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The invention relates to an electrical stringed instrument of the type including a body, a neck having a head, a bridge assembly connected to the body, a plurality of metal strings positioned between the head and the bridge assembly, and one or more pickups positioned on the body and beneath said metal strings. The electrical stringed instrument further comprises a) an audio output circuit electronically connected to said one or more pickups, and to a first channel of a multichannel output jack; and b) a first communication circuit comprising a variable impedance unit, and electronically connected to a second channel of said multichannel output jack.

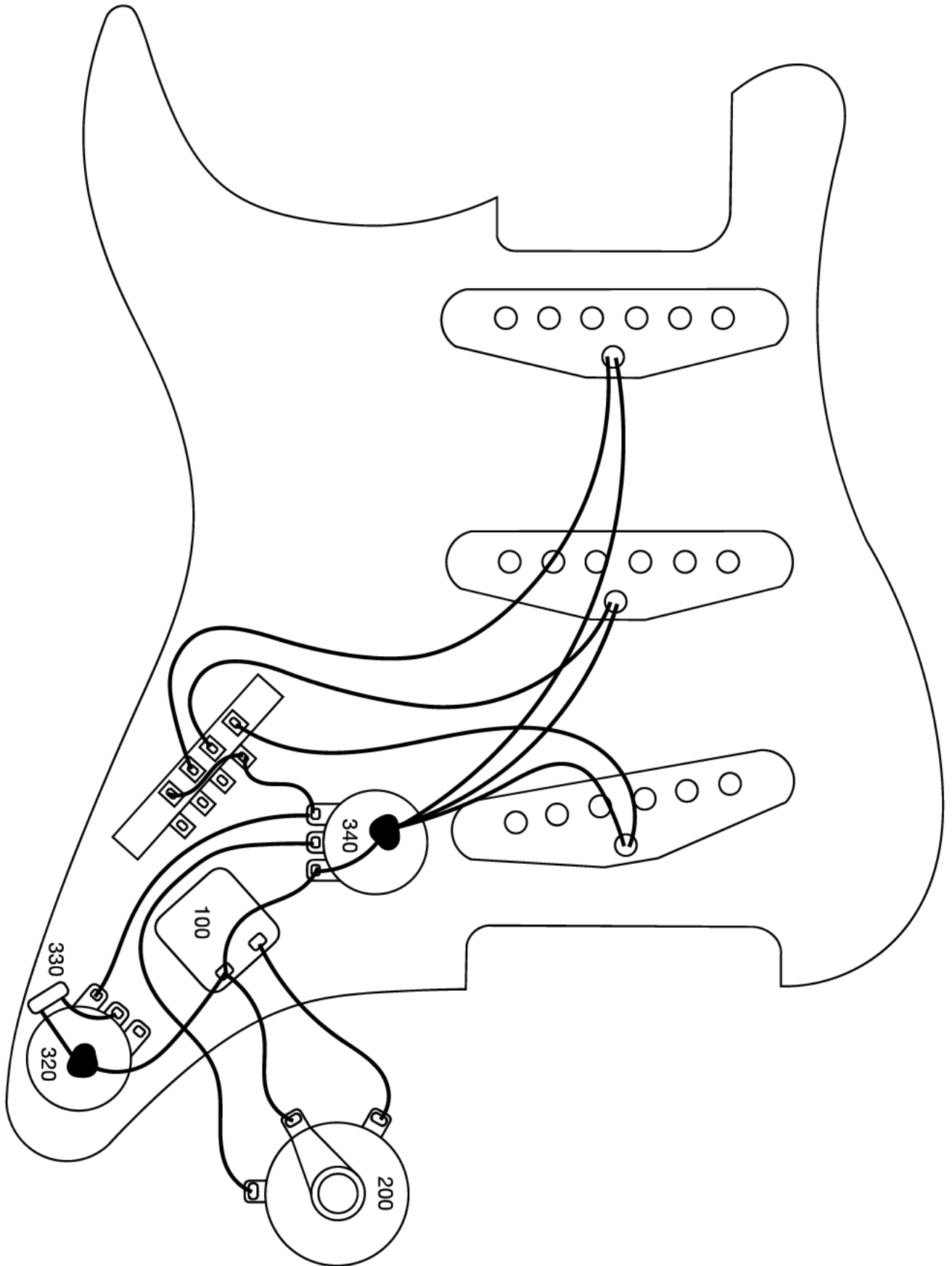


Figure 2

Electrical stringed instrument

Field of the Invention

The present invention relates to the field of electrical musical instruments of the string type.

Background of the Invention

This invention relates broadly to electrical musical instruments of the string type. It is typically applicable to an electrical guitar or bass guitar or similar musical instrument having a plurality of stretched strings extending across a body and a neck, between the head of the instrument and a bridge assembly connected to the body, in which the strings are caused to vibrate by plucking or picking same.

In order to derive an output from such an electrical guitar, bass guitar or other similar electrical musical instrument, the instrument is conventionally provided with an electromagnetic pickup comprising a number of magnetic elements (pole pieces) having wound there around a conductive coil. Typically, one such magnetic element is disposed directly beneath each string of the instrument. The strings are constructed of a magnetizable substance, such as steel, and, therefore, become part of the conductive path for the magnetic lines of flux of the pole pieces. Accordingly, when any of the strings are caused to vibrate this causes a disturbance in the magnetic field of the associated pole piece. This has the effect of generating a voltage in the conductive coil which voltage may be suitably amplified and transmitted to a loudspeaker system.

Audio signal-processing devices are used to modify an audio signal, for making the tone more interesting to the listener. These audio signal-processing devices include, but are not limited to, analog and digital effect pedals, digital multi-effects processors, analog amplifiers, digital amp modelers, digital modelling amplifiers, filters, and equalizers. Each audio signal-processing device typically

has several control parameters used to shape the tone of the audio signal, as well as on/off switches. These control parameters appear as knobs, sliders, buttons and switches on the control panel of the audio signal-processing devices, and may often be controlled by external devices by received analog (e.g. expression pedal) or digital (e.g. midi foot controller) communication signals. It is also well established that musicians desire the ability to manipulate these control parameters and engage/disengage certain effects during a performance. This type of manipulation during a performance is difficult, if the musician constantly moves around on the stage. As an example, when musicians are using stompbox effect pedals or midi foot controllers, they are limited in their movement on the stage, as the sound is controlled by their feet at a fixed location.

US20160049142 discloses apparatuses and systems for movable sensing for stringed instruments. A string selector module selects one or more strings of a stringed instrument in response to a user of the stringed instrument positioning at least a portion of the string selector module over the one or more selected strings. The stringed instrument includes a plurality of strings, and the plurality of strings includes the one or more selected strings and one or more unselected strings. A sensor module produces an electrical signal in response to vibration of the one or more selected strings.

US20030101863 discloses a signal controller for a musical instrument, such as a guitar, that includes a liquid-filled tilt-sensor that has means to cause a variation in electrical resistance that is exploited by control circuitry to vary one or more qualities of the signal of the musical instrument. Such a signal may be a volume control, a tone control, a balance control and/or an effects control.

GB2340286 discloses a remote control system comprising a remote keypad unit providing a group of keys and suitable to be worn by a guitarist or similar musician, and a base station for receiving keypad signals and for generating therefrom digital

commands for controlling electronic equipment during performance, wherein the keypad unit and base station are arranged to generate each specific command in response to a specific simultaneous combination of key presses of keys within a group of keys on the keypad, such that the range of commands that can be generated at a given time is greater than the number of keys in said group. This allows the musician to effect program changes without returning to a bank of foot pedals. Simple finger patterns on a bank of a few keys can select between dozens of programs, which avoids the need for visual contact with a keypad having a large number of keys. The number of specific commands that can be generated at a given time may be greater than twice or three times the number of keys on the keypad.

Object of the Invention

The objective of the present invention is to provide a system that solves some or all the above-mentioned problems.

The present invention allows the user of an electrical stringed instrument to control audio signal processing devices, connected to the instrument, by the use of knobs and/or sliders and/or buttons onboard the instrument. This advantage provides the user with freedom to move around the stage during a performance, while still being able to control the sound.

The present invention may allow the user to use existing holes on the electrical stringed instrument, that before installation were used for other onboard controls of the instrument (e.g. tone potentiometer), thereby avoiding the need to change the appearance or construction of the instrument.

Another advantage of the invention is that the communication signal travels along the same cable as the generated audio signal, but using a different conductor, thereby avoiding the need to use more than one cable, and also avoiding any change of the sound and/or impedance of the audio signal generated by the instrument.

Description of the Invention

A first aspect of the present invention relates to an electrical stringed instrument system comprising:

a) an electrical stringed instrument of the type including a body, a neck having a head, a bridge assembly connected to the body, a plurality of metal strings positioned between the head and the bridge assembly, and one or more pickups positioned on the body and beneath said metal strings; the electrical stringed instrument further comprising:

- an audio output circuit electrically connected to said one or more pickups, and to a first channel of a multichannel output jack; and

- a first communication circuit comprising a variable impedance unit, and electrically connected to a second channel of said multichannel output jack; and
b) a second communication circuit configured to measure the impedance of the first communication circuit, and to convert it to a digital representation.

In the present context, the term “variable impedance unit” may be a variable resistor unit, a variable capacitor unit, or a variable inductor unit. Preferably, the variable impedance unit is a variable resistor unit.

For the most part, electric guitars or electric bass guitars have changed little over the past few decades. To produce sound, electrical guitars or electric bass guitars typically have two or three pickups, which are positioned beneath metal strings. The pickups include one or more electrical coils, which pick up the vibration of the metal strings, in a magnetic field. The electrical output of the coils is output through an audio output circuit electrically connected to the one or more pickups. Typically, electric guitars have an onboard switch for selecting which pickups to be connected. The electrical output of the coils is then amplified, and the amplified signal is reproduced by means of a loud speaker. Typically, each pickup is composed of a single coil of wire having two ends connectable to a guitar audio output circuit.

Electric guitars typically have additional circuitry for processing the electric signals produced by the pickups. The processing circuitry is used to alter different qualities of the tone. To allow the guitar user to adjust the processing of the electric signal, a guitar typically includes various knobs and buttons for controlling the tone and volume. Hence, in one or more embodiments, the audio output circuit further comprises a processing circuitry.

The core of the invention is the first communication circuit positioned within the electrical stringed instrument. The first communication circuit allows the musician to instruct audio signal-processing devices connected, directly or indirectly through a communication unit, to the electrical stringed instrument for processing of the audio signal in accordance with predefined rules. The first communication circuit comprises a variable impedance unit, and is electrically connected to a second channel of a multichannel output jack, i.e. a different channel than the output circuit is connected to. The variable impedance unit may e.g. be a potentiometer, which is a resistor with a movable element positioned by a manual knob or lever. The movable element, typically called a wiper, contacts a resistive strip of material (commonly called the slidewire if made of resistive metal wire) at any point selected by the manual control. The potentiometer's voltage division ratio is strictly a function of resistance and not of the magnitude of applied voltage. Typically, a potentiometer has three terminals. The wiper provides a division of the voltage at two of the terminals controlled by the voltage division ratio. If only two of the terminals are considered and one of them being the wiper terminal, the potentiometer functions as a variable resistor between those two terminals. Hence, a potentiometer functions as a variable resistor set by wiper position. By varying the resistance through the first communication circuit, each individual value or range of values may represent a code for a specific instruction for the audio signal-processing device(s) connected. In one or more embodiments, the variable resistor is operably connected to a rotary or slidable knob mounted on the body of the electrical stringed instrument. As an

example, the rotary switch or potentiometer may be replacing an existing tone potentiometer inside the electrical stringed instrument.

Alternatively, the variable impedance unit may be a multi-position switch, e.g.

5 rotary switch or slide switch, which switches between multiple circuits with different impedances. The first communication circuit may in one or more embodiments comprise a switch adapted to switch between a primary circuit and a secondary circuit, and wherein the secondary circuit has a relatively higher impedance than the primary circuit. This configuration allows for doubling the
10 number of possible codes. In one or more embodiments, the switch is operably connected to a push button mounted on the body of the electrical stringed instrument, preferably embedded into the variable impedance unit, e.g. a potentiometer with push/push or push/pull switch.

15 In one or more embodiments, the output circuit and the communication circuit share the same ground wire.

A second communication circuit is present in a communication unit either built separately or built into the chassis of an audio signal-processing device. The
20 second communication circuit is configured to measure, and convert the impedance of the first communication circuit to a digital representation. The digital representation may be sent to a processor, such as a microcontroller, configured for communicating with an audio signal-processing device by using digital or analog signals. The processor may in one or more embodiments
25 communicate wirelessly with the audio signal-processing device.

In one or more embodiments, the second communication circuit comprises an operational amplifier.

30 In one or more embodiments, the second communication circuit comprises an analog-to-digital converter.

In one or more embodiments, the second communication circuit comprises a processor configured for communicating with an audio signal-processing device.

5 The term “analog” as used with respect to electrical signals has its usual meaning in electrical engineering.

The term “digital” has its usual meaning in electrical and computer engineering.

10 The term “analog-to-digital converter” (ADC) has its usual and ordinary meaning in the field of electrical engineering.

As used in the specification and the appended claims, the singular forms "a", "an", and "the" include plural referents unless the context clearly dictates otherwise. Ranges may be expressed herein as from "about" or "approximately" one particular value and/or to "about" or "approximately" another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by use of the antecedent "about", it will be understood that the particular value forms another embodiment.

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It should be noted that embodiments and features described in the context of one of the aspects of the present invention also apply to the other aspects of the invention.

25 The invention is described in more detail in the following detailed description of a preferred embodiment, with reference to the figures.

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Brief description of the figures

Figure 1 shows an exemplary first communication circuit in accordance with various embodiments of the invention;

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Figure 2 shows an exemplary wiring of an electrical stringed instrument in accordance with various embodiments of the invention;

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Figure 3 shows an exemplary second communication circuit in accordance with various embodiments of the invention; and

Figures 4-5 are examples of electrical stringed instrument systems in accordance with various embodiments of the invention.

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References

	100	First communication circuit
	110	Variable impedance unit
	120	Switch
20	130	Primary circuit
	140	Secondary circuit
	150	Capacitor
	200	Multichannel output jack
	210	First channel
25	220	Second channel
	230	Ground wire
	300	Audio output circuit
	310	Pickup
	320	Tone potentiometer
30	330	Tone capacitor
	340	Volume potentiometer

400	Second communication circuit
410	Operational amplifier
411	Resistor
412	Resistor
5 420	Analog-to-digital converter
430	Microcontroller
440	Voltage source
450	First resistor
500	Communication unit

10

Detailed Description of the Invention

Figure 1 shows an exemplary first communication circuit 100 in accordance with various embodiments of the invention. The first communication circuit 100 allows the musician to instruct audio signal-processing devices connected (see Figures 4 and 5), directly or indirectly through a communication unit, to the electrical stringed instrument to process the audio signal in accordance with predefined rules.

The first communication circuit 100 comprises a variable impedance (here shown as a potentiometer) unit 110, and is electrically connected to a second channel 220 of a multichannel output jack 200, i.e. a different channel than the audio output circuit 300 is connected to, which is the first channel 210. The audio output circuit 300 and the communication circuit 100 is shown sharing the same ground wire 230. The potentiometer 110 is here shown with a maximum resistance of 50 kOhm. By varying the resistance through the first communication circuit 100, each individual value or range of values may represent a code for a specific instruction for the audio signal-processing device(s) connected thereto. The first communication circuit is also shown comprising a switch 120 adapted to switch between a primary circuit 130 and a secondary circuit 140. The primary circuit 130 is shown comprising a resistor of 6.2 kOhm, while the secondary circuit 140 is shown comprising a resistor of 62

kOhm. This configuration allows for doubling the number of possible codes. The first communication circuit 100 further comprises a capacitor 150 in parallel with the electrical load. The capacitor is here shown with 10 nF. This configuration avoids a noticeable "click or pop" (electrical transient signal) into the common ground terminal each time the switch 120 is activated.

The audio output circuit 300 is here shown with a pickup 310, a tone potentiometer 320, a tone capacitor 330, and a volume potentiometer 340.

Figure 2 shows the wiring of an electrical stringed instrument (Fender Stratocaster) in accordance with various embodiments of the invention.

In order to receive the instructions via the first communication circuitry 100, a second communication circuit 400 (Figure 3) may be present in a communication unit 500 either built separately or built into the chassis of the audio signal-processing device.

The second communication circuit 400 is configured to amplify, measure, and convert the voltage from the first communication circuit 100 to a digital representation that is sent to a microcontroller configured for communicating with an audio signal-processing device.

In Figure 3, the second communication circuit 400 is shown comprising an operational amplifier 410 configured to amplify the voltage from the first communication circuit 100. The voltage is in this example amplified 21 times via the resistors 411, and 412 of 1 kOhm and 20 kOhm, respectively. The second communication circuit 400 also comprises an analog-to-digital (ADC) converter 420 configured to measure the voltage, pre-amplified by the operational amplifier 410, from the first communication circuit 100 and to convert said voltage to a digital representation. The analog-to-digital converter 420 is here shown connected to a microcontroller (MCU) 430 configured for communicating with an audio signal-processing device. The second communication circuit 400 also comprises a voltage source 440 (150mV) connected to a first resistor 450

(224kOhm) of a voltage divider. The second resistor of the voltage divider is a part of the first communication circuit 100 that comprises the potentiometer 110, and the resistors in the primary 130 and secondary 140 circuits.

The communication unit 500 further comprises a multichannel input jack 600 and an audio mono output jack 700 electrically connected to one another. The multichannel input jack 600 is electrically connected to the multichannel output jack 200 through a stereo (TRS) cable. This configuration allows for the audio signal to be directly transmitted to the audio mono output jack 700, while the communication signal is passed to the second communication circuit 400.

Figures 4-5 are examples of electrical stringed instrument systems in accordance with various embodiments of the invention.

Patentkrav

1. Elektrisk strengeinstrumentsystem, omfattende:

5 a) et elektrisk strengeinstrument af typen, som omfatter et legeme, en nakke med et hoved, en brokomponent, som er forbundet til legemet, en flerhed af metalstreng, som er placeret mellem hovedet og brokomponenten, og en eller flere pick-up'er, placeret på legemet og under metalstrengene, hvor det elektriske strengeinstrument yderligere omfatter:

10 - et lydudgangskredsløb (300), som er elektrisk forbundet til den ene eller de flere pick-up'er, og til en første kanal (210) i et flerkanalets udgangsstik (200); og
- et første kommunikationskredsløb (100), omfattende en variabel impedansenhed (110), og elektrisk forbundet til en anden kanal (220) i flerkanalets udgangsstikket (200);

kendetegnet ved, at det elektriske strengeinstrumentsystem yderligere omfatter

15 b) et andet kommunikationskredsløb (400), som er tilpasset til at måle impedansen for det første kommunikationskredsløb (100) og til at konvertere det til en digital gengivelse.

20 2. Elektrisk strengeinstrumentsystem ifølge krav 1, hvor lydudgangskredsløbet (300) og det første kommunikationskredsløb (100) deler det samme jordkabel (230).

25 3. Elektrisk strengeinstrumentsystem ifølge et hvilket som helst af kravene 1-2, hvor det første kommunikationskredsløb (100) yderligere omfatter en omskifter (120), som er tilpasset til at skifte mellem et primært kredsløb (130) og et sekundært kredsløb (140), og hvor det sekundære kredsløb (140) har en relativt højere impedans end det primære kredsløb (130).

30 4. Elektrisk strengeinstrumentsystem ifølge krav 3, hvor omskifteren (120) er operativt forbundet med en trykknop, monteret på det elektriske strengeinstruments legeme.

5. Elektrisk strengeinstrumentsystem ifølge et hvilket som helst af kravene 1-4, hvor den variable impedansenhed (110) er operativt forbundet med et roterende eller glidbart organ, monteret på det elektriske strengeinstruments legeme.
- 5 6. Elektrisk strengeinstrumentsystem ifølge et hvilket som helst af kravene 1-5, hvor det første kommunikationskredsløb (100) yderligere omfatter en kondensator (150) parallelt med den elektriske belastning.
- 10 7. Elektrisk strengeinstrumentsystem ifølge et hvilket som helst af kravene 1-6, hvor det andet kommunikationskredsløb (400) yderligere omfatter en operationel forstærker (410), som er tilpasset til at forstærke spændingen fra det første kommunikationskredsløb (100).
- 15 8. Elektrisk strengeinstrumentsystem ifølge et hvilket som helst af kravene 1-7, hvor det andet kommunikationskredsløb (400) yderligere omfatter en analog-til-digital konverter (420), som er tilpasset til at måle spændingen, muligvis før forstærkning, fra det første kommunikationskredsløb (100) og til at konvertere denne spænding til en digital gengivelse.
- 20 9. Elektrisk strengeinstrumentsystem ifølge et hvilket som helst af kravene 1-8, hvor det andet kommunikationskredsløb (400) yderligere omfatter en processor (430), som er tilpasset til at kommunikere med en lydsignalprocessoranordning.

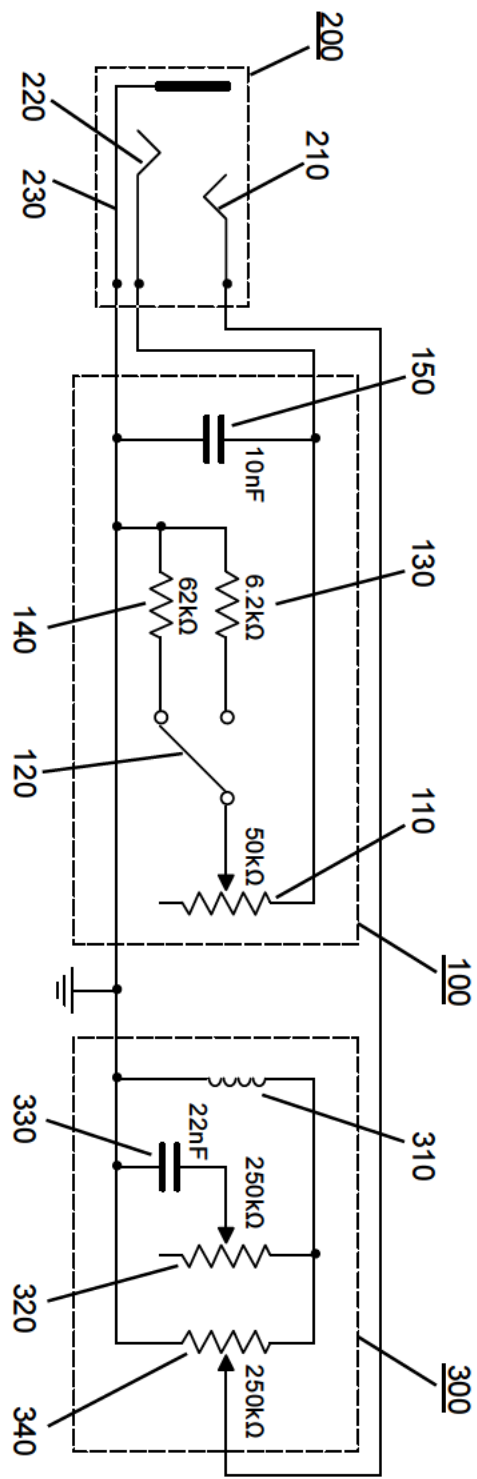


Figure 1

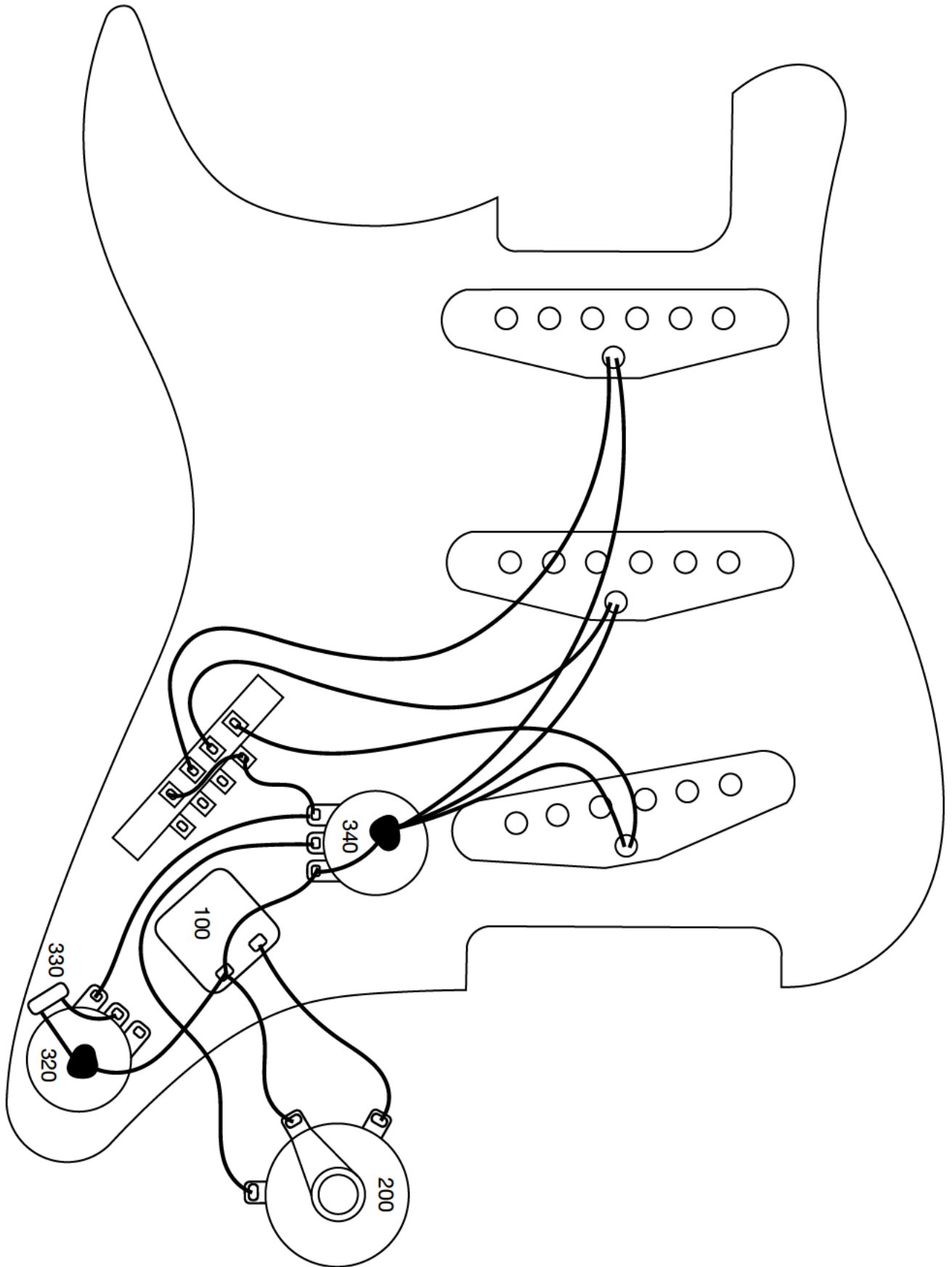


Figure 2

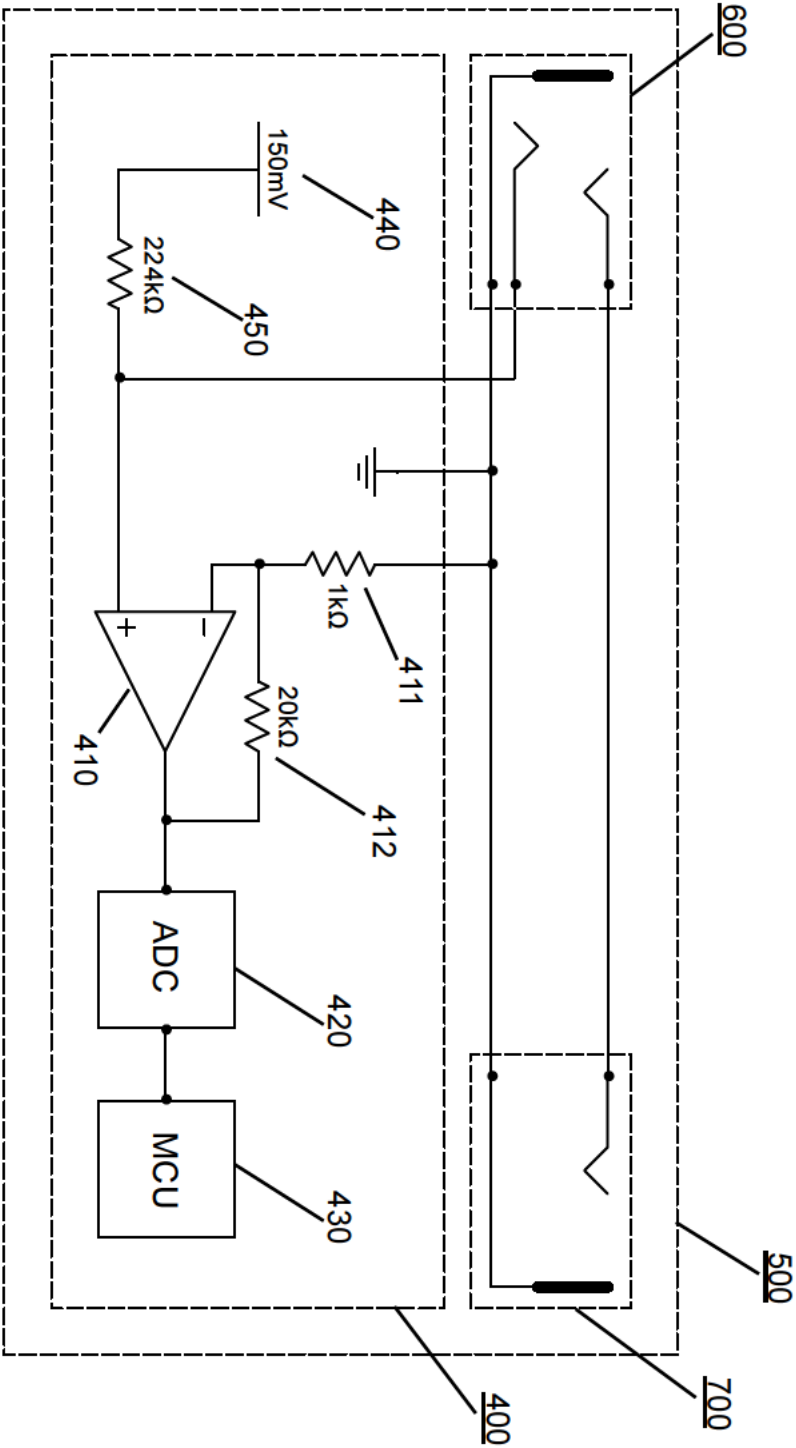


Figure 3

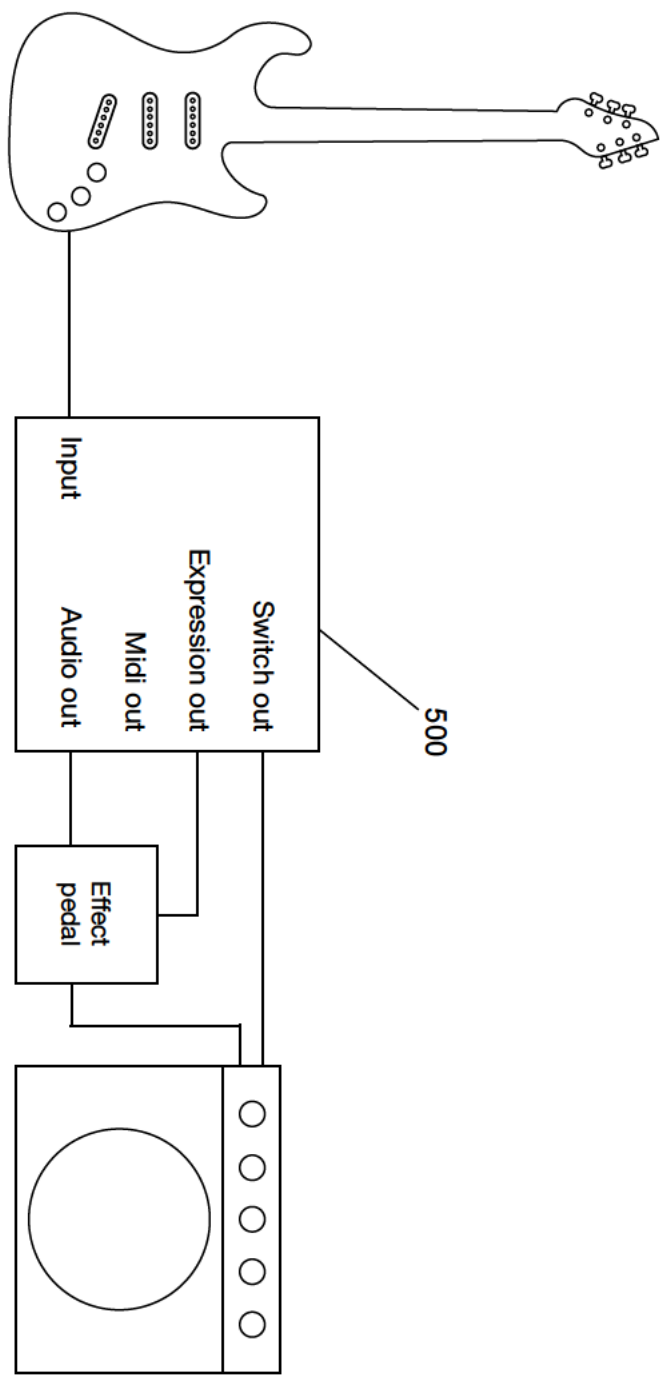


Figure 4

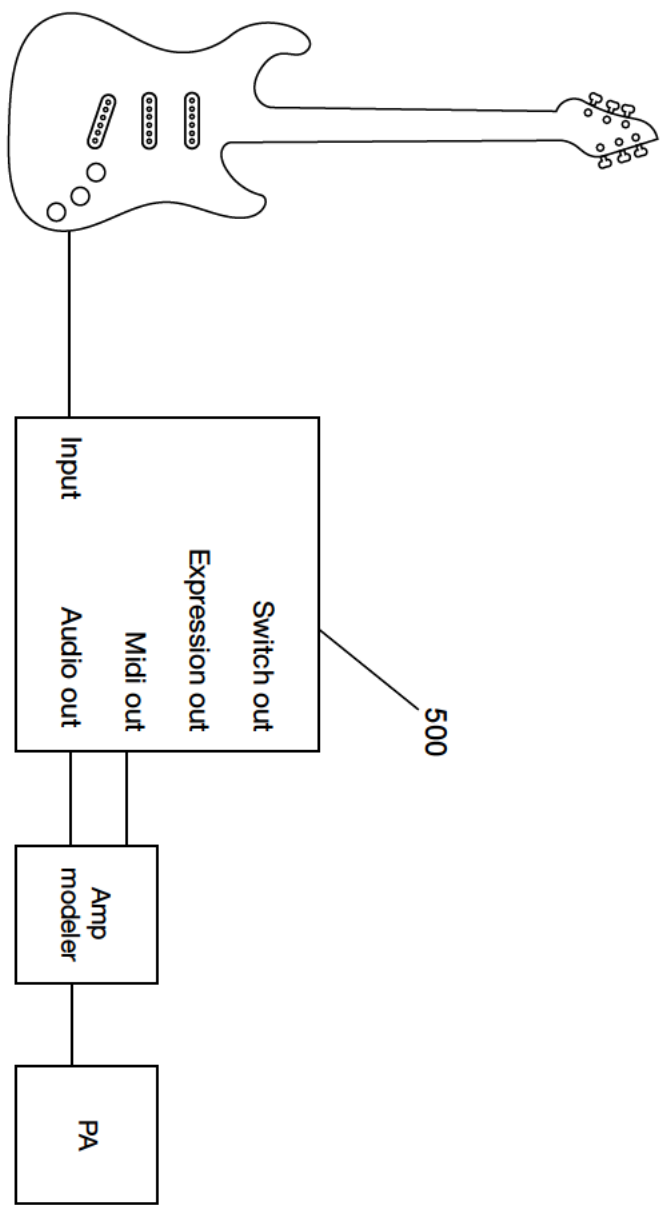


Figure 5