Title of the Invention: Musical effects device

Abstract Title: Musical effect controller with a position sensor comprising a tuned resonant circuit

A musical effect device receives an input signal from an electronic musical instrument or microphone, and provides an output signal comprising a modified version of the input signal. An effect control circuit coupled between the input and output applies a variable controllable effect to modify the input signal. The musical effect device further comprises a position sensor which senses a position of a moveable mechanical control and uses the result to determine the amount of controllable effect to apply to the input signal. The position sensor comprises: a first tuned resonant circuit (fig 1) such as a spiral coil track on a PCB; drive electronics to drive the circuit at a resonant frequency; and an electrically reactive element associated with the moveable mechanical control. The electrically reactive element may be a passive tuned resonant circuit (fig 2). The musical effect device may take the form of: an expression foot pedal (fig 5), a slider knob (fig 6), a rotary knob, or a wearable item (fig 7) such as jewellery or clothing.

FIG. 5
Musical Effects Device

FIELD OF THE INVENTION

We describe sensors for musical instrument control, and related musical effect devices and methods.

BACKGROUND

Musicians often use electronic effects to modify the sound of their instrument during composition and recording and during live performances. For many of these effects it is desirable for the musician to be able to control an aspect of the effect and this is typically achieved by interaction with controllers such as linear sliders, also known as faders, rotary knobs or foot pedals, also known as expression pedals. These controllers permit a musical effect to be varied continuously between a maximum and a minimum of that effect.

Using the example of the expression pedal, the effect of the expression pedal on the musical sound varies as the musician presses the pedal. The pedal is thus the controller that the musician uses to apply the desired amount of the effect to the sound. Different expression pedals exist such as volume pedals where the sound level is modified, wah-wah pedals where the frequency characteristics of the sound is modified and generic controller pedals where a control signal is used, for example, to adjust a parameter of a synthesizer. All of these pedals have in common the need to know how much the pedal has been pressed by the musician so that this can be converted into application of the correct amount of the effect being controlled by the pedal.

Other controllers, such as faders and knobs, use a similar principle to that described for the expression pedal. For a fader, the amount of the effect to be applied to the sound is determined by how much the fader has been moved. For a knob, the amount of the effect to be applied to the sound is determined by how far the knob has been rotated.

It is also possible to control a musical effect by using a controller which does not require the musician to touch it. For example, non-contact optical controllers can detect
the proximity of an object such as the musician’s hand as is described in US 6,153,822 or foot as is described in US 2006/0278068 A1.

All of these controllers have in common the fact that the control of the effect is via the separation of a fixed reference element and a moveable element (such as pedal, slider, knob, ring), the position of which is chosen by the musician to achieve the desired musical effect.

The control of the musical effect can be accomplished in two ways: direct and indirect. Direct control of the effect is where the movement of the moveable element causes direct variation of a circuit element in an electronic circuit. Direct control therefore requires a circuit element whose electrical response can be varied by the movement of said moveable element. Indirect control of the effect is where the position of said moveable element with respect to said fixed reference element is measured to give a value of the mutual separation between said elements and this mutual separation value is used to control a separate circuit element in an electronic circuit or is used as an input parameter to a digital signal processing algorithm. It is therefore a requirement for indirect control to measure accurately the mutual separation of said fixed reference element and said moveable element.

Volume control pedals and wah-wah pedals have characteristically used potentiometers as a direct means of controlling the sound effect, such as is described in US 3,530,224. A significant problem associated with this use of potentiometers is that most potentiometers are not designed for the large number of operating cycles required in such controllers, and those that are very expensive. As potentiometers wear out, the reproducibility of the control is compromised and noise can be introduced into the corresponding electronic circuits. Indeed it is common to need to replace the potentiometers in wah-wah and volume control pedals when they wear out. It is therefore highly desirable to have an alternative solution that is robust and does not suffer from wear during operation.

Optical position sensing can be used as an alternative to potentiometers, for example as is described in US 6,859,541 B1, but the performance of such systems is vulnerable to degradation by contamination and they need to be cleaned to retain optimal performance. Moreover, they can contain delicate optical elements such as shades or films with graduated transparency which make them sensitive to shock and vibration with a corresponding reduction in long-term reliability. They can also be more
expensive than potentiometers. It is therefore desirable to have an alternative position sensor that is unaffected by dirt and moisture contamination and is robust to shock and vibration such as is experienced during normal use.

Magnetic sensors such as Hall probes where a permanent magnet is moved with respect to the Hall probe are another alternative to potentiometers that is sometimes used. The inventors hereof have found that Hall probes that are able to detect precise variations in a magnetic field, such as caused by the movement of a proximate permanent magnet, are expensive and require operating voltages higher than is commonly used for a microcontroller-based musical effect. Hall probes can also be sensitive to other nearby magnetic fields which is a problem when multiple controllers are being used in proximity to one another. Moreover, magnetic sensors which detect the proximity of a permanent magnet can only be used in indirect control schemes. In electronic musical instrument applications, an alternative low-voltage, accurate and inexpensive position sensor that has the flexibility to be used in both direct and indirect control schemes is highly desirable.

Inductive proximity sensors show promise as an alternative to potentiometers. However, they are not currently used in the electronic musical industry because those that are commercially available are expensive and have technical limitations in this field of application. Commercially available inductive proximity sensors use an inductive coil and a ferrite core material to detect the presence of a nearby metallic object and this metallic object needs to be close to the inductive coil for accurate position measurements to be made, or the inductive coil needs to be prohibitively large. Moreover, this type of inductive proximity sensor will interact with others of the same type if used nearby because of their sensitivity to metallic objects; the metallic objects from the different sensors cannot be measured independently. Current inductive proximity sensors are clearly not suitable for use in electronic musical instrument applications, and an alternative solution is required.

We will describe a solution that improves the robustness of the controller so that it is substantially unaffected by dirt and moisture contamination, is not affected by the levels of shock and vibration experienced during normal use and does not wear out, that is accurate, that is inexpensive and that can be manufactured reliably and reproducibly. For maximum flexibility the new solution needs to be capable of providing accurate
position sensing over a range of distances, and be capable of being operated in a multi-sensor environment.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is therefore provided a musical effect device having an input to receive an input signal from an electric or electronic musical instrument or microphone, an output to provide an output signal comprising modified version of said input signal, and an effect control circuit coupled between said input and said output to apply a controllable effect to said input signal to provide said output signal, wherein said effect control circuit has a control connection to control a level of said controllable effect applied to said input signal; and wherein said musical effect device further comprises a moveable mechanical control and a position sensor having an output coupled to said control connection, to sense a position of said moveable mechanical control, wherein said position sensor comprises: first a tuned resonant circuit; drive electronics coupled to said tuned resonant circuit to drive said first tuned resonant circuit at a resonant frequency; an electrically reactive element associated with said moveable mechanical control, wherein said electrically reactive element provides a variable modification to a response of said first tuned resonant circuit dependent on a relative position of said electrically reactive element with respect to first tuned resonant circuit; and read-out electronics coupled to one or both of said first tuned resonant circuit and said electrically reactive element, to provide a variable output signal responsive to said relative position of said electrically reactive element with respect to first tuned resonant circuit, wherein said variable output signal of said read-out electronics provides said position sensor output coupled to said control connection of said effect control circuit.

The above described technique has been found to be particularly reliable and effective. Preferably, but not essentially, the electrically reactive element comprises a second tuned resonant circuit tuned to a frequency at which the first tuned resonant circuit is driven. Optionally multiple first and second tuned resonant circuits may be employed, each operating at a different respective frequency, to provide a plurality of respective control parameters for one or more musical effects.
A particularly advantageous coil arrangement has been found to be a flat or planar coil defined by tracks on a printed circuit board, as this helps achieve a well defined, repeatable geometry. The flat spatial configuration is also advantageous, particularly for a foot pedal type device, when one coil may be mounted on the base and a second on the foot plate. Where the foot plate is metal the coil may be slightly spaced away from the foot plate, to reduce de-tuning, but this is not essential. In embodiments the foot plate incorporates a stop, for example opposite a hinge at one end of the foot plate, to inhibit the coils of the first and second tuned circuits from touching when the foot plate is fully depressed.

In another embodiment the moveable mechanical control is a wearable control, to provide additional scope for musical effect modification. For example the moveable mechanical control may comprise a wrist band or strap on which is attached the second tuned resonant circuit. In embodiments the coil of the second tuned resonant circuit is smaller (as a smaller lateral extent) than that of the first tuned circuit, which may be mounted on the instrument. This helps to achieve increased range and reliable operation.

In a related aspect the invention provides a method of controlling a musical effects device, the method comprising: providing the device with a moveable control; providing an electrically reactive element for said moveable control; sensing a position of said moveable control using a driven tuned resonant circuit and read-out electronics coupled to one or both of said electrically reactive circuit and said tuned resonant circuit to sense a relative position of said moveable control and said tuned resonant circuit by sensing a signal from said driven tuned circuit; and controlling said musical effects device using said position sensing.

The invention also provides a position sensor comprising an active tuned resonant circuit, providing a signal which varies as the mutual separation of said active tuned resonant circuit and an electrically reactive element is varied, drive electronics connected to said active tuned resonant circuit and read-out electronics connected to either said active tuned resonant circuit or said electrically reactive element.
BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will now be described in detail, with reference to the accompanying drawings, in which:

Figure 1 shows an active tuned resonant circuit according to the present invention.

Figure 2 shows a passive tuned resonant circuit according to the present invention.

Figure 3 shows relative movement between the inductive coil of the active tuned resonant circuit and the electrically reactive element which can be detected according to the present invention.

Figure 4 shows an example of a simple read-out electronic circuit comprising a synchronous demodulator which may be used by the present invention.

Figure 5 shows a cross section view of a foot-pedal wherein the position of the foot-pedal is determined using the present invention.

Figure 6 shows a cross section view of a slider control wherein the position of the slider is determined using the present invention.

Figure 7 shows a musician playing a musical instrument wherein said musician is wearing the electrically reactive element and said musical instrument incorporates the active tuned resonant circuit according to the present invention.

Figure 8 shows a cross section view of non-conductive elements interposed between the inductive coils and electrically conductive elements, such as elements of an enclosure, according to embodiments of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

A preferred embodiment comprises an active tuned resonant circuit Fig 1 inductively coupled to an electrically reactive element 20 in Fig 3, henceforth referred to as the reactive element, providing a signal which varies as the mutual separation of said active tuned resonant circuit and said reactive element is varied, a mechanism or housing which enables the mutual separation of said active tuned resonant circuit and
said reactive element to be varied, drive electronics connected to said active tuned
resonant circuit and read-out electronics connected to either said active tuned resonant
circuit or to said reactive element.

The active tuned resonant circuit Fig 1 comprises an input resistor 4, an inductive coil
1, two capacitive elements 2 and 3, a means of connecting 5 drive electronics to the
input resistor 4 and a means of connecting 7 read-out electronics to the read-out point
6. The input resistor 4 may be omitted, but it is preferred because it performs two
useful functions: it limits the current supplied to said active tuned resonant circuit from
said drive electronics which reduces the operating current required and thus reduces
both power consumption and electro-magnetic emissions from said active tuned
resonant circuit; and increases the sensitivity of proximity detection when the read-out
electronics are connected to said active tuned resonant circuit. The inductive coil 1
provides a means of coupling between said active tuned resonant circuit and the
reactive element. The capacitive elements 2 and 3 together with the inductive coil 1
form a resonant LC circuit. The total value of the capacitance can be adjusted to tune
the frequency of resonance of said active tuned resonant circuit. In the case where said
input resistor 4 is not used, only one capacitive element 3 is required.

Referring to Fig 2, the reactive element preferably comprises a passive tuned resonant
circuit which comprises an inductive coil 8, a capacitive element 9 and optionally a
means of connecting 11 read-out electronics to the read-out point 10. In the case
where said read-out electronics are connected to the active tuned resonant circuit Fig 1
said inductive coil 8 and capacitive element 9 are connected to form a closed resonant
LC circuit Fig 2A. The value of the capacitance of said capacitive element 9 is
preferably chosen to tune the frequency of resonance of said passive tuned resonant
circuit to match that of said active tuned resonant circuit Fig 1. When said passive and
active circuits are thus tuned, it is possible to operate in close proximity a plurality of
sensors according to the present invention which can be used, for example, to
simultaneously measure different axes of motion such as but not limited to horizontal,
vertical and rotational.

The reactive element may alternatively comprise an electrically conductive object when
the read-out electronics are connected to the active tuned resonant circuit 7 in Fig 1.
However, the range of mutual separation of the active tuned circuit and the electrically
conductive object over which an accurate position measurement can be made is lower
than when a passive tuned resonant circuit Fig 2 is used.

The inductive coils used in the active tuned resonant circuit 1 and the passive tuned
resonant circuit 8 can be of any type. However using planar spiral coils formed by
tracks on a printed circuit board has three main advantages: they are inexpensive, they
can be made with highly reproducible values of inductance and the printed circuit board
can also be used to mount the other components required, namely the capacitive
elements 2, 3 and 9. It is therefore possible to design two inductive coils whose
inductance values are closely matched. In this case, one such inductive coil can be
used in said active tuned resonant circuit Fig 1, and another similar inductive coil used
in said passive tuned resonant circuit Fig 2. When such matched inductive coils are
used said active and passive circuits can be tuned by matching the capacitance of the
capacitive element 9 (Cp) in said passive tuned circuit Fig 2 with the capacitance of the
series combination of the two capacitive elements 2 (Ca1) and 3 (Ca2) in said active
tuned resonant circuit Fig 1, thus: \[ \frac{1}{C_p} = \frac{1}{(1/Ca1) + (1/Ca2)} \].

When the inductive coil 1 or 8 is placed close to a metallic or other electrically
conductive element, such as an enclosure, the effective value of inductance of said coil
is changed causing a corresponding change in the frequency of resonance of the
active tuned resonant circuit or of the passive tuned resonant circuit, a phenomenon
herein referred to as detuning. Such detuning can be compensated for in two ways.
Firstly, referring to Fig 8, a non-conductive element 22, such as but not limited to an
air-gap or plastic spacer, can be interposed between said inductive coil 1 and said
electrically conductive element 24 to reduce the amount of detuning of said active
tuned resonant circuit. Similarly, a non-conductive element 23, can be interposed
between said inductive coil 8 and said electrically conductive element 25 to reduce the
amount of detuning of said passive tuned resonant circuit. Preferably the thickness of
said non-conductive elements 22 and 23, and thus the separation of said inductive
coils 1 and 8 from said conductive elements 24 and 25, shall be the same. In this way,
detuning is matched and the detuned frequency of resonance of said active tuned
resonant circuit will match the detuned frequency of resonance of said passive tuned
resonant circuit. Secondly, the frequency of resonance of either or both of said active
tuned resonant circuit and said passive tuned resonant circuit can be changed by
changing the value of capacitance of one or more of the capacitive elements 2, 3 and 9.
such that the detuned frequency of resonance of said active tuned resonant circuit
matches the detuned frequency of resonance of said passive tuned resonant circuit.

The drive electronics comprise a means of generating an oscillating voltage drive
waveform at a frequency equal to or close to the resonant frequency of the active tuned
resonant circuit. Typically, but by way of non-limiting example, this waveform is a
square waveform generated by the output of a microcontroller timer or a digital or
analogue timing circuit.

The read-out electronics comprise a means of generating a low-frequency or DC
voltage proportional to the amplitude of the signal at the read-out point 6 or 10.
Typically, but by way of non-limiting example, this comprises a synchronous
demodulator circuit Fig 4 wherein the signal from said read-out point is connected to 22
and demodulated by an analogue switch 25 controlled by the oscillating voltage drive
waveform connected to 23 whose phase is optionally adjusted by a phase shifting
element 24 and a low-frequency (or dc) voltage is presented at 28 by a low-pass filter
comprising a resistor 26 and a capacitive element 27. Alternative read-out electronic
circuits may comprise phase-sensitive rectifiers, phase-insensitive rectifiers, and non-
synchronous demodulators as understood by those trained in the art.

When used to indirectly control the musical signal, the low-frequency output voltage
from the read-out electronics can be used to control a separate circuit element in an
electronic circuit or converted to a digital value via an analogue-to-digital-converter and
used as an input parameter to a digital signal processing algorithm or transmitted as
musical instrument digital interface (MIDI) messages.

In the case where the present invention is used to directly control the musical signal,
the drive waveform can be modulated by the musical signal, and said musical signal
recovered by demodulation in the read-out electronics. The amplitude of the recovered
signal thus depends directly on the mutual separation of the inductive coil of the active
tuned resonant circuit 1 and the reactive element 20, thus an embodiment of the
invention can itself be a circuit element in an electronic musical effect circuit.

In the case where the reactive element is a passive tuned resonant circuit Fig 2, the
active tuned resonant circuit Fig 1 is inductively coupled to said passive tuned resonant
circuit. The strength of the inductive coupling increases as the mutual separation of the
centre of the two inductive coils 1 and 8 which are elements of said circuits is
decreased. There is no requirement for said inductive coils to come into contact with one another, thus eliminating any mechanical wear, thus improving robustness and reliability.

The means of operation of the inductive coupling depends on the configuration of the passive tuned resonant circuit Fig 2. In the case where said passive tuned resonant circuit is connected to the read-out electronics Fig 2B, the oscillating current in the inductive coil 1 of the active tuned resonant circuit Fig 1 induces a corresponding current in the inductive coil 8 of said passive tuned resonant circuit which allows a voltage to be measured by said read-out electronics. In the case where said active tuned resonant circuit is connected to said read-out electronics and said passive tuned resonant circuit forms a closed resonant LC circuit Fig 2A, the oscillating current in the inductive coil 1 of said active tuned resonant circuit induces a corresponding current in said inductive coil 8 of said passive tuned resonant circuit and because said passive tuned resonant circuit is a closed circuit this current is dissipated by the resistance of said inductive coil 8. Energy is thus transferred from said inductive coil 1 in said active tuned resonant circuit Fig 1 to said inductive coil 8 in said passive tuned resonant circuit Fig 2A. A consequence of this energy transfer is that the amount of energy that can be stored in said active tuned resonant circuit Fig 1 is decreased as the mutual separation of said passive tuned resonant circuit and said active tuned resonant circuit is decreased. This decrease in stored energy in the active resonant circuit can be measured by the read-out electronics as a decrease in the voltage amplitude at the read-out point 6.

In the case where the reactive element is an electrically conductive object, the magnetic field generated by the active tuned resonant circuit Fig 1 induces an eddy current in said electrically conductive object. Thus energy is transferred from said active tuned resonant circuit to said electrically conductive object, causing a reduction in the amount of energy that can be stored in said active tuned resonant circuit when the mutual separation of said electrically conductive object and said active tuned resonant circuit is decreased. However, for a given mutual separation of said active tuned resonant circuit and said reactive element, the amount of energy that is transferred in this case is lower than in the case where the reactive element is a passive tuned resonant circuit Fig 2.
The mechanism or housing which facilitates the variable separation of the inductive coil 1 of the active tuned resonant circuit and the reactive element 20 can support different methods of movement: linear Fig 3A, angular Fig 3B, translational Fig 3C, or a combination of these. Thus possible mechanisms and housings include but are not limited to: a foot pedal Fig 5, a slider Fig 6 and a musician moving said active tuned resonant circuit or said reactive element Fig 7.

Such a mechanism or housing typically includes a fixed element and a moveable element. It such cases is preferable for the fixed element to contain the active tuned resonant circuit Fig 1 to which the read-out electronics are connected, and for the moveable element to contain the reactive element 20. In this configuration no electrical connections are required to said moveable element thus improving robustness and reliability. Furthermore, this configuration allows the electronic circuits to be fully enclosed inside a non-conductive housing to further improve the reliability of the entire musical effect electronic circuits. However, it is also possible for the mechanism or housing to include two moveable elements. In such cases there is no preference for the location of said active tuned resonant circuit and said reactive element.

Referring to Fig 5, a foot-pedal may comprise a fixed base-plate 12, a moveable foot-plate 13 connected to said base-plate via a hinge mechanism 14 to facilitate controlled variation of the mutual angular separation Fig 3B of said base-plate and said foot-plate. In such a foot-pedal, the reactive element 20 can be located in said foot-plate and the inductive coil 1 of the active tuned resonant circuit can be located in said base-plate. An end-stop element 26 maintains a minimum separation between said inductive coil 1 and said reactive element 20 to prevent contact thereof, thus improving robustness and reliability. In the case where said base-plate comprises an electrically conductive material, an air gap or spacer 22 comprised of a non-conductive material is interposed between said inductive coil 1 and said base-plate. In the case where said foot-plate comprises an electrically conductive material, an air gap or spacer 23 comprised of a non-conductive material is interposed between said reactive element 20 and said base-plate 13. When the read-out electronics are connected to said active tuned resonant circuit, there are no electrical connections required to be made to the reactive element 20 thus no electrical connection is required to movable parts thus further improving robustness and reliability.
Referring to Fig 6, a linear slider mechanism may comprise a fixed housing 15 and a moveable slider knob 16 moving along a track in said fixed housing wherein the mutual translational separation Fig 3C of said fixed housing 15 and said moveable slider knob 16 can be varied as said slider knob 16 moves back and forth along its track. In such a slider mechanism, the reactive element 20 can be mounted on said moveable slider knob 16 and the inductive coil 1 of the active tuned resonant circuit can be located in said fixed housing 15. When the read-out electronics are connected to said active tuned resonant circuit, there are no electrical connections required to be made to the reactive element 20 thus no electrical connection is required to movable parts thus improving robustness and reliability.

Referring to Fig 7, a musician may vary their position relative to a musical instrument and it is desirable to use the musician’s movement as a means of controlling the sound from the musical instrument. In this case, the inductive coil 1 of the active tuned resonant circuit can be located in an electronic component or musical instrument 17 that forms part of the electronic musical instrument environment used by the musician and the reactive element 20 can be located in a moveable element 18 that the musician holds or wears such as, by way of non-limiting examples, jewellery, a musical instrument, a baton or clothing. Because there need be no electrical connections to said reactive element 20 the moveable element 18 can be moved freely by the musician. Furthermore, in the case of said reactive element comprising a passive tuned resonant circuit Fig 2A whose frequency of resonance is tuned to match that of said active tuned resonant circuit, multiple sets of active tuned resonant circuits and passive tuned resonant circuits can be combined when each set is tuned to operate at a resonant frequency different from the other sets. In this case it is possible for a musician to independently control different aspects of their performance by varying the positions of each reactive element independently.

In summary, we have described a non-contact sensor which can be used in a variety of ways to control aspects of a musical instrument’s sound, whilst overcoming the deficiencies in previously developed sensors used for this purpose.

No doubt many other effective alternatives will occur to the skilled person. Whereas the present invention has been described with respect to specific embodiments thereof, it will be understood that the invention is not limited to the described embodiments and
encompasses modifications apparent to those skilled in the art lying within the spirit and scope of the claims appended hereto.
CLAIMS:

1. A musical effect device having an input to receive an input signal from an electric or electronic musical instrument or microphone, an output to provide an output signal comprising modified version of said input signal, and an effect control circuit coupled between said input and said output to apply a controllable effect to said input signal to provide said output signal, wherein said effect control circuit has a control connection to control a level of said controllable effect applied to said input signal; and

   wherein said musical effect device further comprises a moveable mechanical control and a position sensor having an output coupled to said control connection, to sense a position of said moveable mechanical control, wherein said position sensor comprises:

      a first tuned resonant circuit;

      drive electronics coupled to said tuned resonant circuit to drive said first tuned resonant circuit at a resonant frequency;

      an electrically reactive element associated with said moveable mechanical control, wherein said electrically reactive element provides a variable modification to a response of said first tuned resonant circuit dependent on a relative position of said electrically reactive element with respect to first tuned resonant circuit; and

      read-out electronics coupled to one or both of said first tuned resonant circuit and said electrically reactive element, to provide a variable output signal responsive to said relative position of said electrically reactive element with respect to first tuned resonant circuit, wherein said variable output signal of said read-out electronics provides said position sensor output coupled to said control connection of said effect control circuit.

2. A musical effect device as claimed in claim 1 wherein said electrically reactive element comprises a second tuned resonant circuit.

3. A musical effect device as claimed in claim 2 comprising a plurality of said first and second tuned resonant circuits each associated with a or the moveable mechanical control, each with a different respective tuned frequency, and each to sense a different respective movement, wherein said readout electronics is configured to provide a plurality of respective said variable output signals for said plurality of second tuned resonant circuits, and wherein said effects control circuit has a set of
controllable effect parameters each modified by a respective said variable output signal.

4. A musical effect device as claimed in claim 1, 2 or 3 wherein said first tuned resonant circuit, and when dependent on claim 2 said second tuned resonant circuit, comprises a coil defined by tracks on a printed circuit board.

5. A musical effect device as claimed in claim 1, 2, 3 or 4 wherein said device is a foot pedal device, and wherein said electrically reactive element is located in or on a moveable foot-plate of said foot pedal device.

6. A musical effect device as claimed in claim 5 when dependent on claim 2 wherein said second tuned circuit is spaced away from said foot plate.

7. A musical effect device as claimed in claim 5 or 6 when dependent on claim 2, wherein said first and second tuned resonant circuits each comprise a coil with a substantially planar surface mounted opposite one another on said foot pedal device and said foot-plate.

8. A musical effect device as claimed in any one of claims 1 to 4 wherein said moveable mechanical control is a wearable control.

9. A musical effect device as claimed in claim 8 in combination with said instrument, wherein at least a coil of said first tuned resonant circuit of said musical effects device is mounted on said instrument.

10. A method of controlling a musical effects device, the method comprising: providing the device with a moveable control; providing an electrically reactive element for said moveable control; sensing a position of said moveable control using a driven tuned resonant circuit and read-out electronics coupled to one or both of said electrically reactive circuit and said tuned resonant circuit to sense a relative position of said moveable control and said tuned resonant circuit by sensing a signal from said driven tuned circuit; and controlling said musical effects device using said position sensing.
11. A method as described in claim 10, wherein said electrically reactive element comprises a second tuned resonant circuit and wherein said device is a foot pedal device, and wherein said electrically reactive element is located in or on a moveable foot-plate of said foot pedal device.

12. A method of providing a controllable musical effect using the method of claim 10, the method comprising wearing said moveable control.

13. A position sensor comprising an active tuned resonant circuit, providing a signal which varies as the mutual separation of said active tuned resonant circuit and an electrically reactive element is varied, drive electronics connected to said active tuned resonant circuit and read-out electronics connected to either said active tuned resonant circuit or said electrically reactive element.

14. A position sensor according to claim 13 wherein the electrically reactive element comprises a passive tuned resonant circuit.

15. A position sensor according to claim 13 wherein the electrically reactive element comprises an electrically conductive object.

16. A position sensor according to claim 13, 14 or 15 wherein the mutual separation of the active tuned resonant circuit and the electrically reactive element is varied by a mechanism or housing which directs the relative movement between said active tuned resonant circuit and said electrically reactive element which allows the variation in said mutual separation to be linear, translational, angular or a combination of these.

17. A position sensor according to claim 16 wherein the mechanism or housing comprises a foot pedal.

18. A position sensor according to claim 16 wherein the mechanism or housing comprises a slider knob.

19. A position sensor according to claim 16 wherein the mechanism or housing comprises a rotary knob.
20. A position sensor according to claim 13, 14 or 15 wherein the mutual separation of the active tuned resonant circuit and the electrically reactive element is freely variable.

21. A position sensor according to claim 20 wherein the active tuned resonant circuit or the electrically reactive element is housed in a musical instrument or jewellery or clothing or baton or device moved by person or persons involved in a musical performance.

22. A position sensor according to claim 13 wherein the active tuned resonant circuit comprises an inductive coil, at least one capacitive element and a means of connecting the drive electronics.

23. A position sensor according to claim 22 wherein the active tuned resonant circuit further comprises an input resistor and at least two capacitive elements.

24. A position sensor according to claim 22 or 23 wherein the active tuned resonant circuit further comprises a means of connecting the read-out electronics to the inductive coil.

25. A position sensor according to claim 14 wherein the passive tuned resonant circuit comprises an inductive coil and a capacitive element.

26. A position sensor according to claim 25 wherein the passive tuned resonant circuit further comprises a means of connecting the read-out electronics.

27. A position sensor according to claim 22 wherein the inductive coils are formed from planar spiral tracks on a printed circuit board.

28. A position sensor according to claim 22 wherein the inductive coils are wirewound.

29. A position sensor according to any one of claims 13 to 28 wherein the read-out electronics comprise a synchronous demodulation circuit, or a non-synchronous demodulation circuit, or a phase-sensitive rectification circuit or a phase-insensitive rectification circuit.
30. A position sensor according to claim 14 wherein the active tuned resonant circuit and the passive tuned resonant circuit are tuned to have the same frequency of resonance.

31. A position sensor according to claim 13, 14 or 15 wherein said sensor can be used as an electronic circuit element to directly control a musical effect signal.

32. A position sensor according to claim 13, 14 or 15 wherein the output from said sensor can be used to control a separate circuit element in an musical effect electronic circuit or converted to a digital value via an analogue-to-digital-converter and used as an input parameter to a digital signal processing algorithm or transmitted as musical instrument digital interface (MIDI) messages.

33. A position sensor according to claim 30 wherein a plurality of position sensors are operated in close proximity where each position sensor operates at a different frequency of resonance.

34. A position sensor according to claim 30 wherein a plurality of position sensors are operated in close proximity where each position sensor operates at the same frequency of resonance.

35. A musical effects device substantially as hereinbefore described with reference to one or more of the drawings.
**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

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<td>1, 5-13, 15, 17-20, 22-26 &amp; 28-34</td>
<td>GB 2320125 A (ETHYMONICS LTD) - See the figures, page 1 line 29 to page 2 line 23 and page 8 line 30 to page 9 line 9</td>
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<td>US 2002/140419 A (COMMISSARIAT ENERGIE ATOMIQUE) - See the figures and paragraphs [0031] to [0081]</td>
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<td>13, 14, 20, 22-25, 27 &amp; 30</td>
<td>WO 2011/128698 A1 (AND TECHNOLOGY RESEARCH LTD) - See the figures and pages 5 to 10</td>
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**Categories:**

- **X** Document indicating lack of novelty or inventive step
- **Y** Document indicating lack of inventive step if combined with one or more other documents of same category.
- **&** Member of the same patent family
- **A** Document indicating technological background and/or state of the art.
- **P** Document published on or after the declared priority date but before the filing date of this invention.
- **E** Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

Worldwide search of patent documents classified in the following areas of the IPC:

- G01D; G10H; H03K

The following online and other databases have been used in the preparation of this search report:

- WPI, EPODOC
### International Classification:

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