

Sept. 22, 1970

STRINGED GUITAR WITH ELECTRONIC ORGAN TONE GENERATORS
ACTUATED WITH FINGERBOARD SWITCHES
OR FRETS AND CONDUCTIVE PICK

3,530,227

Filed April 10, 1968

3 Sheets-Sheet 1

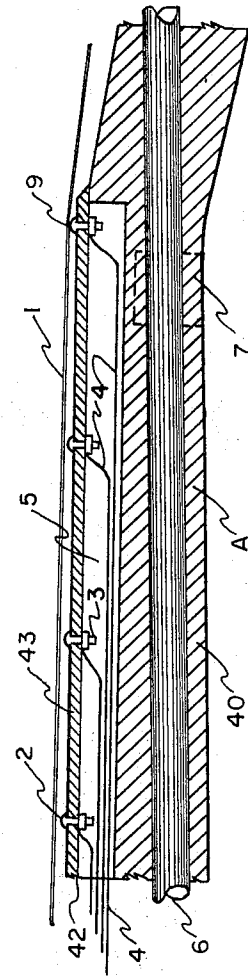


FIGURE 2

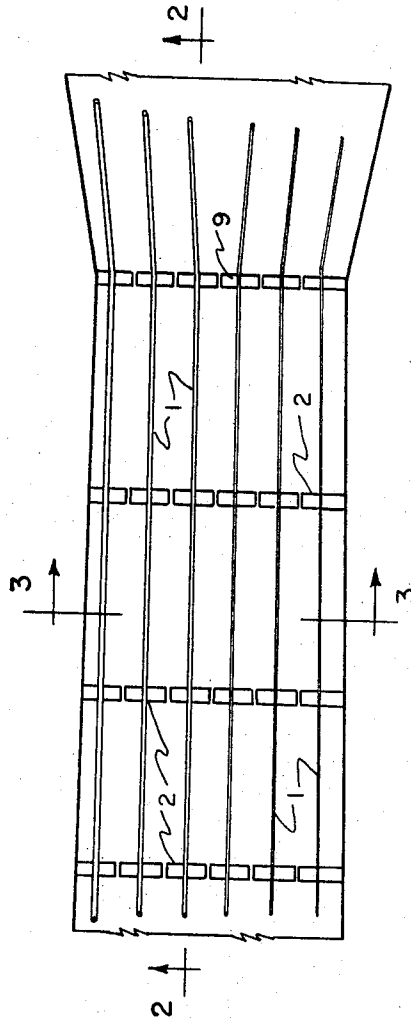


FIGURE 1

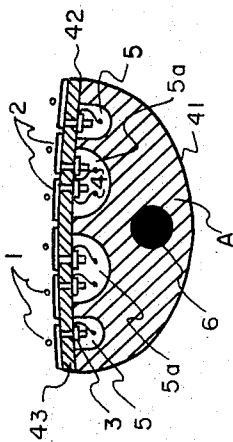


FIGURE 3

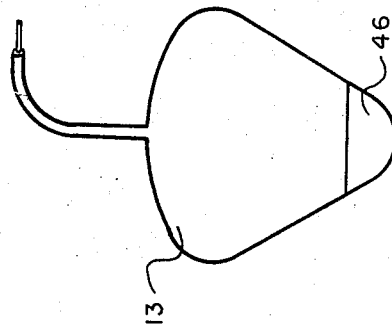


FIGURE 8

INVENTOR
Richard L. Wheeler
Donald J. Terlinde
BY Robert M. Fanning
ATTORNEY

Sept. 22, 1970

R. L. WHEELER ET AL
STRINGED GUITAR WITH ELECTRONIC ORGAN TONE GENERATORS
ACTUATED WITH FINGERBOARD SWITCHES
OR FRETS AND CONDUCTIVE PICK

3,530,227

Filed April 10, 1968

3 Sheets-Sheet 2

FIGURE 4

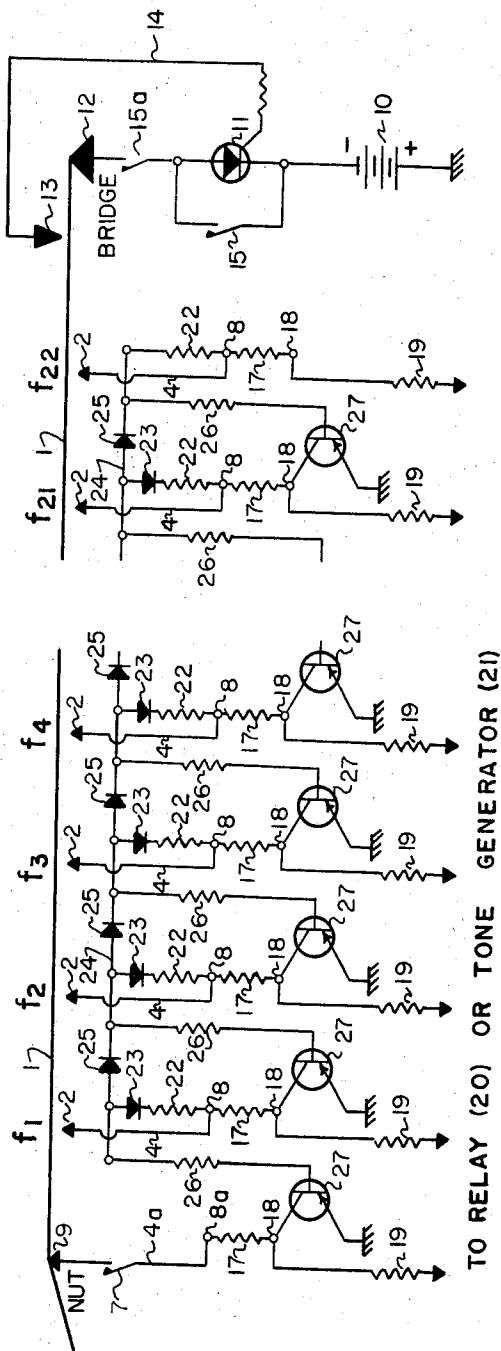
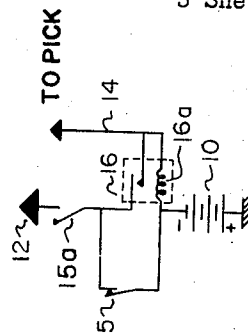


FIGURE 4-A

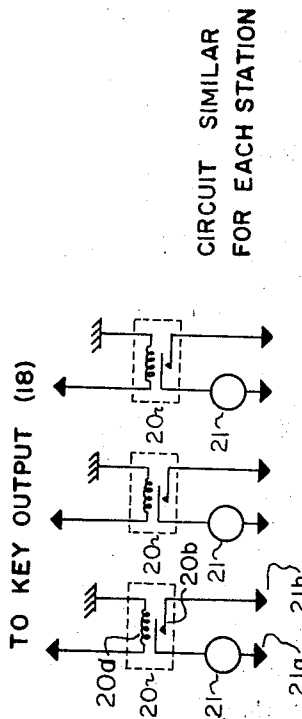


FIGURE 5

INVENTOR

Richard L. Wheeler

Donald J. Terlinde

BY

Robert M. Dunning

ATTORNEY

Sept. 22, 1970

R. L. WHEELER ET AL
 STRINGED GUITAR WITH ELECTRONIC ORGAN TONE GENERATORS
 ACTUATED WITH FINGERBOARD SWITCHES
 OR FRETTS AND CONDUCTIVE PICK

3,530,227

Filed April 10, 1968

3 Sheets-Sheet 3

FIGURE 6

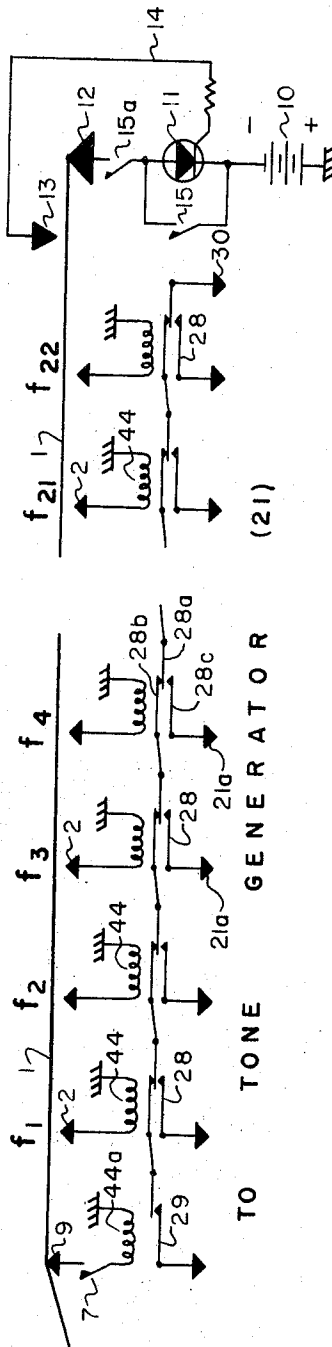
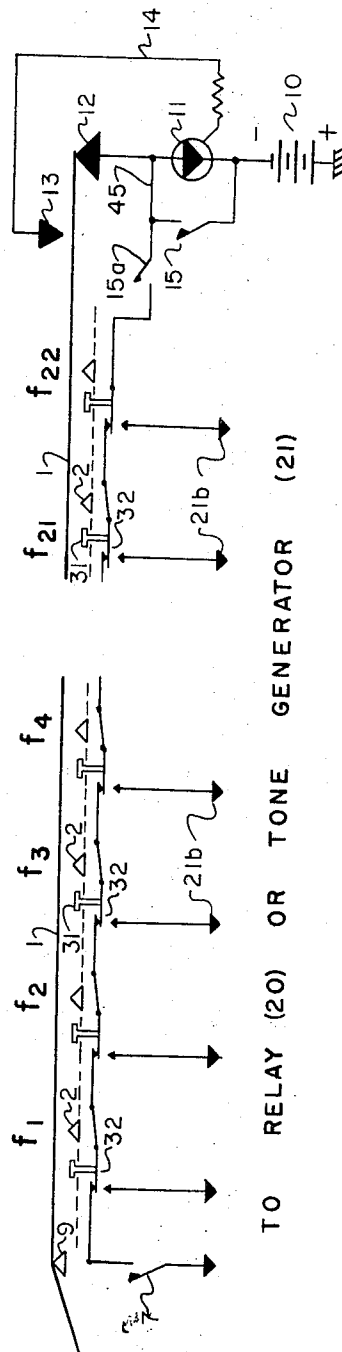


FIGURE 7



INVENTOR

Richard L. Wheeler
 Donald J. Terlinde

BY

Robert M. Dunning

ATTORNEY

1

3,530,227

STRINGED GUITAR WITH ELECTRONIC ORGAN TONE GENERATORS ACTUATED WITH FINGER-BOARD SWITCHES OR FRETS AND CONDUCTIVE PICK

Richard L. Wheeler and Donald J. Terliade, St. Paul, Minn., assignors to General Music Incorporated, St. Paul, Minn., a corporation of Minnesota

Filed Apr. 10, 1968, Ser. No. 720,154

Int. Cl. G10d 3/08; G10h 3/02, 5/04

U.S. Cl. 84-1.16

14 Claims

ABSTRACT OF THE DISCLOSURE

A guitar-organ instrument of guitar-like form includes an instrument neck over which metal strings are stretched. Frets are provided beneath each string. A tone generator is provided for each fret of each string. A switch is provided for each fret of each string. Closing of any switch closes a potential circuit comprising a transistor or relay keying circuit to a corresponding tone generator. The potential circuit is held open by an SCR or relay in a conductive pick circuit pending engagement of the string with a conductive pick which closes the potential circuit. Only the highest note played on any one string will activate a tone generator. A string switch is provided for each string to permit disabling of the string relative to the tone generators.

This invention relates to an improvement in electric guitar organ, and deals particularly with a stringed instrument connected to a tone generator so that when the metal strings are engaged by an electrically conductive pick connected to a source of electrical current, tones simulating those produced by an electronic organ may be generated.

Many types of stringed instruments have been produced in which the tone produced by the instrument is electronically amplified. In some instances the frets of the instrument have been connected to electronic tone generators which produce a different type or quality of sound when a certain note is played. The present device is an instrument of this general class in which the signal to the tone generator is initiated by engagement of an electrically conductive pick with a metal string of the instrument.

An object of the present invention resides in the provision of a stringed instrument including a plurality of metal strings, and including a series of divided frets underlying the strings, the frets being so divided that the current from one string will not be transferred to another. An electrically conductive pick is provided which is connected to a current supply source and which is operable, upon engagement with a string of the instrument, to close a circuit to a tone generator. The particular tone generator which is actuated depends upon the position of a finger of the musician upon the string. Once the string has been contacted by the pick to generate a tone, the circuit to the tone generator will remain closed until the circuit is broken by the release of pressure against the string.

In one form of the construction, the fret which is engaged by the string acts as a contact to close the circuit through the string and the fret engaged by the string to the tone generator connected to that fret. In another form of the invention, switch plungers located between the frets are actuated by finger pressure upon the string to close a corresponding switch which, in turn, closes a circuit to the predetermined tone generator. In either event, when finger pressure is applied between or upon a

2

fret, a circuit is closed to a tone generator corresponding to the note which would be played upon the stringed instrument, and the corresponding note will be generated by the tone generator. In mentioning the corresponding note, it will be understood that the tone generator may generate a tone which is one or more octaves above or below the frequency of the note actually being played on the instrument.

A further feature of the present invention resides in the provision of a means of maintaining the circuit to the tone generator once the tone has been initiated by contact between the pick and the string, as long as finger contact is provided maintaining the circuit to the tone generator. In other words, the pick may engage a certain string momentarily to initiate a circuit tone, the tone being determined by the position of the finger pressing the string against a fret. Once the tone has been initiated, it will remain sounding until the finger pressure against the string has been released. At this time, the circuit will be broken and the tone will be discontinued.

A further feature of the present invention resides in the provision of a device of the type described in which each string, in itself, is capable of generating a single tone regardless of the number of contacts between the string and the frets, or regardless of the number of switch plungers beneath the string that are simultaneously engaged. Means are provided to prevent more than one tone from being generated by finger pressure upon a single string. Only the highest note played on any one string will activate a tone generator. Obviously, harmonics may be generated by the tone generator but in any event only one tone generator is actuated by contact with a string, thereby permitting the stringed instrument to be played in the customary manner without producing false tones.

A feature of the present invention resides in the provision of a device of the type described including a means of closing a circuit to the nut at the end of the string when the tone corresponding to the natural frequency of the string is desired. A switch is mounted in the neck of the instrument in a position where it may be readily engaged by the thumb or finger of the hand, which is described as the open string switch. This switch may be closed when it is desired to produce a tone corresponding to the sound produced by picking the open string when not contacted by a finger of the hand.

A further feature of the present invention resides in the provision of a switch which is capable of controlling the circuit to each string of the instrument. By opening the circuits to certain of the strings and closing the circuit to others, an arrangement is provided whereby the sound developed by vibrating these certain strings may be the natural sound of the instrument which may, if desired, be amplified electronically. The sound from the strings which may be connected to the tone generators may simulate those of an organ or similar instrument. Thus the stringed instrument may produce a combination of natural or amplified natural tones produced by vibration of the strings, and also of tones generated by the tone generators connected to the strings, as 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 top plan view of a portion of the neck of a stringed instrument, showing a series of generally parallel strings overlying spaced and divided frets.

FIG. 2 is a longitudinally sectional view through a portion of the neck of the instrument, the position of the section being indicated by the line 2-2 of FIG. 1.

FIG. 3 is a transverse sectional view through the neck

3

of the instrument, the position of the section being indicated by the line 3—3 of FIG. 1.

FIG. 4 is a circuit diagram of the keying circuit for one string of the instrument showing semiconductors used for the keying circuit. A circuit of the type indicated in FIG. 4 is provided for each of the strings of the instrument.

FIG. 4A indicates a modified portion of the circuit shown in FIG. 4, this figure showing a relay in the pick circuit between the power source and the current supply to the strings.

FIG. 5 is a circuit diagram of the switching circuit for one string. One such circuit is required for each string in the event a relay is used between the keying circuit and the tone generator.

FIG. 6 is a circuit diagram showing the use of stringed-fret contact and magnetic relay for the keying circuit.

FIG. 7 is a circuit diagram showing the use of finger board switches and an electric-mechanical keying system.

FIG. 8 is a diagrammatic view showing a pick which may be used to pluck the instrument strings.

The drawings do not disclose the complete stringed instrument, as such instruments are well known in the art. For example, Pat. 3,116,357 issued Dec. 31, 1963, to L. Krebs discloses a complete musical instrument of the same general type as that for which the present circuit is used. In view of the fact that such instruments are well known, the instruments will be described in general by the letter A, and only the neck portion of the instrument is shown in the drawings.

The neck portion 40 of the instrument A is shown as having a rounded under surface 41, and a generally or somewhat flat convex upper surface 42. A strip 43 of insulating material is secured to overlie the neck portion 40 and to extend the length of the fretted portion of the neck.

The stringed instrument disclosed is provided with six metal strings, these strings being indicated by the numeral 1. The instrument neck 40 is provided in its upper surface with four generally parallel grooves, the two inner grooves 5a being somewhat wider than the outer pair of grooves 5. The inner grooves 5a each lie beneath two of the four central strings 1 of the instrument, while the grooves 5 lie beneath the outer two strings 1.

A neck tension rod 6 extends longitudinally of the neck 40 and acts to reinforce the same. The tension rod 6 lies between the bases of the grooves 5 and 5a and the curved under surface 41 of the neck.

The metal frets are indicated by the numeral 2 and underlie the strings 1. In place of having a continuous metallic fret extending transversely across the neck beneath all of the strings of the instrument, each fret is transversely divided to provide a separate fret portion underlying each string 1. With this arrangement, the portion of the fret 2 which underlies each string is electrically insulated from the portion of the fret which underlies the remaining strings.

As is indicated in FIG. 2 of the drawings, each fret 2 is secured to the insulation panel 43 by a fret terminal 3 which extends through the insulation panel 42 and is anchored thereto. A conductor 4 is connected to each fret of each string, and these conductors extend through the grooves 5 and 5a which extend longitudinally of the instrument neck. The manner in which these conductors function will be described in conjunction with the wiring diagram.

The instrument which is illustrated is provided with 22 frets for each string. For the purpose of illustration, FIG. 4 identifies the fret locations as f1, f2, and f3, and so forth. The fret locations from f5 to f20 have been omitted from this figure as they are similar to the frets illustrated in the circuit. Each string 1 extends over the metal bridge segment 12 near one end of the neck, and over the metal nut 9 near the opposite end of the neck. The first key input terminal 8a is connected by a conductor 4a to the nut 9, the conductor 4a including a switch 7 which may

4

be considered the open string switch and which is actuated when the natural frequency of the string is to be played. As is indicated in FIG. 2 of the drawings, this switch 7 is preferably located in the under surface of the neck A in a position where it may be actuated by pressure from the operator's thumb or fingers. The switch 7 is of the normally open type and is closed by the operator.

A direct current power supply 10 of optional voltage applies a negative potential to the cathode of a silicon controlled rectifier 11. When the entire circuit is closed, and the rectifier 11 is in its conducting condition, the circuit is completed from the power source 10 to the metal bridge segment 12 and to the metal string 1. When the open string tone is desired, the open string switch 7 is closed in the manner described. The nut 9 comprises a divided fret to prevent the current from one string from flowing to the next. As the frets 2 all function similarly in the circuit, the open string tone will be mainly eliminated from the following description. The circuit continues through one of the fret contacts 2 to a corresponding conductor 4 and a key input 8. The circuit is so arranged that contact between a string 1 and any of the fret contacts 2 will not generate a tone until the string is engaged by an electrically conductive pick 13 which is connected by a flexible conductor 14 to the gate of the rectifier 11. As soon as the pick 13 contacts the string 1, the rectifier gate is activated so that current will flow through the string, and will continue to flow as long as the string 1 is in contact with one of the fret contacts 2. When pressure against the string is released, the tone generator circuit is broken and will remain broken until the string 1 is again engaged with one of the fret contacts 2 and the string 1 is again engaged by the pick 13.

It will be noted that a manually operable switch 15 is arranged in shunt relation to the rectifier 11. When the switch 15 is closed, the tone may be generated by merely engaging the metal string 1 with the desired fret contact 2, (or closing the switch 7). It should be noted that a manually operable switch 15a may be provided in the circuit between the rectifier 11 and switch 15 and the bridge segment 2. When the switch 15a is opened, the particular string in question is completely disconnected from the current supply, and this string may be accordingly played and will produce natural instrument tones in the conventional manner. In view of the fact that the portion of the circuitry at each of the positions f1, to f22 is of substantially identical form, the component parts have been given similar identifying numbers.

Each fret 2 is connected by a conductor 4 to a key input 8. Applying a negative potential to the key input 8 causes a negative potential to be applied through a resistor 17 and through the key output 18 to load resistor 19 which leads either to magnetic switch 20 or directly to the tone generator 21. Under certain conditions a semi-conductor switch can be used as an alternate for the magnetic switch 20, but this is not shown in the drawings. The magnetic switch 20 permits a different voltage to be used in the tone generator from that in the keying circuit.

Except at the nut 9, the same negative potential at the key input 8 causes a negative potential to be applied through a resistor 22 and diode 23 to the negative feedback conductor 24. Diodes 25 are provided in the conductor 24 at each keying station to allow this negative potential to feed only to stations of lower pitch or toward the nut 9. This negative potential is thereby fed back to all of the lower stations through their respective feedback resistors 26 applying a negative charge to the base of their respective transistors 27. This negative charge switches each of these affected transistors 27 to the conducting condition, and they each act as a low resistance shunt between the key output 18 and ground, which prevents current flow in the corresponding load resistors 19 and the activation of the corresponding relay

5

switches or alternatively to the tone generators. It is this feedback and transistor shunt switch which allows only the highest fret string contact on each string to generate a tone.

As indicated in FIG. 5 of the drawings, each magnetic relay 20 includes a relay coil 20a which is energized by the flow of current from the key output 18 through the load resistor 19, acting to close a magnetic relay switch 20b. When the switch 20b is closed, a circuit to the tone generator 21 between the power terminals 21a, and 21b is closed.

FIG. 6 shows a modified arrangement in which the metal string is indicated by the numeral 1, the frets are indicated by the numeral 2, and the various fret positions f1 to f22 are shown. The string 1 is stretched between the bridge segment 12 and the nut 9 as in the previous arrangement. At each fret position we disclose a single pole double throw magnetic relay switch 28 which includes an armature 28a normally biased into contact with a terminal 28b and normally in spaced relation to a contact 28c connected to a tone generator such as 21 by a conductor 21a. The negative terminal of the power supply 10 is connected to the bridge segment 12 through the silicon controlled rectifier 11. A shunt switch 15 may be closed to by-pass the rectifier 11, and an individual line switch 15a may be provided to open the circuit to any individual string when it is desired to connect certain strings to the tone generators and to permit other strings to produce their normal tones.

A relay coil 44 has one terminal connected to each fret 2, and has its other terminal connected to the positive side of the power supply 10. A single pole single throw switch 29 is controlled by a relay coil 44a having one terminal connected to the nut 9 through the open string switch 7. The switch 29 is normally open and is closed by the closing of the switch 7.

The operation of the rectifier 11 is similar to that which has been previously described. The electrically conductive pick 13 is connected by the flexible connector 14 to the gate of the rectifier 11. As a result, when the pick 13 engages the string 1 while the string is in engagement with one of the frets 2, the rectifier permits the flow of current through the string and the bridge, energizing the coil 44 connected to the fret 2 which has been contacted by finger pressure upon the string. Energization of the coil 44 will open the circuit between the contact 28b and armature 28a. The movement of the armature 28a simultaneously closes the circuit to contact 28c, and current will flow through the corresponding conductor 21a to the corresponding tone generator.

It is characteristic of the rectifier 11 that once the circuit through the rectifier is established by means of the pick 13, the current will continue to flow through the rectifier until the circuit is broken by releasing the pressure on the string to thereby open the circuit to the fret 2. Thus once the string has been contacted by the pick, the current will continue to flow until the circuit is broken at the fret contact.

FIG. 4A of the drawings shows a modified form of construction designed to take the place of the silicon controlled rectifier 11. In the arrangement illustrated in FIG. 4A, the negative terminal of the power source 10 is connected to the flexible conductor 14 leading to the pick 13 through a relay coil 16a. The relay 16 includes contacts which are closed by the energization of the coil 16a. Thus when a circuit is closed through the conductor 14 leading to the pick 13 by engagement of the pick with the string 1, the coil 16a is energized, closing the relay contacts leading to the bridge segment 12. This forms a holding circuit which remains closed as long as the string 1 is in engagement with one of the frets 2. In other words, this arrangement works in the same manner as the rectifier circuit previously described, the relay 16 maintaining a tone once it has been initiated

6

by engagement of the pick 13 with the string, the tone continuing until finger pressure is released from the string to disengage the string from the fret.

FIG. 7 discloses a modified form of construction which is virtually identical with the structure shown in FIGS. 1 to 5 with the exception of the fact that switch plungers are provided intermediate the frets, and in place of having the tone generators actuated by contact between the metal strings and the electrically conductive frets, the switch plungers mechanically operate to close the circuit to the tone generators. The switch plungers are immediately below the strings and are intermediate the frets, so that the pressure of a finger against the string automatically functions to press inwardly the switch plunger.

As in the previous constructions, the metal string 1 is diagrammatically illustrated as being stretched between the bridge segment 12 and the nut 9. The negative terminal of the power supply 10 is connected through the silicon rectifier 11 to the bridge segment 12 to supply negative current to the string. The current to the string serves only to close a circuit to the gate of the rectifier when the pick 13 strikes the string 1 so as to permit the flow of current. A conductor 45 leads from the rectifier through a series of mechanical single pole double throw switches 32, one of which is below each switch plunger 31, the plungers 31 being located between the frets 2. When there is no pressure against the string 1, the circuit from the conductor 45 extends through the normally closed contacts of the switches 32, all of which are connected in series from the normally closed contact of the last switch of the series. The circuit may be closed by actuation of the open string switch 7.

When any of the switch plungers 31 are depressed, the switches 32 form contact with conductors 21b leading to the tone generators. As is obvious from the circuit, only the highest note on the string will be played, as the actuation of any switch plunger 31 automatically breaks the circuit to lower frets on the same string, thereby preventing more than a single note to be played on any one string regardless of the number of plungers depressed.

Both the construction illustrated in FIG. 6 and the circuit illustrated in FIG. 7 include a manually operable switch 15 which is in shunt relation with the rectifier 11. A similar switch 15 is shown in shunt relation to the contact of the relay 16 in FIG. 4A. When closed, the switch 15 permits the string to function without engagement of the pick 13 with the string 1. Also, in each case, a switch 15a is provided for rendering any one string inoperable to activate the tone generator by breaking the circuit from the power source 10. In the arrangement illustrated in FIG. 7, the switch 15a is in the conductor 45 leading from the rectifier 11 to the switch 32 beneath the fret 22.

As is indicated in FIG. 8 of the drawings, another means may be provided for controlling the sound being emitted from the instrument. FIG. 8 indicates the pick 13 which is normally made of flexible material of high electrical conductivity and partially insulated. The pick 13 is shown as including a pointed extension 46 which is not insulated. The surface of the pick is coated with a flexible insulating material. By merely turning the pick and striking the string with the insulated portion thereof, the circuits initiated by the engagement of the pick with the string will not be closed, and the instrument will emit its normal sounds. By shifting the pick and contacting the strings with the uninsulated extension 46, the circuit to the gate of the rectifier 11 or to the coil of the relay 16 is closed in the manner which has been described.

In accordance with the Patent Statutes, I have described the principles of construction and operation of my improvement in electric guitar organ, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that changes may be made

within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. A guitar organ and the like including:
 - an instrument neck,
 - a metal bridge segment near one end of said neck and a metal nut at the other end of said neck,
 - a metal string stretched between said bridge and said neck and in contact therewith,
 - a series of frets arranged in spaced relation beneath said string along the length of said neck,
 - a source of voltage connected to said string,
 - means between said voltage source and said string normally blocking the flow of current to said string,
 - a tone generator means for each said fret,
 - means associated with each said fret and operated by finger pressure against the string to close a circuit to actuate said tone generating means corresponding to said fret,
 - a conductive pick,
 - means connecting said pick to said current blocking means and operable, upon contact with said string, to render said current blocking means inoperative and to close the circuit from said voltage source to said string when one of said means associated with one said fret is in circuit closing position, whereby engaging said pick with said string will close a circuit to a tone generator associated with said one fret.
2. The structure of claim 1 and in which said blocking means remains inoperative after the pick disengages the string as long as said means operated by finger pressure remains in circuit closing condition.
3. The structure of claim 1 and including means actuated by finger pressure against said finger pressure operated means for preventing the flow of current from said string to any tone generator associated with a fret associated with a tone generator of lower frequency.
4. The structure of claim 1 and including a tone generator connected to said nut, and a manual switch operable to open and close a circuit from said string to said last named tone generator when an open string is desired.
5. A guitar organ and the like including:
 - an instrument neck,
 - a metal bridge segment at one end of said neck and a metal nut at the other end thereof,
 - a metal string stretched between said bridge segment and said nut and in contact therewith,
 - a source of voltage connected to said string,
 - means in series with said source of voltage normally blocking the flow of current to said string,
 - a series of electrically conductive frets on said neck beneath said string and with which said string is engageable upon finger pressure against said string,
 - a tone generator for each fret and actuated by contact of said string with a corresponding fret when current is flowing to said string,
 - an electrically conductive pick,
 - means connecting said pick with said current flow blocking means and operable, upon contact with said string, to render said current flow blocking means inoperative, whereby current may flow to said string and actuate a tone generator corresponding to a fret engaged by said string.
6. The structure of claim 5 and in which said current flow blocking means includes circuit maintaining means holding the circuit to the string closed as long as said string remains engaged with one of said frets.

7. The structure of claim 5 and including a tone generator associated with said nut and including a manual switch controlling the circuit to said last mentioned tone generator.

8. The structure of claim 5 and including a plurality of separate similar strings overlying said neck, and including a manual switch controlling the flow of current to each said string.

9. The structure of claim 5 and including current means connecting said tone generators and including means operable by current flow to the tone generator of any frequency to prevent the closing of any circuit to a tone generator of lower frequency.

10. A guitar organ including:

- a neck,
- a plurality of strings overlying said neck,
- a bridge segment and a nut at opposite ends of said neck beneath each said string,
- a series of spaced conductive frets beneath each of said strings,
- a tone generator connected to each said fret,
- a source of current supply to said strings operable, when one of said strings is engaged with one of said frets, to actuate a corresponding tone generator,
- means connecting said tone generators including means for directing a flow of current actuating one tone generator to flow only toward tone generators of lower frequency, and
- means connected to the input of each tone generator to prevent the tone generators of lower frequency from operation.

11. An electronic musical instrument comprising, a plucked string instrument, a separate row of switches for each of the string positions of said instrument, a tone generator for each of said switches, means responsive selectively to actuation of only the switch of highest frequency for each of said rows for actuating the tone generator of this switch, a string switch for each of said rows, each string switch when inactuated disabling its row and when actuated enabling one switch of each row to control the frequency of the tone generated by actuating the tone generator of highest frequency as determined by said row of switches to the exclusion of any other switch of its row, said rows of switches being located on said instrument for operation by fingering the strings on said instrument by one hand of a player and said string switches being located beneath the strings of said instrument.

12. The structure of claim 11 and in which said string switch when unactuated, permits the corresponding string, when plucked, to produce its normal tone.

13. The structure of claim 1 and in which said means associated with each fret includes a relay.

14. The structure of claim 5 and including a relay actuated by contact of said string with a corresponding fret by said current flowing through said string, said relay actuating said tone generator.

References Cited

UNITED STATES PATENTS

3,116,357	12/1963	Krebs	84-1.16
3,217,079	11/1965	Murrell	84-1.16
3,388,206	6/1968	Sines	84-1.16
3,465,086	9/1969	Borell	84-1.16

WARREN E. RAY, Primary Examiner