United States Patent

Davidson

[15] **3,700,811**

[45] **Oct. 24, 1972**

[54] **TONE AND VOLUME CONTROL FOR A MULTI-CHANNEL AUDIO AMPLIFIER SYSTEM**

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[22] Filed: **July 20, 1970**

[21] Appl. No.: **56,312**

[52] **U.S. Cl.** .....**179/1 D,** 179/1 VL, 333/28 T

[51] **Int. Cl.**.....**H03j 5/04**

[58] **Field of Search** ...179/1 D, 1 VL, 1 G; 333/28 T, 333/2

[56] **References Cited**

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[57] **ABSTRACT**

A tone control circuit for an audio amplifier system whereby the bass tones are enhanced by increasing the total gain or volume of the audio system, the treble tones are shunted to ground potential by a variable impedance network, and the bass and treble controls are effected by the DC control of discrete current control devices.

4 Claims, 2 Drawing Figures

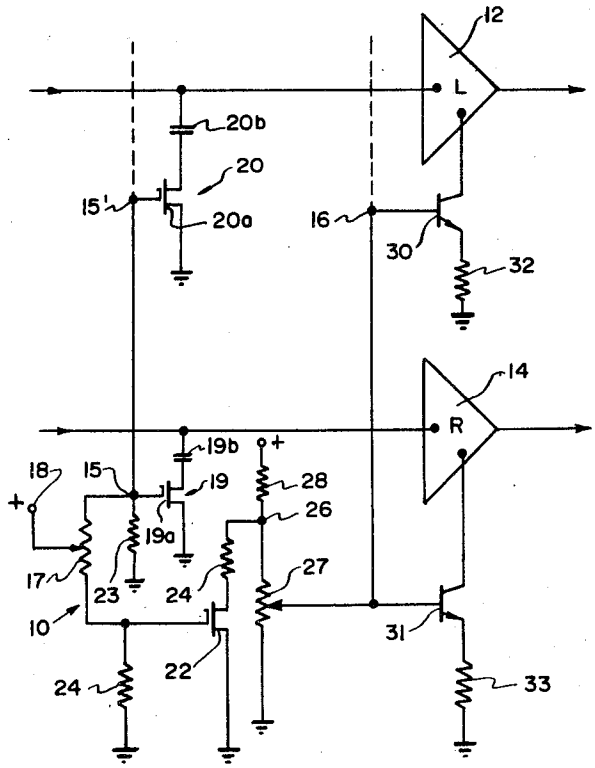


FIG. 1

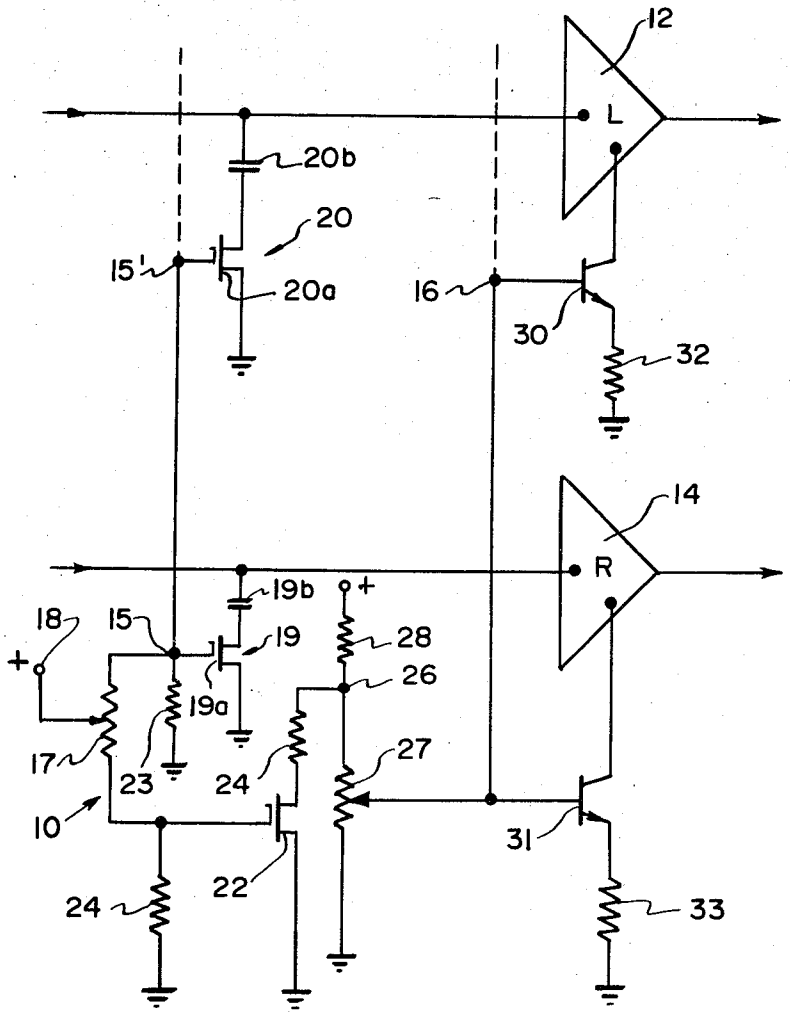
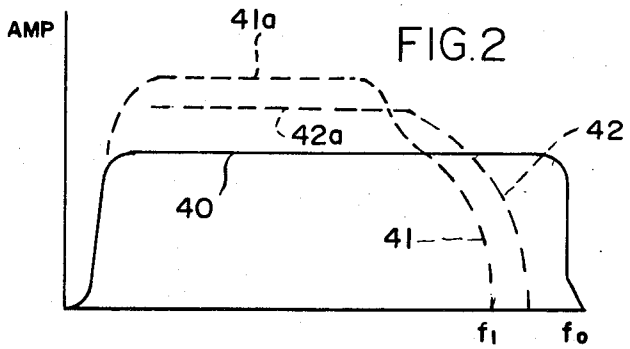


FIG. 2



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TONE AND VOLUME CONTROL FOR A MULTI-CHANNEL AUDIO AMPLIFIER SYSTEM

BACKGROUND OF THE INVENTION

This invention relates generally to tone control devices for audio amplifier systems.

Heretofore, tone control for a plurality of audio channels, such as stereo channels, or the like, required the use of separate variable resistance elements connected together on a common shaft and each resistance element is connected in circuit with the appropriate channel. The need of separate resistance elements was essential because of the fact that audio signal information passed through the variable resistance element and any attempt to combine the function of one element with that of another would result in crosstalk or intermixing of the audio signals. Tone control devices having variable resistance elements in separate housings ganged together for operation from a common shaft are relatively large in configuration and present the further problem of getting each of the resistance elements to track simultaneously. Also, the circuitry utilized in increasing the bass and treble tones of the audio signal were relatively complex, particularly in multi-channel systems, in that the requirement of selecting only a certain frequency range for tone enhancement placed certain limitations on the value and size of components used.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide a tone control circuit for an audio system wherein a single, small variable resistance element can be used to control both bass and treble tones of one or more channels of sound.

Another object of this invention is to provide a tone control circuit which is simple and efficient in design and inexpensive to manufacture.

Briefly, the tone control circuit of this invention includes a plurality of discrete signal tone control networks with the treble networks corresponding in number to the number of channels being controlled and only a single bass network control regardless of the number of channels being controlled. The treble networks generally include a reactance means, preferably a capacitor, connected in series with a variable impedance device, preferably a field effect transistor. The control electrode of the field effect transistor in each treble network is connected to one end of a potentiometer or other variable resistance means for simultaneous control in response to a selectively variable DC potential. The other end of the potentiometer is connected to a separate field effect transistor connected in circuit with the bass network which, in turn, is connected to the volume control of the audio system.

Field effect transistors are particularly useful in the treble tone control as they provide the isolation necessary to obtain control from a single resistance element by varying a DC potential, and the fact that such field effect transistors can be operated by a bias potential applied between the emitter and one base electrode thereof to provide a AC shunt path in series with a capacitor.

The tone control circuit of this invention therefore provides means for simultaneously shunting high frequency tones of audio signals while increasing the overall volume control of the system to enhance the bass tone quality thereof. Similarly, the tone control circuit provides means for simultaneously passing high frequency sounds while decreasing the overall volume of the circuit thus diminishing the bass tone quality and enhancing the treble tone quality. The circuit arrangement lends itself readily to multi-channel sound systems including the sound systems of four or more channels.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a schematic diagram showing the tone control circuit of this invention; and

FIG. 2 is a graph illustrating the frequency versus amplitude characteristics of the audio signal passing through the various channels of the audio system shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, a tone control circuit designated generally by reference numeral **10** is connected to a pair of audio amplifiers **12** and **14** representing left and right channels, respectively, of a stereophonic sound system, or the like. However, it will be understood that as many channels as desired may be connected as indicated by the dotted lines extending upwardly from the circuit points **15** and **16**.

A variable resistance element **17**, for providing DC control of tone characteristics, has the movable contact thereof connected to a voltage source by way of a terminal **18**. One end of the variable resistance element **17** is connected to the circuit point **15**, which, in turn, is connected to a plurality of high frequency bypass circuits or treble networks **19** and **20**, etc. The circuit point **15** is connected to the control electrode of a current control device, preferably a field effect transistor, **19*a*** which acts as a variable impedance element electronically controlled in the circuit. The field effect transistor **19*a*** is connected in circuit with a reactance element, preferably a capacitor **19*b***, to shunt high frequency signals to ground potential as a result of the low resistance condition of the field effect transistor **19*a***.

Similarly, the bypass circuit **20** includes a current control device **20*a***, preferably a field effect transistor, connected in series with a capacitor **20*b***. The bypass circuits **19** and **20** function substantially identically to decrease the frequency response from f_0 to f_1 as indicated in FIG. **2** thus cutting down on the treble tones of the audio system. That is, the low resistance condition of the field effect transistors **19*a*** and **20*a*** serves to shunt the high frequency signals to ground potential.

The other end of the variable resistance element **17** is connected to a control electrode of a current control device **22**, preferably also a field effect transistor. Resistors **23** and **24** are connected to the ends of the variable impedance devices **17**, which, in turn, are connected with the control electrodes of the field effect transistors **19a** and **22**, respectively, to limit the maximum control voltage applied thereto. The field effect transistor **22** is connected in series with a resistor **24** and to a circuit point **26** connected to one end of a volume control potentiometer **27**. Also connected to the circuit **26** is a resistor **28** for applying a DC poten-

tial thereto. The volume control potentiometer **27** has its movable contact connected to the base electrode to a pair of transistors **30** and **31** connected in circuit with the audio amplifiers **12** and **14**, respectively, as well as to other transistors associated with additional amplifiers if included. Each of the transistors **30** and **31** is connected in series with a current limiting resistor **32** and **33**, respectively, and together therewith serve to control the gain of the respective left and right channels **12** and **14** which, in turn, controls the volume of these channels.

Most advantageously, the conduction of the field effect transistor **22** reduces the voltage at the movable contact of the potentiometer **27** as a result of the parallel connection thereto, this action producing an audio frequency bypass as indicated by the solid line waveform **40** of FIG. **2**. This is accomplished by moving the contact of potentiometer **17** toward the resistor **24**. However, by moving the contact in the opposite direction, field effect transistors **19***a* and **20***a* become heavily conductive to shunt high frequency signals as indicated by the broken line **41** of FIG. **2**, which continues to curve upwardly to a plateau **41***a* representing a total volume gain of the circuit as a result of the nonconductance of field effect transistor **22**.

Therefore, by increasing the bass tone qualities of the circuit the entire gain of the circuit is increased, i.e. the volume of the remaining bandpass in increased, while all undesired high frequency signals are shunted to ground potential, or some other reference potential as desired. By adjusting the position of the movable contact on potentiometer **17**, any intermediate range of tone quality can be obtained. That is, the conduction of field effect transistors **19***a* and **20***a* can be decreased so as to extend the broken line **41**, FIG. **2**, to a new position indicated by reference numeral **42**, while simultaneously decreasing the overall volume as indicated by reference numeral **42***a*. This decrease in volume acts as a decrease in bass tones while an increase in treble tones are taking effect.

What has been described is a simple, efficient circuit for controlling the tone quality of an audio system, particularly when a plurality of channels are incorporated with a simple DC control circuit. Accordingly, it will be understood that variations and modifications of this invention may be effected without departing from the spirit and scope of the novel concepts disclosed and claimed herein.

I claim:

1. A control circuit for a multi-channel audio amplifier system comprising a direct current power source and a signal translating path for each channel, including in combination, volume control means connected between the direct current power source and a reference potential, said volume control means including circuit means for varying the direct current therethrough for simultaneously controlling the amplitude of the signals being translated through each of the channels,

a variable resistance element having terminal contact means at the ends of said resistance element and a movable contact selectively adjustable between the ends of said resistance element;

separate reactance means connected in shunt relation with each of said signal translating paths for selectively shunting a portion of the high frequency audio signals;

a separate treble control device connected in circuit with each of said separate reactance means and having load electrodes and a control electrode, each of said load electrodes being connected in series with said respective reactance means and a reference potential, and each said control electrode being connected to one end of said variable resistance elements;

a current control device having load electrodes connected between the direct current source and the reference potential and in shunt with said volume control means of the audio amplifier system, and a control electrode connected to the end of said variable resistance element other than said end connected to each of said treble control devices; and

means applying a control voltage to the movable contact of said variable resistance element so that movement of said contact in one direction on said resistance element will increase the conduction of each of said treble control devices and decrease the conduction of said current control device in shunt with said volume control means thereby reducing the frequency of the high frequency cutoff and increasing the gain of the lower frequencies and movement of said contact in the other direction on said resistance element will increase the conduction of said current control device in shunt with said volume control means and decrease the conduction of each of said treble control devices thereby increasing the frequency of the high frequency cutoff and decreasing the gain of the lower frequencies.

2. The control circuit of claim **1** wherein said treble control device and said current control device comprise field effect transistors.

3. The control circuit of claim **1** including a resistance and said load electrodes of said current control device connected in parallel with said volume control means of the audio amplifier circuit.

4. The control circuit according to claim **1** wherein said volume control means comprises a current control device for each of said channels, each of said devices having load and control electrodes, said load electrodes being coupled in circuit with a respective channel and the reference potential, a DC power source, a variable resistance element coupled between said DC power source and the reference potential and having its variable output voltage terminal coupled to each of said control electrodes of said current control devices of said volume control means.

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