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Description

This invention relates to electronic stringed musical instruments and more specifically, to the use of resistance wires as strings which control the frequency of electronically generated sounds in such instruments.

A variety of techniques are known for controlling the sound effects of electronic musical instruments. US—A—3,624,584 describes an arrangement in which the resistance in a Wien-bridge oscillator in an electrical circuit associated with a musical instrument is variable and US—A—3,626,350 discloses a means to produce a portamento chord by utilizing this principle.

US—A—3,948,137 discloses an arrangement which allows the player of an instrument utilizing a voltage controlled oscillator to control sound effects by providing wave form, filter and gain controls.

US—A—4,235,141 discloses an instrument wherein an apertured insulating strip is inserted between an electrically conducting strip and a resistive strip to allow only contact points at predetermined locations, thereby producing a tone at discrete selected values of frequency.

Electrically synthesized music is becoming an increasingly popular art form and substantial technological advances have been made in this field. In the past, however, most of these advances could only be utilized in a keyboard type instrument and have not been available for musicians skilled primarily in the playing of stringed instruments.

One attempt to provide a voltage controlled electronic stringed instrument is described in US—A—4,038,897. As described a guitar or other fretted instrument may be used to produce input signals for a voltage-controlled tone generator. Alternatively, the guitar may be used in the conventional fashion, the instrument being switchable between these two forms. Each string-fret pair has an assigned musical tone. Voltages analogous to said tones are applied to the frets and such voltage is applied to the strings when the strings are moved to contact the frets.

Such a system has several major limitations. Firstly, the system is limited to fretted stringed instruments. Additionally, complicated wiring of resistors to each fret is required in order to provide each fret with the desired voltage value. Finally, providing the voltage to electrically conducting frets appears to foreclose the possibility of playing chords without fret segmentation.

US—A—3742114 discloses a guitar-like stringed instrument which has electrically conductive strings suspended over a fingerboard the surface of which is provided by elongate strips of electrically resistive material, a respective said strip being provided for each string. When a string is depressed to contact the respective resistive strip at a selected point, the portion of the strip between one end thereof and the point of contact forms a resistance connected in an electronic tone generating circuit, whereby a tone corresponding to the point of depression is produced.

However, the arrangement of US—A—3742114 presents various disadvantages. Thus, for example because the resistances defined by the portions of the resistive strips "tapped off" by the conductive strings are incorporated in the actual oscillator or tone generator circuits, it is necessary, for reasons which will be clear to those skilled in the art, for the resistances of the resistance strips to be relatively high for the instrument to be practicable, and this renders the tuning of the instrument sensitive to surface contamination of the resistive strips, for example by contamination with perspiration from the musician's fingers. Furthermore, the need to provide high values of resistance implies the use of either very thin metal conductors or deposits or of non-metallic resistive materials, with the result, in either case, that the resistance strips are relatively fragile. Furthermore, deterioration or modification of the resistive properties of the resistance strips for any of the above reasons can be rectified only by replacement of the resistance strips, which constitutes a major repair operation.

It is an object of the present invention to provide a stringed electronic instrument in which the above disadvantages can be avoided, and which provides for effective frequency control in either fretted or unfretted string instruments and a means for playing chords whether or not frets are desired.

According to one aspect of the invention, there is provided an electronic musical instrument comprising a body, a fingerboard attached to said body and having an upper surface, a plurality of strings arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said upper surface of the fingerboard is electrically conductive and each said string is electrically resistive and is connected in a respective first electrical circuit with said fingerboard, which first electrical circuit forms part of the respective tone-determining circuit and is so devised as to provide an output voltage dependent on the resistance of the free length of the respective string, each said first electrical circuit being in turn connected with a respective voltage to frequency conversion means, forming a further part of the respective tone-determining circuit, and which serves to convert the respective said output voltage into an electrical signal of a frequency dependent on said voltage, the instrument

including transducer means for receiving said frequency signals and for producing sounds of corresponding pitch, whereby displacing a string to contact said conductive surface at differing points along the length of a string varies said resistance in the corresponding said first circuit to produce, via the respective said voltage to frequency conversion means, and the respective said transducer means, sounds of various pitches.

According to a further aspect of the invention there is provided an electronic musical instrument comprising a body, a fingerboard attached to said body and having an upper surface, a plurality of spaced strings arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said upper surface of the fingerboard includes electrically conductive frets upstanding from the remainder of the fingerboard and each said string is electrically resistive and is connected in a respective first electrical circuit with said frets, which first electrical circuit forms part of the respective tone-determining circuit and is so devised as to provide an output voltage dependent on the resistance of the free length of the respective string, each said first electrical circuit being in turn connected with a respective voltage to frequency conversion means, forming a further part of the respective tone-determining circuit, and which serves to convert the respective said output voltage into an electrical signal of a frequency dependent on said voltage, the instrument including transducer means for receiving said frequency signals and for producing sounds of corresponding pitch, whereby displacing a string to contact different said conductive frets at differing points along the length of a string varies said resistance in the corresponding said first circuit to produce, via the respective said voltage to frequency conversion means, and the respective said transducer means, sounds of various pitches.

According to a yet further aspect of the invention, there is provided an electronic musical instrument comprising a body, a fingerboard attached to said body and having an upper surface, a plurality of strings arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said fingerboard has an electrically conducting upper surface, and in that each of said strings comprises a core, resistance wire insulated and generally tightly wound about and attached to said core, said insulation having been removed from an outer surface of said wound string, whereby displacing a string to contact said conductive surface at differing points along the string's length varies said resistance incorporated in said electrical tone-determining circuit thereby providing a means to variably control the circuit's output voltage, and means for converting said output voltage into a predetermined frequency.

According to a still further aspect of the invention, there is provided an electronic musical instrument comprising a body, a fingerboard attached to said body and having an upper surface, a plurality of strings arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said fingerboard has an upper surface which is electrically insulating apart from a plurality of spaced conducting frets extending across the fingerboard at desired points along its length, and in that each of said strings comprises a core, resistance wire insulated and generally tightly wound about and attached to said core, said insulation having been removed from an outer surface of said wound string, whereby displacing a string selectively to contact differing frets along the string's length varies said resistance incorporated in said electrical tone-determining circuit thereby providing a means to incrementally control the circuit's output voltage, and means for converting said output voltage into a predetermined frequency.

In preferred embodiments of the invention a variable voltage output that controls frequency is obtained by supplying a constant electrical current to each string, whereby depressing a string at various points along its length to contact the fingerboard or a respective fret thereon outputs a desired voltage. The output voltage depends upon the point along its length at which the string is shorted. The mode of shorting operation employed depends upon the type of stringed instrument. In a guitar or other fretted instrument the resistance strings can be shorted at any

selected frets to provide a means to incrementally control the voltage output of the instrument. In a violin or other non-fretted instrument the resistance strings can be shorted at any point to the electrically conductive upper surface of the fingerboard to providing a means to control voltage output over a continuous range.

Desirably, each string is provided with a separate current source but all strings are referenced to the same grounding point. The frets or, in the case of a non-fretted instrument, the entire conducting surface of the neck are also grounded. The non-grounded end of each string is connected to a current source. The voltage drop produced when each string is grounded is detected so that the strings do not interfere with each other at the frets and consequently, chords can be played.

In the past, most voltage-controlled electronic instruments employed Wien-bridge oscillators or similar circuits which required relatively high resistance values for the control element. The preferred embodiment of the present invention, however, utilizes voltage-to-frequency converter circuit which can be controlled by relatively low resistance values as the respective voltages can be amplified before conversion, making possible the use of low resistance wires as the control elements. Furthermore, the high stability of the resistance, the constant current sources, and the precision of commercial voltage-to-frequency converters will make this instrument of professional quality.

Preferably, means are provided for controlling the intensity and harmonic content of the signals produced. More specifically, suitable attenuators and filters that may be controlled by one of a player's hands while the other presses the strings to produce the desired frequency are provided. Wound resistance wire strings may be provided for low notes.

Conveniently, an internal power supply and speaker may be provided to make the instrument readily portable.

Desirably, a frequency counter is integrated into the instrument's electrical circuit to facilitate tuning.

It is further contemplated that combining the electrical and mechanical string-produced sounds may have potential for expanding the instrument's artistic possibilities.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, an embodiment of the invention will be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of one form of instrument of the invention including an electrically insulated fingerboard and conducting frets;

Figure 2 is a cross-sectional view of the fingerboard shown in Figure 1 taken through the line 2—2 of Figure 1;

Figure 3 is a schematic circuit diagram of a circuit to provide a suitable constant source for an instrument;

Figure 4 is a cross-sectional view of a portion of a wound resistance wire string; and

Figure 5 is a block diagram illustrating the various steps involved in converting changes in string resistance into frequency signals of desired quality characteristics.

As used herein, in the absence of a clear, express indication to the contrary, the terms "string" and "strings" refer to either straight or wound electrically conductive resistance wires and the terms "conducting" and "insulating" refer respectively to a material's capacity to conduct or to resist the conduction of an electrical current.

In summary, the present invention provides a stringed musical instrument capable of varying the input voltage to an electrical circuit which converts the voltage to a frequency to produce a responsive musical tone. The voltage (V) in the circuit is dependent upon two variables, current (I) and resistance (R) according to the relationship $V=IR$. It is preferred, but not required, to provide the instrument with a constant current source of power which results in a linear relationship between the voltage and resistance. The instrument's strings provide resistance elements in the circuit. By urging a string against a conducting surface at different points along the string's length the circuit's resistance and the resulting voltage change can be effectively controlled and varied.

Referring more specifically to Figures 1 and 2 (wherein, for clarity of illustration, the strings have not been shown), one embodiment of the present invention in the form of a guitar type fretted instrument 3 is shown. The instrument 3 has a body 6 having any convenient shape and preferably is made of a rigid, electrically insulating, material. One end of a neck 9 is secured to the body by conventional means. The neck 9 is also preferably an insulator but both the neck and body may be conductors if desired. A rigid insulating fingerboard 12 is attached to the neck 9. A hardboard or rigid plastics material would be a suitable material to construct the fingerboard 12. An insulating bridge 15 is also so secured to the body 6, as to provide a means to elevate the strings a slight distance above the fingerboard 12.

A plurality of conducting frets 16 are embedded across the fingerboard 12 at desired points along its length. The fret spacing may remain essentially the same as in regular guitars, and, as will be described further hereinafter, the current can be adjusted to correspond respective frets to the same notes as would be found in a conventional instrument. The frets 16 are preferably made from a hard conducting metal such as stainless steel. Embedded at the end of the fingerboard 12 farthest from the body 6 is a rigid conducting shorting bar 18 to support the strings a slight distance above the uppermost fret 16. The shorting bar 18 is electrically grounded.

The frets 16 are electrically connected to one another and to the electrically grounded shorting bar 18 by a conductive connecting wire 30, as shown in Figures 1 and 2. The frets 16 may be connected together and to the shorting bar 18 by

any other suitable means, such as by a conducting strip mounted under the insulating fingerboard 12 which contacts each of said frets 16 and the shorting bar 18.

The strings (not shown) are attached to the instrument by conventional means and, as mentioned, are supported above the frets at one end by the insulating bridge 15 and at the other end by the shorting bar 18. The strings are tuned mechanically by adjusting their tension using appropriate tuning keys 26 in the usual fashion. Electronic tuning of each string is accomplished by turning a potentiometer knob 27 suitably wired into the circuit by conventional means. A frequency counter 33 may also be integrated into the circuit to facilitate tuning.

A constant current power source and amplifier circuit 28 (also illustrated schematically in Figure 3) is connected to each string at or near the bridge 15 by any suitable means. It is preferable to make such connections at points 29 on the bridge 15 to avoid interference with the mechanical vibration of the strings. Points 29 may also serve as the input to an amplifier.

It is contemplated that an optional internal power supply 42 and speaker 45 could also be provided to make the instrument more portable.

Preferably, the resistance value of each string is maintained below 1000 ohms so that the changes in resistance due to finger contact do not play a perceptive role, unless such an effect is desired. Contacting a string to a chosen fret will complete an electrical circuit and create a desired voltage output which is then converted into a frequency signal by means well known in the art. Such voltage-to-frequency converters are now available as commercial integrated circuits.

It will be appreciated by those skilled in the art that by eliminating the frets and replacing or covering the insulating fingerboard with a sheet-like conducting fingerboard, a violin type non-fretted instrument will function essentially as described above. With this embodiment continuous variability of pitch can be achieved.

Means may also be provided for controlling the harmonic content and intensity of the signals produced. First, the pitch or fundamental frequency is selected by means of a particular string. Harmonic frequencies are then selected by color control registers 39.

It is contemplated that the loudness can be effectively controlled in one of two ways. In one embodiment, the strings may be plucked or banged as in conventional instruments. In this case an electromagnetic pickup would be placed below each string as is done in conventional electric guitars. The output of the pickup 31 may then be amplified and rectified to derive the desired intensity envelope of the vibration, which is proportional to loudness. This loudness envelope voltage would then be used to control the loudness of the electronic sound by means of voltage controlled amplifiers.

In an alternative embodiment suitable pressure transducers 32, which can respond properly and rapidly to finger pressure, could be manipulated by the player's free hand to control loudness. The pressure transducers 32 could be in the form of buttons, perhaps one to control each string or any combination of strings. The voltage from these transducers would be applied through a voltage-controlled amplifier to control loudness. The separate control of the duration and loudness of each note in a chord thereby made possible by the use of this method, allows for greater flexibility and creative potential.

Figure 3 shows a schematic circuit diagram of a typical circuit to provide a suitable constant current source for this instrument and for first stage of amplification. A constant reference voltage $-V_z$ is determined by means of a Zener diode 80 and a resistor 81. A resistor network R_3, R_2 and R_T apply a fraction of this voltage to the non-inverting input of an operational amplifier 82. The inverting input of the operational amplifier is connected to a resistor R_1 in which the voltage drop is proportional to the current I_S which flows through a controlling field-effect transistor 83 and a string 84 with an effective resistance R_S. The voltage drop over R_S is I_SR_S. The resultant voltage, I_SR_3, is fed to an operational amplifier 85, the gain of which may be adjusted by means of a variable control 86. The value of the constant current I_S can be adjusted by means of a tuning control 87 through the relationship $I_S=V_ZR_3/R_1(R_2+R_3+R_T)$.

Figure 4 represents a cross-sectional view of a string 79 wound with resistance wires that is suitable for producing low notes. The string 79 has a core of steel wire 75. A well insulated resistance wire 77 is tightly wound onto core wire 75. The whole string 79 has been dipped into a suitable resin (such as epoxy) to tightly fixate the insulation 78 in order to prevent electrical contact towards the core and between the turns of the resistance wire 77 that may result from abrasion due to internal flexing. The insulation 78 has been removed from an outer surface of the string, for example, by sanding, so that the string can make electrical contact with the frets 16.

Figure 5 is a block diagram showing the various steps involved in one suitable method of converting voltage signals into frequency signals of desired wave characteristics. As a string 39 is pressed to contact a fret 40 an electrical circuit is completed. The resistance of the portion of the string now included in the circuit will alter the voltage in the circuit according to V=IR. By pressing the string to contact other frets (not shown) different voltage outputs can be obtained. The voltage signal is then amplified by the operational amplifier circuit 45 as shown. As indicated in block 50 of Figure 5, the amplified voltage signal obtained by the above described method is then converted into a frequency signal. Depending on the type of voltage-to-frequency converter employed the output frequency signal may be a sine wave or some other wave form. This output frqeuency signal may then be inputted into a wave shape former shown in block 55. After a desired wave form is obtained, the basic fre-

quency signal may be filtered to remove undesired "harmonics" in the circuit as is indicated by block 60. Block 65 shows a selectable mixer which can be used to combine the frequency signals to produce various coloration of the sound. The output of the mixer is then attenuated as desired by a suitable circuit to control loudness, as shown by block 70.

Claims

1. An electronic musical instrument (3) comprising a body (6), a fingerboard (12) attached to said body and having an upper surface, a plurality of strings (79, 84) arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said upper surface of the fingerboard is electrically conductive and each said string is electrically resistive and is connected in a respective first electrical circuit (82—86) with said fingerboard, which first electrical circuit forms part of the respective tone-determining circuit and is so devised as to provide an output voltage dependent on the resistance of the free length of the respective string, each said first electrical circuit being in turn connected with a respective voltage to frequency conversion means (50), forming a further part of the respective tone-determining circuit, and which serves to convert the respective said output voltage into an electrical signal of a frequency dependent on said voltage, the instrument including transducer means (45) for receiving said frequency signals and for producing sounds of corresponding pitch, whereby displacing a string to contact said conductive surface at differing points along the length of a string varies said resistance in the corresponding said first circuit to produce, via the respective said voltage to frequency conversion means, and the respective said transducer means, sounds of various pitches.

2. An electronic musical instrument (3) comprising a body (6), a fingerboard (12) attached to said body and having an upper surface, a plurality of spaced strings (79, 84) arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said upper surface of the fingerboard includes electrically conductive frets upstanding from the remainder of the fingerboard and each said string is electrically resistive and is connected in a respective first electrical circuit (82—86) with said frets, which first electrical circuit forms part of the respective tone-determining circuit and is so devised as to provide an output voltage dependent on the resistance of the free length of the respective string, each said first electrical circuit being in turn connected with a respective voltage to frequency conversion means (50), forming a further part of the respective tone-determining circuit, and which serves to convert the respective said output voltage into an electrical signal of a frequency dependent on said voltage, the instrument including transducer means for receiving said frequency signals and for producing sounds of corresponding pitch, whereby displacing a string to contact different said conductive frets at differing points along the length of a string varies said resistance in the corresponding said first circuit to produce, via the respective said voltage to frequency conversion means, and the respective said transducer means, sounds of various pitches.

3. An electronic musical instrument (3) comprising a body (6), a fingerboard (12) attached to said body and having an upper surface, a plurality of strings (79, 84) arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said fingerboard (12) has an electrically conducting upper surface, and in that each of said strings (79, 84) comprises a core (75), resistance wire (78) insulated and generally tightly wound about and attached to said core, said insulation (77) having been removed from an outer surface of said wound string, whereby displacing a string to contact said conductive surface at differing points along the string's length varies said resistance incorporated in said electrical tone-determining circuit (82—86) thereby providing a means to variably control the circuit's output voltage, and means for converting said output voltage into a predetermined frequency.

4. An electronic musical instrument (3) comprising a body (6), a fingerboard (12) attached to said

body and having an upper surface, a plurality of strings (79, 84) arranged in spaced apart relationship relative to one another above said upper surface, the arrangement being such that each said string, when depressed to contact a portion of said upper surface immediately therebelow, forms, with the material affording the portion of said upper surface thus contacted, a resistance, incorporated in an electrical tone-determining circuit, which resistance is variable with the position at which the string contacts said upper surface, and which resistance determines the frequency of a corresponding electrical signal supplied by said tone-determining circuit to a corresponding sound production facility, characterised in that said fingerboard has an upper surface which is electrically insulating apart from a plurality of spaced conducting frets (16) extending across the fingerboard at desired points along its length, and in that each of said strings (79, 84) comprises a core (75), resistance wire (78) insulated and generally tightly wound about and attached to said core, said insulation (77) having been removed from an outer surface of said wound string, whereby displacing a string selectively to contact differing frets along the string's length varies said resistance incorporated in said electrical tone-determining circuit thereby providing a means to incrementally control the circuit's output voltage, and means for converting said output voltage into a predetermined frequency.

5. An instrument according to claim 3 or claim 4 wherein each string is operatively associated with an independent electrical circuit.

6. An instrument according to claim 3, 4 or 5 wherein said musical instrument has means for electrically energizing said strings and a speaker both fixedly secured thereto.

7. An instrument according to any of claims 1 to 6 including means arranged to pass a constant electrical current through the portion of each string which forms said resistance in the respective electrical circuit.

8. An instrument according to any preceding claim wherein each string has a resistance value less than 1,000 ohms.

9. An instrument according to any preceding claim which incorporates a frequency counter to facilitate tuning.

10. An instrument according to any preceding claim including a means for controlling the intensity and harmonic content of the musical sounds produced.

11. An instrument according to claim 10 wherein said means for controlling intensity and harmonic content is attached to said body so as to allow control thereof by a player's free hand.

12. An instrument according to any of claims 1 to 9 including means for controlling the loudness of the sounds generated electronically by the instrument relative to the intensity of vibration of a vibrating string thereof, the last-noted means including an electromagnetic pickup (31), for detecting the vibration of a string, means for amplifying and rectifying the output of said pickup to derive the intensity envelope voltage of said vibration, and a voltage controlled amplifier controlled by said envelope voltage and serving to amplify the frequency signals supplied to said transducer means.

13. An instrument according to any of claims 1 to 9 including means for proportionally controlling the loudness of sounds generated electronically by the instrument, said means including a plurality of pressure transducers (37) accessible to the player, and respective voltage controlled amplifiers (45) controlled by the voltage output of said pressure transducers, said voltage controlled amplifiers serving to amplify the frequency signals applied to said transducer means, whereby a player of the instrument can vary the loudness of the sounds produced by varying the pressure he applies to said pressure transducers.

Patentansprüche

1. Elektronisches Musikinstrument (3), mit einem Körper (6), einem an den Körper angesetzten und mit einer Oberfläche versehenen Griffbrett (12), einer Mehrzahl von Saiten (79, 84), die mit Abstand voneinander über der Oberfläche angeordnet sind, wobei die Anordnung derart ist, daß jede Saite bei Herabdrücken zur Berührung eines Abschnitts der Oberfläche unmittelbar darunter mit dem Material, das den Abschnitt der so berührten Oberfläche darstellt, einen in einem elektrischen Tonbestimmungskreis liegenden Widerstand bildet, der mit dem Ort, an dem die Saite die Oberfläche berührt, variabel ist und die Frequenz eines entsprechenden, von dem Tonbestimmungskreis zu einer entsprechenden Tonerzeugungseinrichtung geführten elektrischen Signals bestimmt, dadurch gekennzeichnet, daß die Oberfläche des Griffbretts elektrisch leitend ist und die Saiten einen ohmschen Widerstand haben und mit jeweils einem ersten elektrischen Schaltkreis (82, 86) mit dem Griffbrett verbunden sind, wobei der erste elektronische Schaltkreis einen Teil jeweils eines Tonbestimmungskreises bildet zur Erzeugung einer von dem Widerstand der freien Länge der jeweiligen Saite abhängigen Ausgangsspannung und weiter mit jeweils einem Spannungs/Frequenz-Wandler (50) verbunden ist, der einen weiteren Teil des jeweiligen Tonbestimmungskreises bildet und zum Wandeln der jeweiligen Ausgangsspannung in ein elektrisches Signal mit einer von der Spannung abhängigen Frequenz dient, und wobei das Instrument einen Übertrager (45) aufweist zum Aufnehmen der Frequenzsignale und zum Erzeugen von Tönen einer entsprechenden Tonhöhe, wodurch ein Verlagern einer Saite zum Berühren der leitenden Oberfläche an verschiedenen Orten die Länge der Saite den Widerstand in dem entsprechenden ersten Schaltkreis ändert zur Erzeugung von Tönen unterschiedlicher Tonhöhe über die jeweiligen Spannungs/Frequenz-Wandler und die jeweiligen Übertrager.

2. Elektronisches Musikinstrument (3), mit einem Körper (6), einem an den Körper angesetz-

ten und mit einer Oberfläche versehenen Griffbrett (12), einer Mehrzahl von Saiten (79, 84), die mit Abstand voneinander über der Oberfläche angeordnet sind, wobei die Anordnung derart ist, daß jede Saite bei Herabdrücken zur Berührung eines Abschnitts der Oberfläche unmittelbar darunter mit dem Material, das den Abschnitt der so berührten Oberfläche darstellt, einen in einem elektrischen Tonbestimmungskreis liegenden Widerstand bildet, der mit dem Ort, an dem die Saite die Oberfläche berührt, variabel ist und die Frequenz eines entsprechenden, von dem Tonbestimmungskreis zu einer entsprechenden Tonerzeugungseinrichtung geführten elektrischen Signals bestimmt, dadurch gekennzeichnet, daß die Oberfläche des Griffbretts elektrisch leitende Bunde aufweist, die sich über dem Griffbrett erheben und die Saiten einen ohmschen Widerstand haben und mit jeweils einem ersten elektrischen Schaltkreis (82, 86) mit den Bunden verbunden sind, wobei der erste elektronische Schaltkreis einen Teil jeweils eines Tonbestimmungskreises bildet zur Erzeugung einer von dem Widerstand der freien Länge der jeweiligen Saite abhängigen Ausgangsspannung und weiter mit jeweils einem Spannungs/Frequenz-Wandler (50) verbunden ist, der einen weiteren Teil des jeweiligen Tonbestimmungskreises bildet und zum Wandeln der jeweiligen Ausgangsspannung in ein elektrisches Signal mit einer von der Spannung abhängigen Frequenz dient, und wobei das Instrument einen Übertrager (45) aufweist zum Aufnehmen der Frequenzsignale und zum Erzeugen von Tönen einer entsprechenden Tonhöhe, wodurch ein Verlagern einer Saite zum Berühren unterschiedlicher Bunde an unterschiedlichen Orten der Länge der Saite den Widerstand in dem ersten entsprechenden Schaltkreis ändert zur Erzeugung von Tönen unterschiedlicher Tonhöhe über die jeweiligen Spannungs/Frequenz-Wandler und die jeweiligen Übertrager.

3. Elektronisches Musikinstrument (3), mit einem Körper (6), einem an den Körper angesetzten und mit einer Oberfläche versehenen Griffbrett (12), einer Mehrzahl von Saiten (79, 84), die mit Abstand voneinander über der Oberfläche angeordnet sind, wobei die Anordnung derart ist, daß jede Saite bei Herabdrücken zur Berührung eines Abschnitts der Oberfläche unmittelbar darunter mit dem Material, das den Abschnitt der so berührten Oberfläche darstellt, einen in einem elektrischen Tonbestimmungskreis liegenden Widerstand bildet, der mit dem Ort, an dem die Saite die Oberfläche berührt, variabel ist und die Frequenz eines entsprechenden, von dem Tonbestimmungskreis zu einer entsprechenden Tonerzeugungseinrichtung geführten elektrischen Signals bestimmt, dadurch gekennzeichnet, daß das Fingerbrett (12) eine elektrisch leitende Oberfläche hat und daß jede der Saiten (79, 84) einen Kern (75), einen isolierten und recht fest um den Kern gewickelten und an diesen angebrachten Widerstandsdraht (78), wobei die Isolation (77) von der Außenfläche der umwickelten Saite entfernt ist, wodurch ein Verlagern einer Saite zur Berührung der leitenden Oberfläche an verschiedenen Punkten entlang der Länge der Saite den Widerstand in dem elektrischen Tonbestimmungskreis (82, 86) ändert, wodurch ein Mittel zur veränderlichen Steuerung der Ausgangsspannung des Schaltkreises erzeugt wird und das Mittel Mittel zum Umwandeln der Ausgangsspannung in eine vorgegebene Frequenz vorgesehen sind.

4. Elektronisches Musikinstrument (3), mit einem Körper (6), einem an den Körper angesetzten und mit einer Oberfläche versehenen Griffbrett (12), einer Mehrzahl von Saiten (79, 84), die mit Abstand voneinander über der Oberfläche angeordnet sind, wobei die Anordnung derart ist, daß jede Saite bei Herabdrücken zur Berührung eines Abschnitts der Oberfläche unmittelbar darunter mit dem Material, das den Abschnitt der so berührten Oberfläche darstellt, einen in einem elektrischen Tonbestimmungskreis liegenden Widerstand bildet, der mit dem Ort, an dem die Saite die Oberfläche berührt, variabel ist und die Frequenz eines entsprechenden, von dem Tonbestimmungskreis zu einer entsprechenden Tonerzeugungseinrichtung geführten elektrischen Signals bestimmt, dadurch gekennzeichnet, daß das Fingerbrett (12) eine Oberfläche hat, die elektrisch isoliert ist von einer Mehrzahl von mit Abstand voneinander angeordneten Bunden (16), die sich quer zu dem Fingerbrett an bestimmten Orten entlang dessen Länge erstrecken, und daß jede der Saiten (79, 84) einen Kern (75), einen isolierten und recht fest um den kern gewickelten und an diesen angebrachten Widerstandsdraht (78), wobei die Isolation (77) von der Außenfläche der umwickelten Saite entfernt ist, wodurch ein Verlagern einer bestimmten Saite zur Berührung unterschiedlicher Bunde entlang der Länge der Saite den Widerstand in dem elektrischen Tonbestimmungskreis (82, 86) ändert, wodurch ein Mittel zur veränderlichen Steuerung der Ausgangsspannung des Schaltkreises erzeugt wird und daß Mittel zum Umwandeln der Ausgangsspannung in eine vorgegebene Frequenz vorgesehen sind.

5. Instrument nach Anspruch 3 oder Anspruch 4, wobei jede Seite einem unabhängigen elektrischen Schaltkreis zugehörig ist.

6. Instrument nach Anspruch 3, 4 oder 5, wobei das Musikinstrument Mittel zur elektrischen Versorgung der Saiten und Lautsprecher aufweist, die beide fest mit diesem verbunden sind.

7. Instrument nach einem der Ansprüche 1 bis 6, mit Mitteln zum Führen eines konstanten elektrischen Stromes durch den Abschnitt jeder Saite, die den Widerstand in dem jeweiligen elektrischen Schaltkreis bildet.

8. Instrument nach einem der vorangehenden Ansprüche, wobei jede Saite einen Widerstandswert von weniger als 1000 Ohm hat.

9. Instrument nach einem der vorangehenden Ansprüche, mit einem Frequenzzähler zur Ermöglichung einer Abstimmung.

10. Instrument nach einem der vorangehenden Ansprüche, mit Mitteln zum Steuern der Intensität und des Oberwellengehalts der erzeugten Musik.

11. Instrument nach Anspruch 10, wobei die Mittel zum Steuern der Intensität und des Oberwellengehaltes mit dem Körper verbunden sind, so daß eine Steuerung durch die freie Hand des Spielers möglich ist.

12. Instrument nach einem der Ansprüche 1 bis 9, mit Mitteln zur Steuerung der Lautstärke der von dem Instrument elektronisch erzeugten Töne relativ zu der Intensität der Vibration dessen vibrierender Saiten, wobei die letzterwähnten Mittel einen elektromagnetischen Aufnehmer (31) zum Erkennen der Vibration einer Saite, Mitteln zum Verstärken und zum Gleichrichten des Ausgangs des Aufnehmers zur Ableitung einer der Intensität der Vibration entsprechenden Hüllspannung, und einem von der Hüllspannung gesteuerten elektrischen Verstärker, der zur Verstärkung der von dem Übertrager gelieferten Frequenzsignale dient.

13. Instrument nach einem der Ansprüche 1 bis 9, mit Mitteln zum proportionalen Steuern der Lautstärke der von dem Instrument elektronisch erzeugten Töne, wobei die Mittel eine Mehrzahl von für den Spieler zugänglichen Druckwandlern (37) sowie jeweilige spannungsgesteuerte Verstärker (40) aufweisen, die von dem Spannungsausgang der Druckwandler gesteuert werden, wobei die spannungsgesteuerten Verstärker zum Verstärken der Frequenzsignale, die von dem Druckwandler geliefert werden, dienen, wodurch der das Instrument benutzende Spieler die Lautstärke der erzeugten Töne durch Ändern des Drucks, den er auf den Druckwandler aufbringt, ändern kann.

Revendications

1. Un instrument musical électronique (3) comprenant un corps (6), un clavier (12) fixé audit corps et ayant une surface supérieure, plusieurs cordes (79, 84) agencées de façon séparée les unes par rapport aux autres au-dessus de ladite surface supérieure, l'agencement étant tel que chacune desdites cordes, lorsqu'elle est pressée en contact avec une portion de ladite surface supérieure située immédiatement en dessous, constitue, avec le matériau composant la portion de ladite surface supérieure ainsi mise en contact, une résistance, incorporée dans un circuit électrique déterminant un son, laquelle résistance est variable en fonction de la position de contact de la corde avec ladite surface supérieure, et laquelle résistance détermine la fréquence d'un signal électrique correspondant généré par ledit circuit déterminant un son et attaquant une unité de production du son correspondant, caractérisé en ce que ladite surface du clavier est électriquement conductrice et chacune desdites cordes est électriquement résistante et est raccordée dans un premier circuit électrique respectif (82, 86) avec ledit clavier, lequel premier circuit électrique constitue une partie du circuit respectif déterminant un son, et est agencé pour fournir une tension de sortie dépendante de la résistance de la longueur libre de la corde respective, chacun desdits premiers circuits électriques étant à son tour raccordé avec une tension respective à des moyens de conversion de fréquence (50), formant une partie supplémentaire du circuit respectif déterminant un son, et qui sert à convertir ladite tension respective de sortie en un signal électrique de fréquence dépendante de ladite tension, l'instrument comprenant des moyens transducteurs (45) pour recevoir lesdits signaux de fréquence et pour produire des sons d'une hauteur correspondante, de sorte que déplacer une corde pour créer un contact avec ladite surface conductrice en différents points le long de la longueur de la corde fait varier ladite résistance dans ledit premier circuit correspondant pour produire, via les moyens de conversion de ladite tension respective en fréquence et lesdits moyens transducteurs respectifs, des sons de hauteurs variées.

2. Un instrument électronique de musique (3) comprenant un corps (6), un clavier (12) fixé audit corps et ayant une surface supérieure, plusieurs cordes espacées (79, 84) agencées de façon séparée les unes par rapport aux autres au-dessus de ladite surface supérieure, l'agencement étant tel que chacune desdites cordes, lorsqu'elle est pressée en contact avec une portion de ladite surface supérieure située immédiatement en dessous, constitue, avec le matériau composant la portion de ladite surface ainsi mise en contact, une résistance, incorporée dans un circuit électrique déterminant un son, laquelle résistance est variable avec la position de contact de la corde avec ladite surface supérieure, et laquelle résistance détermine la fréquence d'un signal électrique correspondant généré par ledit circuit déterminant un son et attaquant une unité de production de son correspondant, caractérisé en ce que ladite surface supérieure du clavier comporte des touchettes électriquement conductrices se dressant à partir de la partie restante du clavier et chacune desdites cordes est électriquement résistante et est raccordée dans un premier circuit électrique respectif (82, 86) avec lesdites touchettes, lequel premier circuit électrique constitue une partie d'un circuit respectif déterminant un son et est agencé pour fournir une tension de sortie dépendante de la résistance de la longueur libre de la corde respective, chacun desdits premiers circuits électriques étant à son tour raccordé avec une tension respective à des moyens de conversion de fréquence (50), formant une part supplémentaire du circuit respectif déterminant un son, et qui sert à convertir ladite tension respective de sortie en un signal électrique d'une fréquence dépendante de ladite tension, l'instrument comportant des moyens transducteurs pour recevoir lesdits signaux de fréquence et pour produire des sons d'une hauteur correspondante, de sorte que le déplacement d'une corde pour entrer en contact avec lesdites différentes touchettes conductrices à des points différents le long de la longueur de la corde fait varier ladite résistance dans ledit premier circuit correspondant pour produire, via les moyens de conversion de ladite tension respective en fréquence, et lesdits

moyens transducteurs respectifs, des sons de hauteur variée.

3. Un instrument électronique de musique (3) comprenant un corps (6), un clavier (12) fixé audit corps et ayant une surface supérieure, plusieurs cordes (79, 84) agencées de façon séparée les unes par rapport aux autres au-dessus de ladite surface supérieure, l'agencement étant tel que chacune desdites cordes, lorsqu'elle est pressée en contact avec une portion de ladite surface supérieure située immédiatement en dessous, constitue, avec le matériau composant la portion de ladite surface ainsi mise en contact, une résistance, incorporée dans un circuit électrique déterminant un son, laquelle résistance est variable avec la position de contact de la corde avec ladite surface supérieure, et laquelle résistance détermine la fréquence d'un signal électrique correspondant généré par ledit circuit déterminant un son attaquant une unité de production de son correspondant, caractérisé en ce que ledit clavier à touches (12) a une surface supérieure électriquement conductrice, et en ce que chacune desdites cordes (79, 84) comprend un coeur (75), un câble de résistance (78) isolé et lié de façon généralement serrée le long et attaché audit corps, ladite isolation (77) ayant été enlevée à partir d'une surface externe de ladite corde de liaison, de sorte que le déplacement d'une corde pour entrer en contact avec la surface conductrice en différents points le long de la longueur de la corde varie, ladite résistance incorporée dans ledit circuit électrique déterminant un son (82, 86) fournissant ainsi des moyens de commande variable de la tension de sortie du circuit, et des moyens pour convertir ladite tension de sortie en une fréquence prédéterminée.

4. Un instrument électronique de musique (3) comprenant un corps (6), un clavier à touches (12) fixé audit corps et ayant une surface supérieure, plusieurs cordes espacées (79, 84) agencées de façon séparée les unes par rapport aux autres au-dessus de ladite surface supérieure, l'agencement étant tel que chacune desdites cordes, lorsqu'elle est pressée en contact avec une portion de ladite surface supérieure située immédiatement en dessous, constitue, avec le matériau composant la portion de ladite surface ainsi mise en contact, une résistance, incorporée dans un circuit électrique déterminant un son, laquelle résistance est variable avec la position de contact de la corde avec ladite surface supérieure et laquelle résistance détermine la fréquence d'un signal électrique correspondant généré par ledit circuit déterminant un son attaquant une unité de production de sons correspondants, caractérisé en ce que ledit clavier a une surface supérieure qui est isolante électriquement, à part de plusieurs touchettes conductrices (16) séparées les unes des autres s'étendant au travers dudit clavier à des emplacements déterminés le long de sa longueur, et en ce que chaque corde (79, 84) comprend un corps (75), un câble résistant (78) isolé et lié de façon généralement serrée le long et attaché audit corps, ladite isolation (77) ayant été enlevée d'une surface extérieure de ladite corde attachée, de sorte que en déplaçant une corde de façon sélective pour entrer en contact avec différentes touchettes le long de la longueur de la corde, on fait varier ladite résistance incorporée dans ledit circuit électrique déterminant un son en fournissant ainsi un moyen de commander de façon incrémentée, la tension de sortie du circuit et des moyens de conversion de ladite tension de sortie en une fréquence prédéterminée.

5. Un instrument selon la revendication 3 ou 4 dans lequel chaque corde est associée fonctionnellement avec un circuit électrique indépendant.

6. Un instrument selon la revendication 3, 4 ou 5 dans lequel ledit instrument musical a des moyens pour alimenter électriquement lesdites cordes et un haut-parleur, les deux étant attachés de façon fixe audit instrument.

7. Un instrument selon l'une quelconque des revendications 1 à 6 comprenant des moyens agencés pour faire passer un courant constant électrique au travers d'une portion de chaque corde qui constitue ladite résistance dans ledit circuit électrique respectif.

8. Un instrument selon l'une quelconque des revendications précédentes dans lequel chaque corde a une valeur en résistance inférieure à 1000 ohms.

9. Un instrument selon l'une quelconque des revendications précédentes qui incorpore un compteur de fréquences pour faciliter l'accord de l'instrument.

10. Un instrument selon l'une quelconque des revendications précédentes comprenant un moyen de commande de l'intensité et du contenu harmonique des sons musicaux produits.

11. Un instrument selon la revendication 10 dans lequel ledit moyen pour commander l'intensité et le contenu harmonique est attaché audit corps de façon à permettre la commande de celui-ci par la main libre de l'instrumentiste.

12. Un instrument selon l'une quelconque des revendications 1 à 9 comprenant des moyens de commande de la puissance des sons générés électroniquement par l'instrument en fonction de l'intensité de vibration d'une corde vibrante de celui-ci, lesdits moyens mentionnés comprenant un capteur électromagnétique (31), pour détecter les vibrations d'une corde, des moyens pour amplifier et redresser la sortie dudit capteur pour obtenir la tension enveloppe d'intensité de ladite vibration, et un amplificateur à commande par tension, commandé par ladite tension enveloppe et servant à amplifier les signaux de fréquence fournit par lesdits moyens transducteurs.

13. Un instrument selon l'une quelconque des revendications 1 à 9 comprenant des moyens de commande proportionnels de la puissance des sons générés électriquement par l'instrument, lesdits moyens comportant plusieurs transducteurs de pression (37) accessibles à l'instrumentiste, et des amplificateurs (45) respectifs à commande par tension, commandés par la tension de sortie desdits transducteurs de pression, lesdits amplificateurs à commande par tension servant à

amplifier les signaux de fréquence appliqués auxdits moyens transducteurs, de sorte qu'un instrumentiste jouant de l'instrument peut faire varier la puissance des sons produits en faisant varier la pression qu'il applique auxdits transducteurs de pression.

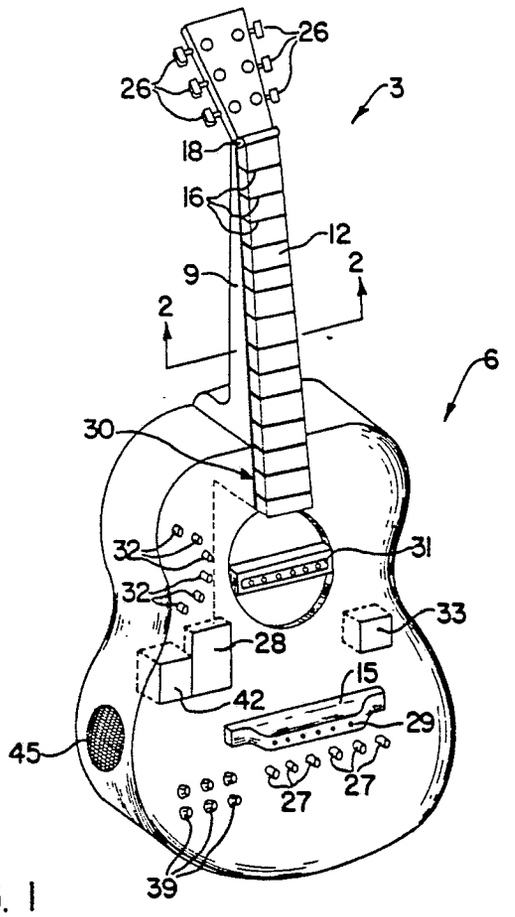

FIG. 1

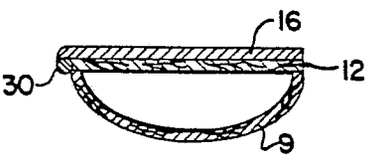

FIG. 2

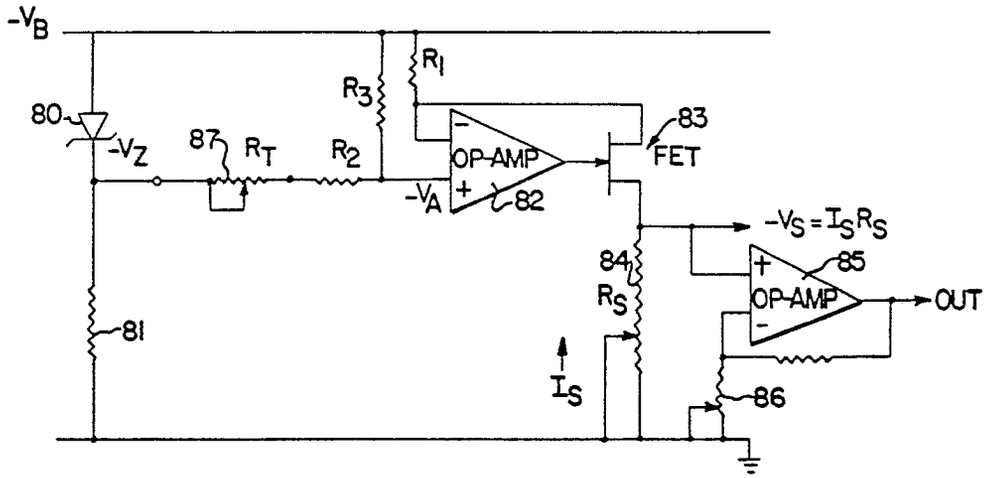
-V_B
80
-V_Z
87
R_T
R_2
R_3
R_1
OP-AMP
-V_A
82
83
FET
-V_S = I_S R_S
84
R_S
85
OP-AMP
OUT
81
I_S
86

FIG. 3

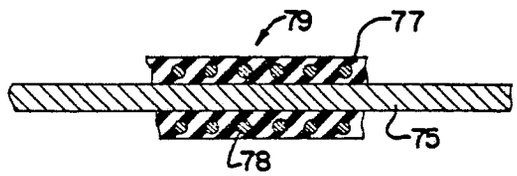
79
77
75
78

FIG. 4

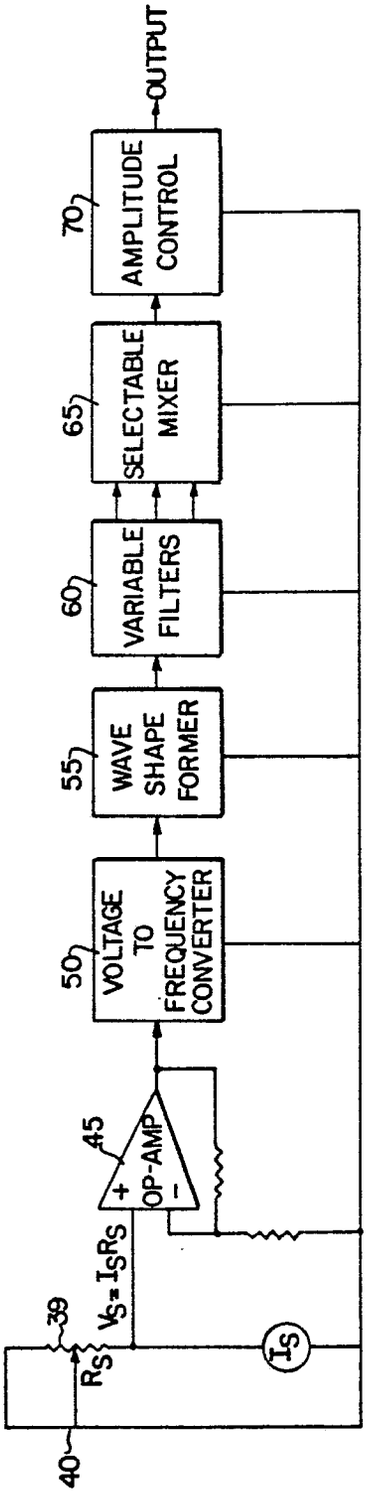
OUTPUT
70
AMPLITUDE CONTROL
65
SELECTABLE MIXER
60
VARIABLE FILTERS
55
WAVE SHAPE FORMER
50
VOLTAGE TO FREQUENCY CONVERTER
45
OP-AMP
+
-
39
$V_S = I_S R_S$
R_S
I_S
40

FIG. 5