

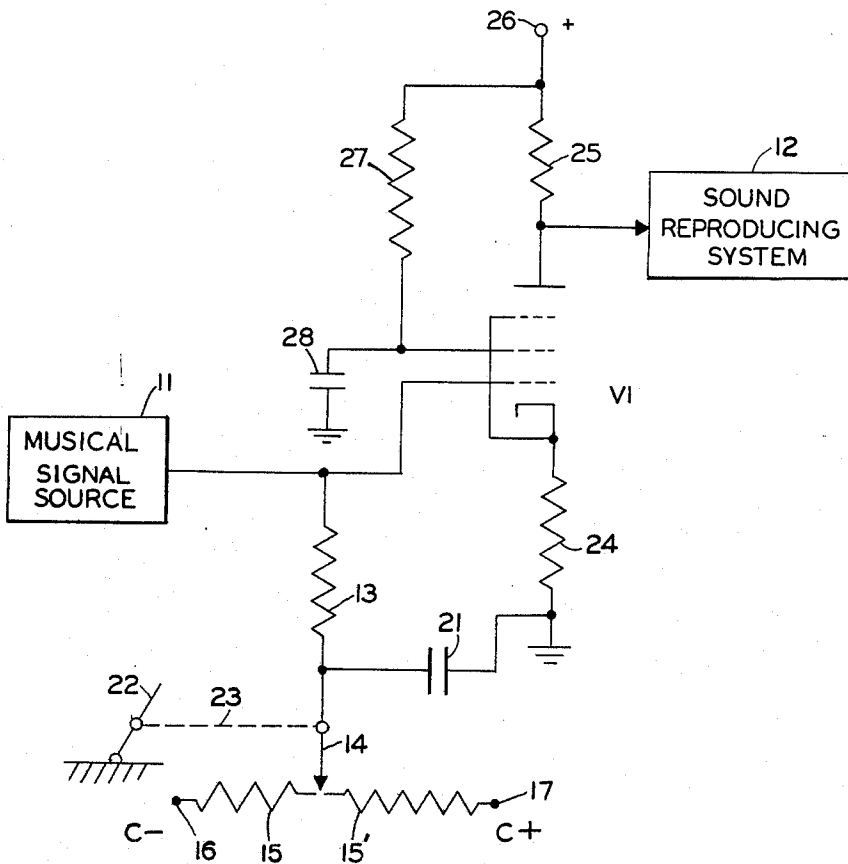
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INTENSITY RATE OF CHANGE CONTROL FOR MUSICAL INSTRUMENTS

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INTENSITY RATE OF CHANGE CONTROL FOR MUSICAL INSTRUMENTS

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7 Claims. (Cl. 84-1.27)

The present invention relates in general to electronic musical instruments and more particularly concerns a novel circuit for controlling the rate of change of sound level. A performer may control a musical instrument incorporating the invention to produce desired musical effects by changing the rate for attaining a new intensity. The apparatus embodying the invention is relatively low in cost, easy to construct and reliable in operation.

Many musical compositions include passages where changes in the intensity of the music should occur at a predetermined rate. This goal is generally accomplished by each individual performer gradually changing the sound intensity emitted by his own instrument. While the most highly skilled musicians usually effect such changes smoothly, musicians of lesser skill exercise more erratic control and the sounds they produce during such changes in level are less pleasing.

Accordingly, the present invention has as an important object the provision of means for manually or pedally selecting the rate at which the intensity of electronic instrument music is changed and effecting such change so smoothly that even a mediocre or poor musician produces pleasant-sounding level changes.

It is still another object of the invention to achieve the preceding object with a low cost reliably operating apparatus that is relatively easy to fabricate.

According to the invention, a variable gain amplifier receives a musical signal at its input and delivers the amplified signal to a sound reproducing system. A gain control signal establishes the amplifier gain, an associated electrical circuit initially resisting changes in the gain control signal when a parameter of the circuit is changed. Means mechanically coupled to the circuit change the parameter, causing the gain control signal to approach a new steady-state value at a rate determined by the circuit.

In an exemplary embodiment of the invention, the circuit comprises means including a variable resistance for selectively direct coupling a capacitor to a source of direct potential so that the gain control signal is developed across the capacitor. A rate pedal is linked to a movable arm which selectively contacts a resistor at different points. As the musician moves the pedal from a neutral position with the arm floating, the arm contacts the resistance to progressively decrease the resistance in series with the source, thereby correspondingly increasing the rate of intensity change.

Numerous other objects, features and advantages of the invention will become apparent from the following specification when read in connection with the accompanying drawing.

The single FIGURE of the drawing shows a combined block-schematic circuit diagram of a musical instrument according to the invention.

With reference now to the drawing, a musical signal provided by the source 11 is amplified by the variable gain amplifier comprising tube V1 and associated circuit components and reproduced by the sound reproducing system 12 which converts the electrical music signals to sound energy.

Tube V1 may be a sharp cut-off pentode which receives the musical signal from source 11 on its grid. A grid resistor 13 direct-couples the grid to the arm 14, shown in its normal neutral position unconnected to either of resistors 15 and 15'. Resistors 15 and 15' are connected

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respectively to a source of negative potential on terminal 16 and a source of positive potential on terminal 17. The potential across capacitor 21 selects the grid bias for tube V1 and controls the transconductance of this tube which in turn determines the gain of the associated amplifier. Thus, the circuit components which establish the grid bias for tube V1 represent a source of a gain control signal. This timing capacitor 21 is connected between the arm 14 and ground, the steady-state potential across this capacitor with arm 14 in the neutral position being zero due to the leakage resistance of the physical capacitor itself. However, the quasi steady-state potential across this capacitor is the potential which existed across the capacitor just before the arm 14 was returned to the neutral position. This potential drifts to zero very slowly because the time constant of the capacitor 21 and its leakage resistance is very large, it being understood that source 11 presents a high impedance D.-C. path to ground through the use of a coupling capacitor (not shown) in series with the junction of the grid of tube V1 and resistor 13, for example.

A rate pedal 22 is attached to the musical instrument and a mechanical linkage 23 mechanically couples the pedal 22 to the arm 14, the arm position being selected by positioning the pedal 22.

Tube V1 is otherwise connected as a conventional pentode amplifier which may have a small unbypassed resistor 24 in the cathode circuit to increase stability and lessen distortion. A plate load resistor 25 is connected between the plate and a source of positive potential on terminal 26. The screen grid receives its potential through a screen dropping resistor 27 and is bypassed to ground by an electrolytic capacitor 28. The signal on the plate of tube V1 is delivered to the sound reproducing system 12.

Operation is as follows. The arm 14 normally resides in a neutral floating position. The steady-state potential on the grid of tube V1 is then substantially zero to establish a normal gain for the amplifier. If the pedal 22 is depressed, the arm 14 moves toward the right, causing capacitor 21 to charge to the potential on terminal 17. Capacitor 21 prevents the grid bias from changing instantaneously. However, the rate of change in bias and consequently amplifier gain is determined by the time constant of the capacitor 21 with the fraction of resistance 15' through which it charges. If the pedal position change is great, the change in the sound level will occur rapidly but smoothly while a slight change in pedal position is accompanied by a smooth slow change in volume.

The specific embodiment described herein is by way of example only. It is evident that those skilled in the art may employ other types of amplification devices and networks of different form for effecting the desired control of the rate of change of intensity. Numerous other modifications of and departures from the specific embodiment described herein may be practiced by those skilled in the art without departing from the inventive concepts. Consequently, the invention is to be construed as limited only by the spirit and scope of the appended claims.

What is claimed is:

1. An intensity rate of change control for a musical instrument comprising, a variable gain amplifier having a signal input and a signal output, a source of a gain control signal, means for coupling said gain control signal to said amplifier to establish the amplifier gain, an electrical circuit associated with said source for initially resisting changes in said gain control signal when a parameter of said circuit is changed, means mechanically coupled to said circuit for changing said parameter and selecting a new finite value for said gain control signal which the latter approaches at a rate determined by said parameter,

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and means for maintaining the new selected value of said gain control signal when that new value is reached.

2. Apparatus in accordance with claim 1 wherein said circuit comprises, an adjustable arm, a source of direct potential, a capacitor connected to said arm, and a resistor connected to said source of direct potential, said gain control signal being developed across said capacitor, said arm being selectively connectable to different points of said resistor in response to actuation of said mechanically coupled means.

3. Apparatus in accordance with claim 2 wherein said mechanically coupled means comprises a pedal and further comprising, a linkage between said pedal and said arm for causing said pedal and said arm to move together.

4. Apparatus in accordance with claim 3 wherein said amplifier comprises an electron tube whose transconductance is a function of its grid bias, and a resistor connected between the grid of said electron tube and said arm, the potential across said capacitor thereby establishing said grid bias.

5. In an electrical musical instrument, apparatus for controlling the rate of change of music intensity comprising, a source of an electrical musical signal, variable gain amplifying means responsive to said electrical musical signal for providing an output signal, transducing means responsive to said output signal for providing corresponding pressure variations, a capacitor, means for coupling the potential across said capacitor to said amplifying means to control the gain thereof, a source of a fixed potential, resistive means connected to said fixed potential

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source, a movable arm for selectively exchanging charge between said capacitor and said source through said resistive means, the resistance of the latter between said fixed potential source and said capacitor being related to the position of said arm along a path including points of contact with said resistive means, whereby said capacitor charges toward said fixed potential at a rate determined by the time constant of said resistance and said capacitor, means for controlling movement of said arm along said path, said path including a neutral position disconnected from said resistive means, and means for maintaining said arm in said neutral position to then maintain said gain at a value determined by the potential on said capacitor at the time said arm is moved to said neutral position.

6. Apparatus in accordance with claim 5 wherein said amplifying means comprises a remote cutoff electron tube, the grid bias of said tube being related to the potential across said capacitor, said time constant being large compared to the period of a low audio frequency.

7. Apparatus in accordance with claim 6 wherein said time constant is greater than one second.

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