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VOLUME CONTROL DEVICE FOR ELECTRIC MUSICAL INSTRUMENTS

Filed Sept. 26, 1960

Fig. 1

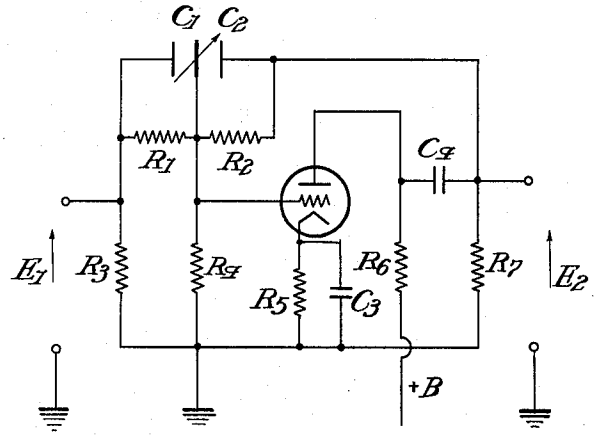
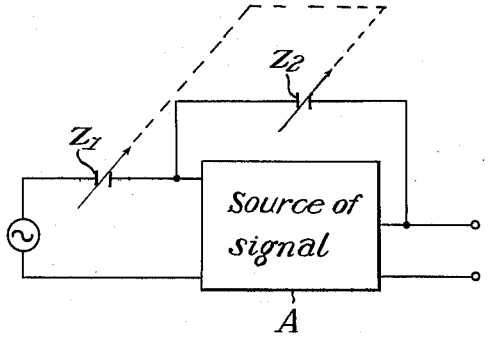


Fig. 2



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VOLUME CONTROL DEVICE FOR ELECTRIC MUSICAL INSTRUMENTS

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2 Claims. (Cl. 84—1.09)

The present invention relates to a volume control device for electric musical instruments.

In prior electric musical instruments, volume control has been effected by means of a variable resistor or an attenuator. However, since the volume of an electric musical instrument is very frequently and quickly changed, the former has short operating life and the latter is disadvantageous in that it is inevitably accompanied by noise because it changes the volume discontinuously. While in some cases variable condensers have been used, they are not suitable for use in electric musical instruments because of their narrow range of volume control.

It is the principal object of the present invention to provide, for electric musical instruments, a long life circuit arrangement for volume control having a wide range of volume control without the accompaniment of the above-mentioned disadvantages.

Further objects and advantages of the present invention will become apparent, and this invention will be better understood from the following description, taken in connection with the accompanying drawing, in which:

FIG. 1 is a connection diagram showing one embodiment of the present invention;

FIG. 2 shows a block diagram of the embodiment of FIG. 1.

Referring now to the accompanying drawing, more particularly to FIG. 2, an electric circuit utilizing a fixed resistor as an impedance Z_1 and a fixed condenser as an impedance Z_2 is known in the art as the Miller's integrating circuit. According to a feature of the present invention, variable condensers are used as said impedances Z_1 and Z_2, and also said condensers are connected to operate differentially.

Referring to FIG. 1, let it be assumed that resistances R_1, R_2 and R_3 are sufficiently larger than $1/\omega c_1$ and $1/\omega c_2$ and R_1 is approximately equal to R_2 and that the amplification factor of the vacuum tube is sufficiently large. Then, the following relation exists between the input voltage E_1 and the output voltage E_2.

$$\frac{E_2}{E_1} \doteqdot \frac{Z_2}{Z_1} \doteqdot \frac{C_1}{C_2}$$

$$Z_2 = \frac{1}{\frac{1}{R_2} + j\omega c_2}$$

$$Z_1 = \frac{1}{\frac{1}{R_1} + j\omega c_1}$$

Further, let it be assumed that in the case when the capacitance of the condenser C_1 is changed from a value of C_{11} to a value of C_{12}, capacitance of the condenser C_2 differentially changes from a value of C_{21} to a value of C_{22}

and that, in a particularly ideal case the values, $C_{11}=C_{22}$, $C_{12}=C_{21}$ and $C_{11}>C_{12}$. In this case, if

$$\frac{E_2}{E_1} = G$$

is changed from a value of G_1 to a value of G_2, then

$$\frac{G_2}{G_1} = \left(\frac{C_{12}}{C_{11}}\right)^2$$

which means that the sound volume would change in proportion to the square of the change in the capacitance.

Thus, for instance, when a differential condenser which can vary from 10 μf. to 100 μf. is used, the volume will be changed by 100 times (40 db), said range being sufficiently wide for practical use.

The variable condenser utilized in the present circuit may be a condenser which is formed by slightly modifying a conventional variable condenser, or it may be designed to have small angle of rotation especially suitable for electric musical instruments.

In addition to the above, this invention is also characterized by the fact that the constant of the circuit can be varied in accordance with the frequency sensitivity curve of the ear by suitably selecting the resistances R_1, R_2, and R_4. Thus, it is possible to effect so-called loudness control. Since apparent impedances of various portions are considerably low, it becomes possible to prevent noise from entering by suitable care. It is desirable that the capacitances of the variable condensers utilized in the present circuit be linearly variable.

While the invention has been explained by describing a particular embodiment thereof, it will be apparent that improvements and modifications may be made without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. A volume controlled amplifier stage for electronic musical instruments wherein tones are generated by appropriate oscillator and filter circuits, said amplifier stage comprising an electronic valve having a control electrode and a first and a second conductive electrode, an input terminal for applying a generated tone to said control electrode, an output terminal, means for connecting a load impedance across said first and second conductive electrodes and to said output terminal, a first resistor connected between said input terminal and said control electrode and adapted to apply said input signals to said control electrode, a second resistor connected between said output terminal and said control electrode to feed output signals back to said control electrode, one end of each of said first and second resistors being connected together and to said control electrode, a third resistor connected at one end to the junction of said first and second resistors and said control electrode and at the other end to said second conductive electrode and providing means in which the input signal and the feedback signal combine algebraically, said feedback signal being in phase opposition to said input signal across said third resistor, a first capacitor connected across said first resistor, a second capacitor connected across said second resistor, and means for simultaneously varying the capacitances of said first and second capacitors in opposite directions to modify the relative impedances of the first and second resistor-capacitor combinations to modify the amount of feedback signal applied to said third resistor in relation to the amount of

said input signal applied to said third resistor to determine the amount of cancellation of said input signal and the amplitude of said output signal at said output terminal.

2. The amplifier stage defined in claim 1 wherein the resistance values of said first and second resistors are respectively greater than the reactance values of said first and second capacitors.

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