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[54] AUTOMATIC ON-OFF CONTROL

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[52] **U.S. Cl.** **84/1.11**, 84/1.16, 84/1.24, 307/119

[51] **Int. Cl.** **G10h 3/00**

[58] **Field of Search** ..... 84/1.01, 1.08, 1.11, 1.19, 84/1.22, 1.24, 229 LD, 229 B, DIG. 19, 229 P, 229 PC, 229 F, 1.26, 1.27; 178/7.3; 179/1 SW; 307/119; 333/17

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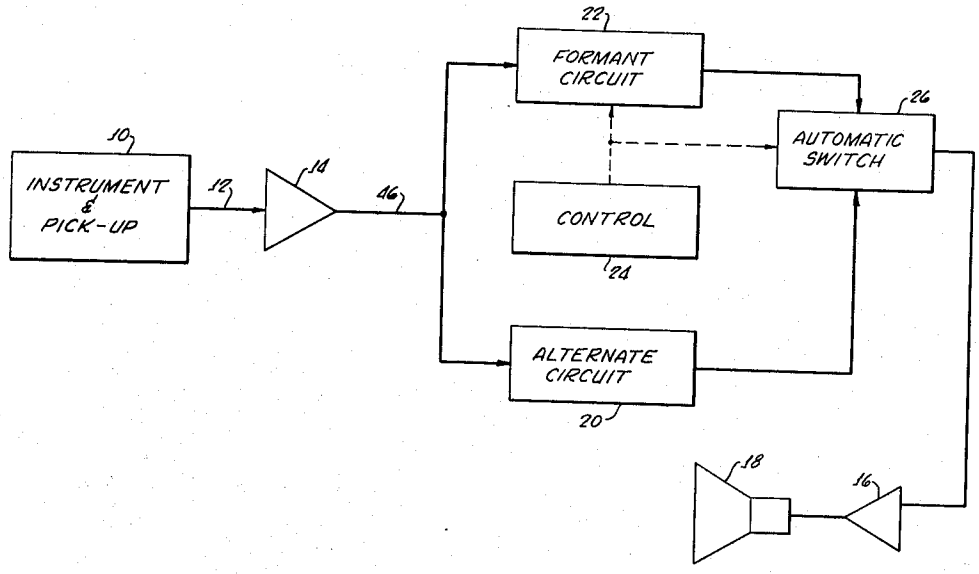
[57] **ABSTRACT**

An electric musical instrument includes several tone modifying circuits. One of these is a special effects formant circuit operated by oscillatory motion of a foot control pedal. The formant circuit and another straight through or tone circuit are caused to have mutually exclusive operation by means of a pair of switches in the formant and alternate circuits that are actuated upon motion of the foot control pedal.

24 Claims, 3 Drawing Figures



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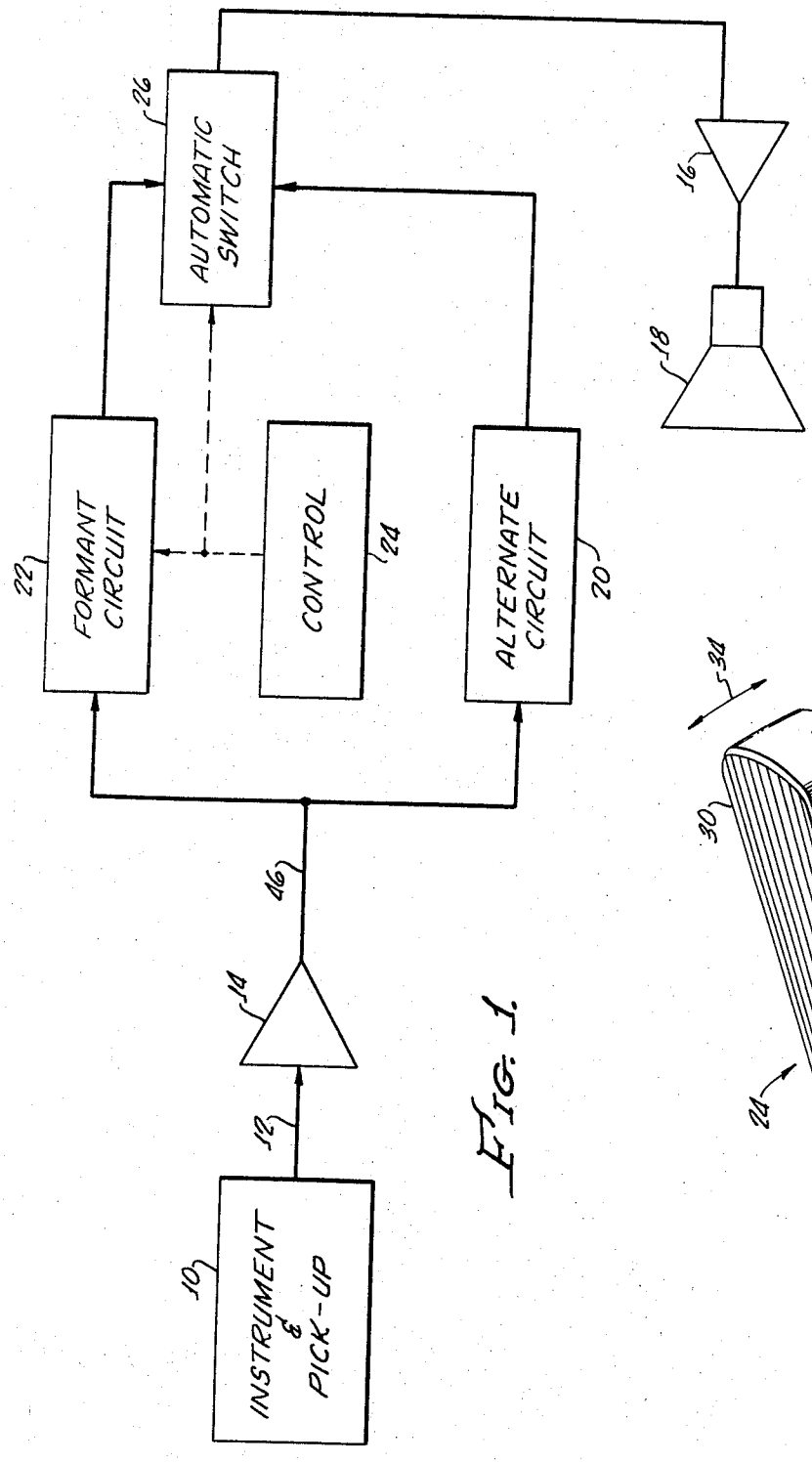

FIG. 1.

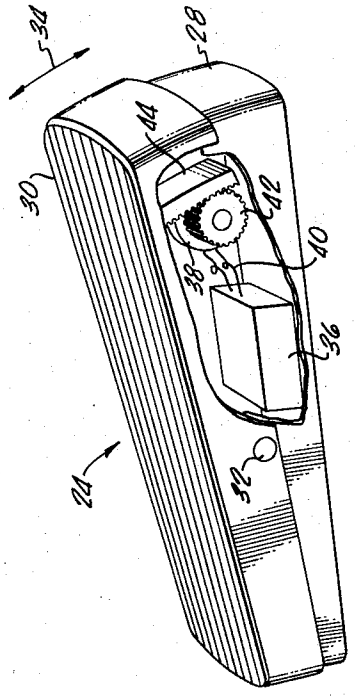

FIG. 2.

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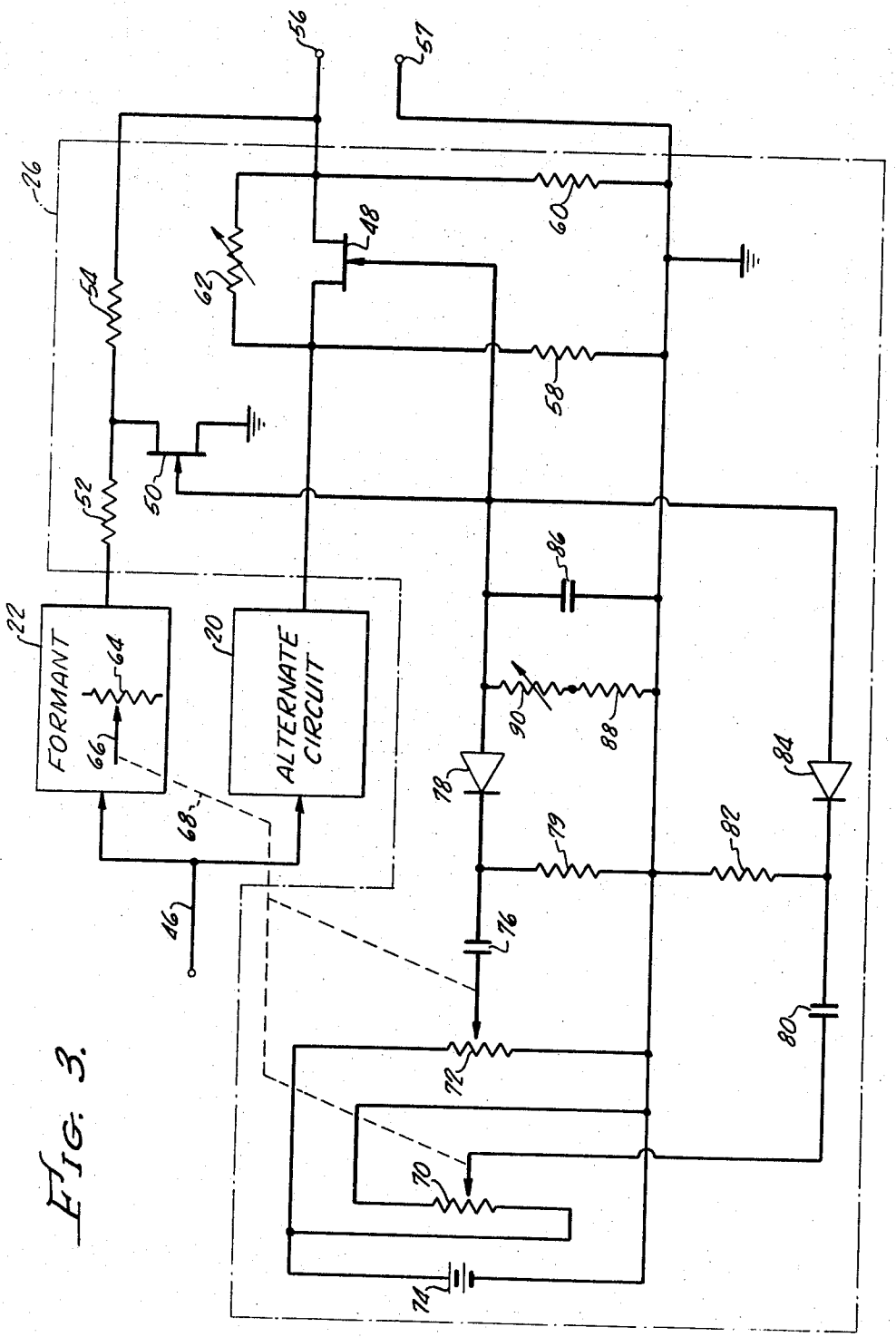

FIG. 3.

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AUTOMATIC ON-OFF CONTROL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to motion operated circuits and more particularly concerns a motion operated special effects circuit for a musical instrument and a control therefor.

Description of Prior Art

In electric musical instruments such as the string, percussive and wind instruments, including the electric organ, several different types of voicing or tone color circuits are employed to produce different sound effects. Generally, such circuits are employed alternatively. Pedal controlled switches are provided to enable selection of a given one of such circuits. Among such circuits are special effects circuits such as the formant circuit that is employed to simulate, for example, the sound made by a trumpet player as a mute is moved into and out of the trumpet bell. Such a special effects circuit embodies a variable potentiometer of which the wiper is caused to oscillate or move to and fro to thereby shift the peak frequency response of the circuit through the frequency spectrum. The operating or controlling potentiometer of such a circuit is physically connected to a foot pedal which, as it is rocked, causes the special effect. When the formant circuit is not being used, its controlling potentiometer is preferably in a central or neutral position and an alternative circuit is employed.

In present arrangements, a special switch on or closely adjacent the foot pedal must be operated to respectively enable and disable the special effects formant circuit. If, as commonly occurs, the operator completes playing a passage employing special effects of the formant circuit, but fails thereafter to operate the formant circuit disabling switch, subsequent passages will be modified by the formant circuit and its operative potentiometer which may not have stopped in a null or central position. Accordingly, subsequent passages will be either attenuated in power or shifted in frequency response.

Various arrangements for foot pedal controlled switches in a musical instrument are illustrated in U.S. Pat. No. 2,953,958 to T. J. George, but no automatic operation of a motion operated control is shown. U.S. Pat. No. 3,176,060 to A. J. Bissonette, et al., teaches the use of gating devices or switches for an electrical musical instrument that can provide a gradual onset of a variety of reproduced tones. Other switching arrangements for circuitry of electric musical instruments are shown in U.S. Pat. No. 3,374,316 to M. A. Slaats, et al., who employs the impedance of photo cells responsive to a switch operated light source for alternatively selecting one of a pair of musical sources. None of the arrangements of the prior art recognize the problem of motion operated control of special effects circuits and, accordingly, suggest no solution.

An object of this invention is to provide a solution to this problem and achieve a motion operated control for an electrical circuit that automatically turns itself on and off.

SUMMARY OF THE INVENTION

In carrying out principles of the present invention in accordance with a preferred embodiment thereof, a signal modulating circuit includes a movably mounted operating member connected to cause the circuit to modulate upon motion of the operating member. Not only does the circuit modulate in response to motion of the member, but it is also turned on during such motion. In a specific embodiment of the invention, an automatic on-off switch is connected in circuit with both a special effects circuit and an alternate circuit or signal path. Oscillation of a control for the special effects circuit automatically enables the latter and disables the alternate path.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of an electric musical instrument embodying an automatically controlled formant circuit in accordance with principles of the present invention,

FIG. 2 illustrates a foot pedal control for the instrument of FIG. 1 and

FIG. 3 comprises a circuit diagram of the automatic switching arrangement of the circuit of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in FIG. 1 an electric musical instrument **10**, such as a guitar having a number of strings and a transducer or pickup, provides an electrical signal output that represents the particular musical tone obtained from the instrument string. Although the present invention may most commonly be employed with an electric guitar, it will be readily appreciated that the described principles and circuitry may be employed with any type of electrical instrument, whether stringed, percussive, wind, or the like, that provides an electrical signal on an output lead such as lead **12** representing the desired musical tone. Such instrument need not be limited to a type including a vibratile or vibratory member and a pickup therefor that generates the musical tone, but may be of the general type that provides electrical generation of a variety of tones such as the conventional electric organ or an instrument employing percussive effect of the electric piano.

The electrical signal generated by the instrument is normally supplied to a conventional preamplifier circuit **14** from whence it may be fed via a lead **46** to an output amplifier **16** and speaker **18** through a signal shaping or alternate circuit **20**. Such an alternate circuit may be one of many different types that provides any of several well known tone expression, volume control, or modifying circuits. For example, various types of voicing circuits, tone control, volume control or other special effects circuits may be used in the alternate path. In many applications no alternate signal shaping is desired, wherefor the alternate path performs no function other than to feed the signal from the amplifier **14** to the output amplifier and speaker. Where the circuit **20** includes different types of circuits, these may be alternatively selected by means of a conventional switching arrangement (not shown).

In order to provide for special effects in the form of continuous shifting of the peak of the frequency response of the electrical signal handling circuitry through the frequency spectrum, there is provided a conventional formant circuit **22** that includes a variable potentiometer (not shown in FIG. 1) of which the wiper arm is reciprocated or oscillated by a reciprocating or oscillating motion of a foot pedal control **24**. The output of both the alternate circuit **20** and the formant circuit **22** are fed through an automatic switch **26**, through which all of the signals are supplied to the output amplifier and speaker **16, 18**.

In general, when the formant circuit is being employed, the alternate circuit **20** is not employed, and substantially all of the signal is fed from preamplifier **14** through the formant circuit and thence through the output amplifier. Alternatively, when the formant circuit is not being employed, desirably this circuit is not operable upon the tone signal, and all of the signal is sent through alternate circuit **20** to the output amplifier.

The formant circuit is operable by causing a rocking motion of foot pedal control **24**. In accordance with the present invention, the automatic switch **26** is interposed between the input of output amplifier **16** and the output of both the formant circuit **22** and the alternate tone circuit **20**, so as to provide automatic alternative operation of circuits **20** and **22**, each to the exclusion, or substantial exclusion, of the other. To this end, the automatic switch involves a derivative action and is, in effect, a derivative circuit that responds to velocity or change of position of the control **24** to pass the output of formant circuit **22** when and only when the pedal control is in motion. Simultaneously, switch **26** disconnects the output of alternate circuit **20**. When motion of foot pedal control **24** ceases, the switch **26** automatically returns to its normal position wherein the output of alternate circuit **20** is coupled to amplifier **16** and the formant circuit **22** is disabled.

Thus, with the illustrated arrangement, the player does not have to perform any specific operation to switch from use of the alternate circuit to the formant circuit and vice versa, nor

does he have to operate any particular switch to enable or disable the formant circuit. When a particular passage being played calls for operation of the formant circuit, the player merely performs the usual rocking or oscillation of the foot pedal. This normal operation automatically enables the formant circuit and disables the alternate circuit. When operation of the foot pedal is stopped, the arrangement automatically goes back to its normal position wherein the formant circuit is disabled and the tone signal is passed through circuit **20**.

Illustrated in FIG. **2** is a substantially conventional arrangement of oscillating or rocking foot pedal control **24** for the formant circuit. A substantially rectangular open-top housing **28** carries a treadle member **30** that is pivoted to the housing by a shaft **32** for bi-directional or rocking motion around the pivot as indicated by the double-ended arrow **34**. Carried within the housing **28** is an electronics package **36** that may constitute a microcircuit or other miniaturized arrangement of substantially all or part of the preamplification, switching and other circuits of FIG. **1**. The housing **28** mounts three rotary potentiometers **38** that are electrically connected by a cable **40** to electronics package **36** as will be more particularly described hereinafter in connection with the description of FIG. **3**. The three potentiometers **38**, fixedly carried within the housing **28**, have a common operating shaft to which is affixed a gear **42**. The latter meshes with a toothed rack **44** carried by treadle member **30** and depending therefrom into operative engagement with the teeth of gear **42**. As the treadle member **30** is oscillated about pivot **32**, the rack **44** reciprocates through a vertically oriented arcuate path and effects a back and forth oscillatory rotation of gear **42**. Accordingly, the three rotary potentiometers **38** have their wiper arms oscillated by the rocking action of the treadle **30**.

Illustrated in FIG. **3** is the circuit of the automatic switch **26** of FIG. **1**. The musical tone signal from preamplifier **14** appears at lead **46** whence it is fed as an input to both the formant circuit **22** and the alternate circuit **20**. At the outputs of circuits **20** and **22** are series and shunt variable impedance or switching devices in the form of field effect transistors **48** and **50**, respectively. These devices, which may be junction field effect transistors such as No. F1175 made by Union Carbide, for example, have a normally low impedance between the source and drain electrodes thereof, on the order of about 1,500 ohms. Upon receipt of a negative signal to the gate electrode thereof, the impedance of the device increases rapidly, and to a large value which may, for practical purposes, approach infinity.

The output of circuit **22** is fed through a pair of series connected resistors **52**, **54** and thence to a terminal **56** which, together with ground terminal **57**, forms the output of the automatic switching device. The shunt field effect transistor **50** has one of its drain and source electrodes connected to the junction between resistors **52** and **54** and the other of its drain and source electrodes connected to ground as indicated in FIG. **3**. The drain and source electrodes of the series switching field effect transistor **48** are connected in series between the output of tone circuit **20** and the automatic switch output terminal **56**. In addition, such drain and source electrodes of transistor **48** are connected to ground via resistors **58** and **60**, respectively. A variable resistor **62** is connected across these electrodes of transistor **48** to provide an adjustable minimum value of the impedance of this device whereby some of the signal fed through alternate circuit **20** may be mixed with the output even when formant circuit **22** is in operation.

Formant circuit **22** conventionally includes a potentiometer **64** having a wiper arm **66** connected to be operated as indicated by dotted line **68** by rocking of the treadle **30**. Thus, whenever the formant circuit is to be employed, the treadle **30** is oscillated, wiper arm **66** of the formant circuit moves back and forth across the resistance of the potentiometer **64**, and the peak frequency response of the output is caused to move back and forth through the frequency spectrum.

One such formant circuit is combined with a "fuzz" circuit and sold as the "FENDER FUZZ-WAH" unit, described on page 31 of the 1969 catalog of Fender Musical Instruments of Santa Ana, California. The formant or "wah" circuit basically comprises a parallel inductance capacitance circuit in which a signal component of variable phase angle is controlled by position of the potentiometer wiper.

In order to operate series and shunt switches **48** and **50** automatically upon occurrence of motion (e.g., change of position) of treadle **30**, there are provided first and second oppositely poled switch operating potentiometers **70**, **72**, each having its wiper arm connected to be operated by the same treadle motion input as indicated at **68**. The three potentiometers **66**, **70**, and **72** are those collectively illustrated at **38** in FIG. **2** and are all mounted within the housing **28**. Preferably, all potentiometers have a common operating shaft so that all are ganged for operation upon rocking of treadle **30**. Potentiometers **70** and **72** are energized in opposite sense by means of dc source such as a battery **74**. As the wiper arms of potentiometers **70** and **72** are moved together downwardly in the illustration, for example, the voltage on the wiper of potentiometer **70** goes more positive. Simultaneously the voltage on the wiper of potentiometer **72** goes more negative.

For potentiometer **72**, the negative going voltage on its wiper arm that occurs during one direction of motion of treadle **30** is coupled through a capacitor **76**, across a resistor **79**, having one end connected to ground, and thence through a diode **78** to the gate electrodes of both the series and shunt field effect transistors **48** and **50**. Similarly, upward motion of the wiper arm of potentiometer **70** provides a negative going voltage that is coupled through a capacitor **80**, across a resistor **82** having one end grounded, and through a diode **84** to the gate electrodes of both of the switching devices **48**, **50**.

Because of the polarity of both of the diodes **78**, **84**, only negative going voltage changes on the wiper arms of potentiometers **70**, **72**, can be passed to the gate electrodes of the switching transistors. So, too, it will be observed that the coupling capacitors **76** and **80** allow the gate electrodes of the switching transistors to receive a signal from the potentiometers only during motion of the wiper arms thereof, since the capacitors, of course, block dc signals. Furthermore, the illustrated arrangement allows transmission of a changing signal from only one of the potentiometers for a given direction of motion of treadle **30** and potentiometer wiper arms.

For example, as the wiper arms of both potentiometers **70** and **72** move downwardly in FIG. **3**, the voltage on the arm of potentiometer **70** increases and, accordingly, is blocked by diode **84**. However, the voltage on the arm of potentiometer **72** concomitantly decreases and, accordingly, a negative going voltage is coupled via capacitor **76** through diode **78**. On the other hand, when the two potentiometer arms are moved in the other direction, upwardly in FIG. **3**, the positive going voltage on the wiper arm of potentiometer **72** is blocked and a negative going voltage on the arm of potentiometer **70** is coupled to the gate electrodes via diode **84**.

Thus, no matter which way the treadle **30** is moving one or the other of the potentiometers **70**, **72** couples a negative going signal to the gate electrodes of both field effect transistors **48** and **50** whereby the impedance of both of these is increased when the treadle is moved. Accordingly, whenever formant circuit **22** is operated by rocking motion of the treadle **30**, the impedance of switching device **48** increases to attenuate or block the output of circuit **20**. At the same timer, the impedance of shunting switch **50** increases to allow the output of formant circuit **22** to pass through resistor **54** to the automatic switching device output terminals **56**, **57**, instead of passing to ground. The values of resistors **52**, **54** and **58**, **60** are considerably greater than the value of the impedance of the field effect transistors **48** and **50** when the latter are in their low impedance state. When in their high impedance state, the switching devices have a resistance considerably greater than the values of resistors **52**, **54**, **58** and **60**.

The described circuit has a derivative type action that provides a signal only upon and during motion of the foot pedal control. It may be modified in order to round off, in effect, the otherwise relatively sharp on-off action that accompanies initiation and termination of foot pedal motion. Thus, it is desired to maintain the formant circuit operating for a short period of time after termination of foot pedal motion. Further, as the foot pedal reverses its direction, and the arms of potentiometers **70, 72** reverse direction, the control signal is shifted from one path such as, for example, that including capacitor **76** and diode **78**, to the other path of the circuit, that including capacitor **80** and diode **84**. Each such diode has a voltage or conduction threshold of about a 0.65 volts. Accordingly, upon reversal of direction of motion of the potentiometer arms, the transmission of signal through one of the diodes **78**, for example, is stopped, but transmission of the signal through the other diode **84** cannot begin until the motion in reverse direction has progressed sufficiently to overcome the forward conduction threshold of the previously non-conducting diode **84**. This could result in a decrease in the negative signal applied to the gates of the field effect transistor switches and achieve a momentary switching of the signal from formant to alternate circuit.

To avoid this undesired momentary switching, and to provide a selectively variable extension of the time of automatic switch operation, the anodes of both diodes **78** and **84** are connected to ground via a parallel RC circuit comprising a capacitor **86**, a fixed resistor **88** and a variable resistor **90**. Thus, any negative going gate control signal passed through either of diodes **78** or **84** is stored in capacitor **86** to maintain the gate electrodes sufficiently negative after motion of the arms of potentiometer **70** and **72** is stopped.

The period of extension of switch operation is controlled by the value of the resistance in the discharge path of capacitor **86**, since the charge on the capacitor will leak off through resistors **88** and **90**. For example, capacitor **86** may be on the order of 0.1 microfarads, resistor **88** may be about 2 megohms, and resistor **90** may be variable between 2 and 20 megohms. With resistor **90** at its maximum value, the switches **48** and **50** will continue to operate for as long as 5 seconds after termination of motion of the potentiometer arms. With resistor **90** at its minimum value of about 2 megohms, delay in operation of switches **48, 50** is substantially negligible. Even at minimum value of resistor **90**, sufficient delay exists to accommodate the dead time of control signal that would otherwise occur at the instant of reversal of the direction of motion of the potentiometer wiper arms.

When the foot pedal control is operated to rock the wiper arms of the three ganged potentiometers **64, 70, 72**, a desired signal is provided at the output of formant circuit **22** and the impedance of switch **48** goes so high as to completely block the output of circuit **20**. In some situations, it may be desirable to retain a portion of the output of circuit **20**, although attenuated, even during the operation of formant circuit **22**. To this end, there is provided the variable resistor **62** connected across the drain and source electrodes of series switch **48** whereby the total impedance across these terminals will not go above a predetermined level as controlled by adjustment of resistor **62**. Accordingly, no matter how high the impedance of switch **48** may be, the resistance **62** may be adjusted to allow a desired portion of the output of circuit **20** to be mixed with the output of formant circuit **22** during operation of the latter.

It will be readily appreciated that a variety of different arrangements of the pair of switching devices **48, 50** may be employed without departing from principles of the present invention. Fundamentally, the switching devices **48** and **50** are variable impedance devices and are of a type and are connected to provide a mutually opposite sense impedance variation in the formant and alternate circuits when the foot pedal is oscillated. Both switching devices may be series connected or both may be connected in shunt if opposite conductivity types are employed, or if provision is made to reverse polarity of the signal applied to one. Similarly, instead of locating one or both of switches **48, 50**, at the output of the formant and alternate circuits, these may be positioned at the input of such circuits, or voltage controlled impedance devices may be employed within the formant or tone control circuits themselves. Furthermore, only one of potentiometers **70, 72** is needed if diodes **78, 84** are oppositely poled, both connected to the same potentiometer wiper arm, and switching transistors of opposite polarity types are used. Any one of these or other arrangements may be implemented to provide automatic enabling of the formant circuit and concomitant automatic disabling of tone control or other alternate circuit, either completely or partially, when and only when the foot pedal control is in motion. Further, although field effect transistors are preferred as variable voltage controlled impedance devices, it will be readily appreciated that a variety of other types of transistors and other types of voltage controllable impedances may be employed.

In some applications other special effects circuits are employed with the formant circuit. For example, a circuit known as a "fuzz" circuit introduces a particular type of intentional distortion, in effect increasing the overtone content by its nonlinearity. Such a "fuzz" circuit may be connected in series with the illustrated formant circuit and suitable switching provided to allow any one of the "fuzz," formant or alternate circuits to be used individually, or to feed the input to the formant circuit through the "fuzz" circuit. Other combinations are readily available as may be deemed necessary or desirable.

In such arrangements, any additional circuit, such as a "fuzz" circuit, that is connected in series with, and ahead of the formant circuit, would be indirectly controlled by operation of the illustrated automatic switching.

The arrangement of potentiometers **70** and **72**, ganged for operation together with the operation of potentiometer **64**, is a preferred form of simple, reliable and efficient motion actuated signal generator. Many other devices are well known to those skilled in the art for generating a signal upon or in response to an input mechanical motion. Various types of magnetic devices employing a relatively movable magnet and coil, piezoelectric devices responsive to pressure on the pedal, and variable capacitance devices are among elements well known to those skilled in the art that are capable of generating a control signal in response to an input mechanical motion. Variable impedance photo cells such as shown in the above-mentioned patent to Slaats, et al, may be employed as the switches of the automatic switching device and caused to receive illumination when the foot pedal control is operated.

There has been described an improved automatic on-off control for circuitry of an electrical musical instrument wherein a special effects circuit is caused to be operated by substantially continuous motion of a movable control member. The special effects circuit and a parallel alternative circuit path for electrical signals are automatically enabled and disabled respectively when and only when the movable operating member of the special effects circuit is in motion. Thus, the instrument player need not directly switch in or out the special effects circuit, but simply upon operation thereof, the desired switching is automatically established.

The foregoing detailed description is to be clearly understood as given by way of illustration and example only, the spirit and scope of this invention being limited solely by the appended claims.

I claim:

1. For use with an electrical musical instrument,
first and second circuits adapted to pass a musical instrument
input signal,
a movable control member,
said first circuit comprising
means operable in response to motion of said control member for modulating said musical input signal, and
switching means responsive to motion of said control member for automatically enabling said first circuit and concomitantly disabling
said second circuit,

said first circuit including a formant circuit having a variable resistance connected to be operated by said control member,

said switching means comprising a first variable impedance device connected in circuit with said formant circuit,

a second variable impedance device connected in circuit with said second circuit,

first and second potentiometers having the wiper arms thereof ganged for operation by said control member in unison with operation of the variable resistance of said formant circuit,

said first and second potentiometers being oppositely poled whereby voltage on the wiper arm of said first potentiometer increases as voltage on the wiper arm of said second potentiometer decreases,

a first series connected capacitor and diode connected between the wiper arm of the first potentiometer and both of said variable impedance devices,

a second series connected capacitor and diode connected between the wiper arm of the second potentiometer and both said variable impedance devices,

said first and second diodes being of like polarity whereby one conducts upon motion of the wiper arms of the first and second potentiometers in a first direction and the other of said diodes conducts upon motion of the wiper arms of said first and second potentiometers in the opposite direction.

2. The apparatus of claim **1** including

a temporary signal storage device connected to momentary retain the value of the voltage generated by said first and second potentiometers,

said storage means being connected to provide said stored signal to said variable impedance devices.

3. The apparatus of claim **1** including

a parallel resistance capacitance circuit connected to both said diodes at the junction thereof with said variable impedance devices.

4. The apparatus of claim **1** including

a variable resistor connected across one of said variable impedance devices.

5. The apparatus of claim **4** wherein said variable impedance devices are field effect transistors.

6. In combination,

a formant circuit,

a motion operated control for the formant circuit,

a second circuit connected in parallel with the formant circuit, and

means responsive to motion of said control for automatically enabling the formant circuit and concomitantly substantially disabling said second circuit, said means including means for automatically disabling said formant circuit and enabling said second circuit by cessation of motion of said control and maintaining such disabled and enabled conditions when said control is not in motion and is at rest in any one of a number of its positions.

7. The combination of claim **6** including means for momentarily retaining said formant circuit enabled and said second circuit disabled after termination of motion of said control.

8. The combination of claim **6** including

a housing,

said control for said formant circuit and said means for automatically enabling and disabling being mounted on said housing,

an operating member movably mounted on the housing, and

mechanical motion transfer means for causing motion of said control in response to motion of said operating member.

9. In combination,

a modulating circuit,

a movable control member connected to operate said modulating circuit when the member is in motion,

switch means for maintaining said modulating circuit in disabled condition in the absence of a switching signal applied to said switch means,

a derivative circuit responsive to said control member for generating a switching signal only when said control member is in motion, and means for applying said switching signal to said switch means to enable said modulating circuit when said control member is in motion and to cause said switch means to disable said modulating circuit in the absence of said switching signal,

a second circuit connected in parallel with said modulating circuit,

second switch means for maintaining said second circuit in enabled condition in the absence of a switching signal applied to said second switch means,

said means for applying said switching signal including means for applying said switching signal to said second switch means to disable said second circuit when said control member is in motion and to cause said second control means to enable said second circuit in the absence of said switching signal.

10. The method of automatically actuating first and second sound control circuits for a musical instrument, said circuits being connected in parallel, said method comprising the steps of

reciprocating an operator connected with said first circuit to continuously vary the signal therefrom, and

employing the same reciprocating motion of the operator that varies the signal to maintain said first circuit in enable condition, said last mentioned steps including

enabling said first circuit only upon said reciprocating motion of said operator and simultaneously disabling said second sound control circuit by and during said operator motion in either direction of its reciprocation.

11. A control circuit comprising

a signal modulating circuit,

an operating member movably mounted for bidirectional motion,

modulating means responsive to said operator to cause said circuit to modulate upon motion imparted to said operating member,

means responsive to motion of said member for selectively enabling said circuit only during said motion, and in either direction of said motion, said means including

means for maintaining said modulating circuit in disabled condition whenever said operating member is at rest,

a second circuit connected in parallel with said signal modulating circuit,

said means for enabling said signal modulating circuit including

means for concomitantly disabling said second circuit by and during motion of said member in either direction of its motion, and

means for maintaining said second circuit in disabled condition whenever said operating member is in motion.

12. The control circuit of claim **11** wherein said means for enabling said modulating circuit and said means for disabling said second circuit comprises

first and second variable impedance devices each having an impedance controlling input,

means responsive to motion of said operator in either direction for generating an impedance control signal, and

means for applying said control signal to the inputs of both of said devices.

13. The circuit of claim **12** including

means for momentarily extending the duration of said impedance control signal.

14. Apparatus for handling a musical signal comprising

a first circuit responsive to said musical signal for generating a first signal representing a musical sound,

a second circuit responsive to said musical signal for generating a second signal representing a musical sound,

common output means connected to receive said first and second signals,

a movable operator,

said first circuit including means for producing an output that varies in accordance with motion of said operator,

means for normally disabling said first circuit, and

means responsive to said operator for enabling said first circuit only during motion of said operator.

15. The apparatus of claim **14** including

means for normally enabling said second circuit, and means responsive to said operator for disabling said second circuit only during motion of said operator.

16. The apparatus of claim **14** wherein said first circuit is a formant circuit having a frequency response peak that varies with position of said operator.

17. The apparatus of claim **15** wherein said operator is movably mounted, said first circuit comprising

a formant circuit that varies in frequency response as said operator is moved,

said means for enabling and disabling said first circuit comprising

a variable impedance coupled with said first circuit,

means responsive to motion of said operator for developing a control voltage, and

means responsive to said control voltage for varying said impedance.

18. A control circuit comprising

a signal modulating circuit

a movably mounted operating member connected to cause said circuit to modulate upon motion imparted to said operating member, said member being mounted for bi-directional motion, and

means responsive to motion of said member for selectively enabling said circuit only during said motion of said member in either direction of its motion,

a second circuit connected entirely with said signal modulating circuit,

said means for enabling said signal modulating circuit including means for concomitantly disabling said second circuit, and

said means for enabling and said means for disabling comprising

first and second variable impedance devices each having an impedance controlling input,

means responsive to motion of said operator in either direction for generating an impedance control signal, and means for applying said control signal to the inputs of both of said devices,

said signal modulating circuit further comprising

a formant circuit having a potentiometer for varying the frequency response thereof,

said operating member being connected to operate said potentiometer,

said means for enabling said circuit comprising

a variable impedance device connected in circuit with the formant circuit,

first and second potentiometers, each having wiper arms ganged for operation in unison with the said formant circuit potentiometer upon motion of said operating member,

a first series connected capacitor and diode connected between the wiper arm of said first potentiometer and said variable impedance device to control impedance thereof,

a second series connected capacitor and diode connected between the wiper arm of the second potentiometer and the variable impedance device to control impedance thereof,

said first and second potentiometers being connected in mutually opposite polarity whereby the voltage on the wiper arms thereof varies in mutually opposite sense as said wiper arms are operated.

19. The circuit of claim **18** including

a parallel resistance capacitance circuit connected to the junction of said diodes and said variable impedance devices.

20. For use with an electrical musical instrument first and second circuits adapted to pass a musical input signal,

a movable control member,

said first circuit comprising

means operable in response to motion of said control member for modulating said musical input signal, and

switching means responsive to said motion of said control member for automatically enabling said first circuit and concomitantly disabling said second circuit, said switching means including means for maintaining said first circuit in disabled condition in the absence of said motion of said control member.

21. The apparatus of claim **20** wherein said first circuit includes

a formant circuit having a variable resistance connected to be operated by said control member.

22. The apparatus of claim **21** wherein said switching means comprises

first and second switching devices respectively connected in circuit with said first and second circuits,

a first voltage generator for producing a first switch control signal upon motion of said control member in a first direction,

a second voltage generator for producing a second switch control signal in response to motion of said control member in a second direction, and

means for feeding said switch control signals to both said switching devices to effect concomitant opposite sense operation thereof.

23. The apparatus of claim **22** including

storage means for momentarily continuing operation of said switching means for a relatively short time after termination of motion of said control member.

24. The apparatus of claim **21** including

means connected with said switching means for retaining a portion of the output of the second circuit during operation of said formant circuit.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,663,735 Dated May 16, 1972

Inventor(s) Chauncey R. Evans

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, lines 65 and 66 (lines 3 and 4 of Claim 1), the words "input signal," should follow immediately after "ment". Thus, the clause beginning with line 64 and ending with line 66 should read as follows:

--- first and second circuits adapted to pass a musical instrument input signal, ---;

Column 6, lines 73 and 74 (lines 11 and 12 of Claim 1), the words "said second circuit," should follow immediately after "disabling". Thus, the clause beginning with line 71 and ending with line 74 should read as follows:

--- switching means responsive to motion of said control member for automatically enabling said first circuit and concomitantly disabling said second circuit, ---.

Column 7, line 30 (line 2 of Claim 2), cancel "momentary" and substitute --- momentarily ---.

Signed and sealed this 9th day of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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