positioned beneath the spaced strings of the instrument, this finger board being provided with transversely extending frets against which the strings may be urged by the fingers to produce a tone of a desired frequency upon vibration of the string. In playing an instrument of the type in question, the string is usually pressed inwardly rearwardly of one of the frets so as to provide contact between the string and the fret. This operation changes the effective length of the string and accordingly changes the frequency of vibration thereof. In the present arrangement, a switch plunger is provided adjacent to each fret, and which may be automatically depressed by the operation of forcing the string against the fret.

In preferred form, the finger board comprises a panel having the frets projecting from the upper or outer surface thereof. The undersurface of the finger board is longitudinally grooved, the grooves extending parallel to, and inwardly of, the strings of the instrument. In other words, instruments having six strings, such as a guitar, have been provided with a finger board having on its under surface six grooves which are arranged immediately below the strings. Resilient switch arms are provided in these grooves, the switch arms all being similar. Each switch arm includes an end portion which is held in fixed engagement with the base of the groove in which it is located, and a free end which over-laps the secured end of the next adjacent switch arm. The over-lapping ends of the arms are normally in contact. A switch plunger over-lies each switch arm, the plungers under-lying the various strings. Depressing the string between the frets of the instrument acts to depress a corresponding switch plunger. Movement of the plunger acts to flex the underlying spring switch arm out of engagement with the adjoining arm, therefor breaking the circuit to the switch arms underlying frets of lower frequency. Beneath the finger board is provided a circuit board which preferably includes a printed circuit. When a predetermined switch arm is flexed out of engagement with the anchored end of the next adjacent switch arm, it is flexed into engagement with the contact on the circuit board. The circuit board contacts are connected to tone generators usually corresponding to the frequency of the tone being played on the string. As a result, when the string of the instrument is plucked, a circuit is closed to a corresponding tone generator. At the same time, the circuit is broken to switches of lesser frequency in the same row so that only the tone of highest frequency will be played on any one string.

A feature of the present invention resides in the provision of a device of the type described which may be produced at a very low cost. The six stringed instrument may be provided with more than twenty frets, and quite obviously requires a very considerable number of switches, as one switch is required for each fret of each string. In the present arrangement, grooves are provided on the undersurface of the finger board, these grooves being depressed sufficiently to freely accommodate the spring switch arms. The springs are bent so that one end of each spring is anchored against the base of the groove in which it is located. Each spring is kinked to accommodate a retaining pin which holds the anchored end of each switch arm against the base of the groove. The other and longer end of each switch arm extends into overlapping relation with the anchored end of the next adjacent switch arm. The switch operating plunger over-lies the longer end of each switch arm and operates, when depressed, to disengage the longer end of the switch arm from the anchored end of the next adjacent switch arm, and to form contact with a suitable terminal on the circuit board under-lying the finger board.

With this arrangement, the six switch arms which underlie each fret may be inserted in their respective grooves, and a retaining pin may be inserted to hold all six switch arms in place. Six more switch arms are then inserted in the grooves in over-lapping relation with the anchored

ends of the previously inserted switch arms. A second retaining pin is inserted to anchor the second series of switch arms in place. This operation is continued until all of the switch arms are in place. As a result, the entire assembly of the finger board may be accomplished in a short period of time, and as a result the cost of production is low.

A further feature of the present invention resides in the fact that a manually operable switch is connected to the circuit board terminal beneath the switch arm representing the lowest frequency of the string, or frequency of the open string. This switch is manually operable when the open string tone of the string is desired.

These and other objects and novel features of the present invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of the specification:

FIG. 1 is a longitudinal sectional view through a portion of the neck of a stringed instrument, showing the general arrangement of certain of the switches therein.

FIG. 2 is a transverse section through the neck of the instrument and through a series of switches, the switch operating plungers being indicated beneath the strings of the instrument.

FIG. 3 is a bottom plan view of the finger board, showing the grooves therein and showing the spring switch arms anchored in position in these grooves.

FIG. 4 is a wiring diagram showing in general the arrangement of the circuit leading to the tone generators.

FIG. 5 illustrates a portion of the circuit shown in FIG. 4, showing relays arranged in the circuits to the various tone generators.

FIG. 6 is a perspective view of one of the switches used in conjunction with the structure illustrated.

In general, the device comprises a guitar-like instrument which is illustrated as having six strings, but which may have more or less. In view of the fact that instruments of this type are well known in the art, the instrument is illustrated diagrammatically in the drawings. The strings are indicated in general by the numeral **10**, and are diagrammatically illustrated in FIG. 4 of the drawings as extending from a bridge segment **8** to a lower-more open string fret or nut **9**, the bridge and nut being near opposite ends of the instrument neck **13**. As is usual in structures of this type, frets **11** are provided extending transversely of the neck, these frets being engageable with the strings to produce a tone depending upon the position of a finger pressing against the string and forcing the same against the predetermined fret.

In the present arrangement, the finger board **12** of plastic or other material over-lies the neck **13** of the instrument and provides a mounting for the various frets **11**. Behind each fret is provided an aperture **12***b* in which is slidably supported a push button or switch plunger **14**. Each push-button **14** is provided with a peripheral flange **14***a* at its inner end to limit the outward movement of the push button. The push buttons are preferably formed of material which is a non-conductor of electricity.

One of the important features of the present invention resides in the particular manner in which the instrument is made, this construction contributing very materially to the low cost at which the instrument may be produced. The under surface of the finger board **12** is provided with a series of longitudinally extending grooves **12***a* which underlie the strings **10**. In other words, a groove **12***a* is centered immediately beneath each string **10**, and the finger board comprises merely the elongated member having the frets **11** extending across its upper surface, and the grooves **12***a* extending longitudinally of its under surface. The finger board **12** also supports the push buttons or switch plungers **14** which are aligned with the strings **10**, and which are located between each adjacent pair of frets **11**.

The grooves **12***a* each support a series of overlapping switch arms **15** which are all of similar construction. As

indicated in FIG. 6, each of the switch arms **15** includes a bearing portion **15***a* designed to engage the base of a corresponding groove **12***a*, an upwardly arched intermediate portion **15***b* which is designed to extend into a corresponding transverse groove **12***c* on the undersurface of the finger board, and an elongated contact arm **15***c* which under lies the bearing portion **15***a* of an adjoining contact and is resiliently urged into contact therewith. The various contacts **15** are held in place by a series of transversely extending pins **16** which are of plastic or other insulating material so as to prevent electrical contact between the laterally spaced switch arms **15** in the spaced grooves **12***a*. The elongated contact end **15***c* of each switch arm underlies one of the switch plungers or push buttons **14** so that pressure on the push button will flex the switch arm out of electrical connection with the next adjacent switch arm in the same row. It should be mentioned that the size and thickness of the contacts **15** is materially exaggerated in the drawings, as the contacts are actually formed of thin metal of high electrical conductivity which may or may not be provided with the precious metal contact points so as to insure good electrical conductivity throughout the entire row of contacts located in each groove **12***a* when the device is in operation.

The simplicity of the structure and the ease with which it may be assembled is of importance. With the finger board in inverted position and the grooves **12***a* uppermost, a series of push buttons or switch plungers **14** are dropped into a row of transversely aligned apertures **12***b* between a pair of spaced frets **11**. A series of spring arms **15** are dropped into the spaced grooves **12***a* with the arched intermediate portions **15***b* thereof extending into the corresponding transverse groove **12***c* at the base of the grooves. A pin **16** is inserted to intersect the grooves **12***a*, and to hold switch arms **15** in place in each of the grooves. A second row of push buttons **14** is inserted in the next series of apertures **12***b*, a second series of spring fingers **15** are positioned in the side by side grooves **12***a*, and a second retaining pin **16** is inserted to hold the second row of contacts in proper position. This operation is merely continued until all of the push buttons **14** and springs **15** are in place.

A circuit board **17** is positioned beneath the finger board **12**, and is sandwiched between the finger board and the instrument neck **13**. The circuit board is not shown in detail, but preferably includes a printed circuit including contacts **18** positioned beneath the flexible ends **15***c* of the switch arms **15**. When any of the push buttons **14** are depressed, they flex the corresponding end **15***c* of a switch arm **15** out of contact with the anchored end **15***a* of the next adjacent switch arm **15** and engage a corresponding contact **18** on the circuit board **17**. Each circuit board contact **18** is connected to a corresponding tone generator or to a relay controlling corresponding tone generator.

As the push buttons **14** are located between the frets, there is no push button **14** for controlling the open string tone of the instrument. The corresponding contact **18***a* on the circuit board **17** is connected to a tone generator designed to produce a tone of similar frequency to the open string tone. An open string push button **19** is slidably supported on the instrument neck **13**. An angular contact arm **20** extends from the contact **18***a* into a recess **19***a* in a convenient part of the neck which is normally closed by a cover plate **19***b* through which the push button **19** extends. A curved switch arm **21** is connected by a conductor **22** to the last switch arm **15** of each row. By depressing the push button **19**, the spring arm **21** is engaged with the contact **20** closing the circuit to the open string tone generator.

As indicated in FIG. 4 of the drawings, a voltage source **30** of suitable voltage has its negative terminal connected to the cathode of a silicon controlled rectifier **31**. The rectifier **31** is connected by a conductor **32** to a metal bridge segment **8** and to the metal string **10**. As

previously stated, the string **10** is stretched between the bridge segment **8** and the open string fret or nut **9** near the opposite end of the instrument neck.

An electrically conductive pick **33** is connected by a conductor **34** to the gate of the rectifier **31**. As a result, when a circuit to any of the tone generators controlled by the string is closed, and when the pick **33** momentarily engages the string **10**, current will flow through the rectifier to a conductor **31***a* leading to a single string control switch **35***a*. When the switch **35***a* is closed, a current may flow through a conductor **35***b* to the row of overlapping switch arms **15** in one of the grooves **12***a* controlled by the push buttons **14**. When a push button is depressed, a corresponding switch arm **15** is flexed into engagement with a corresponding circuit board contact **18** each of which is connected by a suitable conductor such as **36** to a corresponding tone generator.

A switch **35** is arranged in shunt relation to the rectifier **31**. When the switch **35** is closed, the actuation of the push buttons **14** will energize a corresponding tone generator without the sound first being initiated by the action of plucking the string by the pick **33**. The open string tone may be produced by closing the switch **21** and plucking the string by the pick **33**.

FIG. 5 of the drawings indicates the open string switch **21** as energizing a relay coil **37** operable, when actuated, to close contacts **38** closing a circuit to the tone generator **39** to produce a tone of the same frequency as the open string. The depressing of any of the push buttons **14** acts to flex the corresponding switch arm **15** out of contact with the next adjacent switch arm and into engagement with a corresponding circuit board contact **18**. This contact is either directly connected to a corresponding tone generator **42**, or to a relay coil **40** capable of actuating relay contacts **41** closing a circuit from an independent current supply to the tone generator **42**. The use of independent relays as shown in FIG. 5 serves mainly to provide a different source of current to the tone generators from that used in the push button circuits described.

In accordance with the patent statutes, we have described the principles of construction and operation of our improvement in electric guitar or similar instrument, and while we have endeavored to set forth the best embodiment thereof, we desire to have it understood that changes may be made within the scope of the following claims without departing from the spirit of our invention.

We claim:

1. A musical instrument including:
- an instrument neck,
- a bridge at one end of said neck and an open string fret at the other end thereof,
- a finger board overlying said neck and including a series of spaced intermediate frets mounted thereupon,
- a plurality of strings extending between said bridge and said open string fret and engageable with said intermediate frets upon the presence of finger pressure between said frets,
- switch plungers beneath each string between each pair of adjacent frets,
- a series of switches supported by said finger board beneath said plungers,
- a circuit board adjoining said finger board and including a series of contacts,
- tone generators secured to said contacts to produce a tone of a predetermined frequency,

- each of said switches being operable upon energization of a corresponding switch plunger to flex the switch into engagement with said circuit board to energize one of said tone generators.

2. The structure of claim **1** and in which said switches comprise normally overlapping flexible arms.

3. The structure of claim **1** and including a series of grooves underlying said strings and in which said switches are located.

4. The structure of claim **3** and in which said switches comprise electrically conductive arms flexibly supported in said grooves.

5. A musical instrument including:
- a finger board,
- a series of spaced intermediate frets on said finger board and an open string fret, at the other end thereof,
- a series of strings extending from said bridge to said open string fret,
- a series of push buttons slidably supported by said finger board intermediate said frets,
- a series of grooves in the under surface of said finger board underlying the strings,
- a series of switch arms in said grooves,
- said switch arms including an anchoring end and an elongated flexing end, and an arched intermediate portion between said ends,
- pins intersecting said grooves and engaging in the arched intermediate portions of a plurality of switch arms positioned in said grooves,
- a circuit board beneath said finger board and including contacts underlying the elongated flexing end of each of said switch arms and normally spaced therefrom,
- said flexing ends of said switch arms being operable when flexed by depression of a corresponding push button to engage a corresponding contact on said circuit board.

6. The structure of claim **5** and including tone generators secured to said contacts on said circuit board.

7. The structure of claim **5** and including a current supply source connected to the switch arm underlying the fret nearest to said bridge, and including tone generators connected to said circuit board contacts.

8. The structure of claim **7** and including a switch controlling the current supply source to each series of switch arms in one of said grooves.

9. The structure of claim **5** and including a current supply source to the switch arms in each of said grooves, a tone generator connected to each of said circuit board contacts and to said open fret, and a normally open switch controlling the flow of current to said tone generator connected to said open string fret.

10. The structure of claim **5** and in which the flexing ends of said switch arms operate when flexed to open connection with the next adjacent switch arm in the corresponding groove.

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