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TONE CONTROL CIRCUIT

Filed Nov. 16, 1962

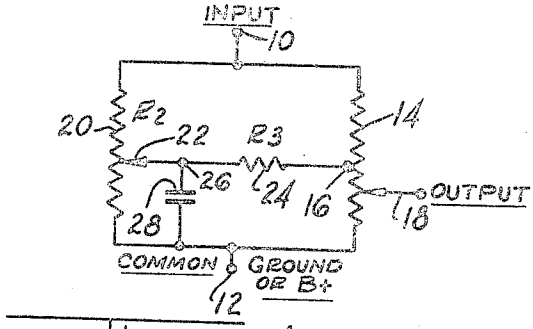


FIG. 1

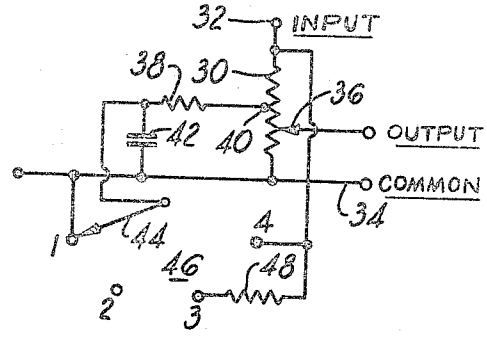


FIG. 3

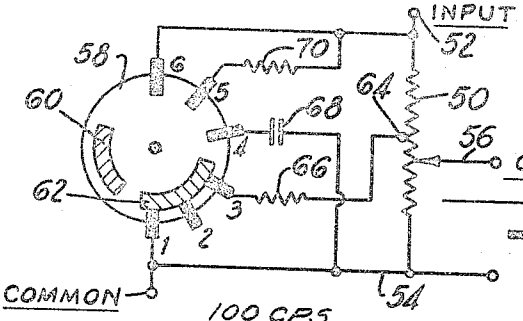


FIG. 4

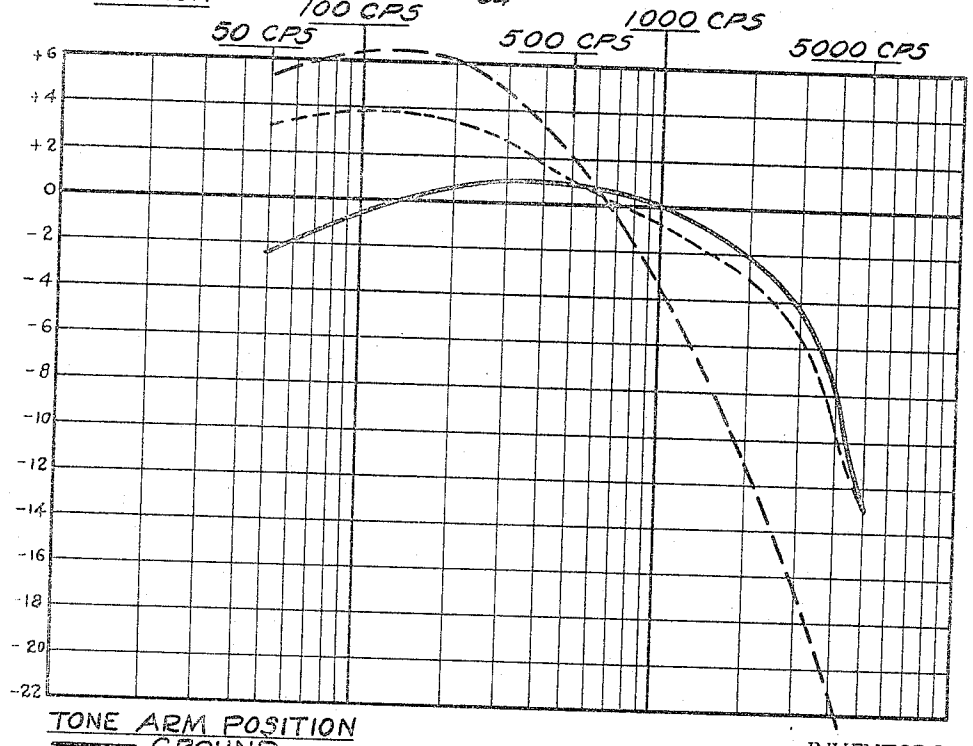


FIG. 2

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TONE CONTROL CIRCUIT

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ABSTRACT OF THE DISCLOSURE

A tone control circuit for an audio amplifiers utilizing an adjustable resistance bass boost voltage divider and a single treble cut capacitor generally parallel connectable to a tapped volume control potentiometer. The potentiometer tap and the divider center tap may be resistance coupled.

This invention relates to a tone control circuit for an audio amplifier.

In even the least expensive automobile radio receivers a tone control is usually required because of the need to contend with greatly varying amounts and kinds of background noise. It also permits the listener to suit his own preference as to response characteristics and provides some compensation for speaker and baffle limitations. A typical satisfactory tone control circuit provides for both emphasis at the lower frequency end of the audio spectrum ("bass boost") and deemphasis at the higher frequency end ("treble cut"). When used with a typical potentiometer type of control, the normal operation of the receiver (without any effect from the tone control) usually is provided when the potentiometer is set at one end of its travel. The amount of "bass boost" is increased as the tone control is moved toward the center, reaching a maximum at the center. Further movement in the same direction results in introducing a "treble cut" which effect reaches a maximum at the opposite end of travel of the tone control potentiometer. This type of response normally requires a resistance-capacitance network including separate capacitance means in each of two separate branches to accomplish the desired "bass boost" and "treble cut." Such circuits do add an appreciable element of cost to the receiver and so it is an object of the present invention to provide a tone control circuit which will accomplish the desired frequency discrimination and which is less expensive to produce than those presently in the field.

It is another object of the present invention to provide a tone control circuit which accomplishes the above object and in which the "bass boost" tends to be a substantially linear function over the entire range of the tone control.

It is a further object of the present invention to provide a tone control circuit accomplishing the above objects and in which the direct current impedance change is minimized when the tone control is moved to different positions.

Other objects and advantages will become apparent from the following specification taken in connection with the accompanying drawings in which:

FIG. 1 is a schematic drawing of a tone control circuit embodying our invention;

FIG. 2 is a graph showing the frequency discrimination characteristics of the circuit of FIG. 1;

FIG. 3 is a schematic drawing of a modified form of our invention in which a step function switch is used rather than a tone control potentiometer; and

FIG. 4 is a schematic drawing of an additional modification of our invention using a step function switch.

Referring now to FIG. 1, an input terminal is shown at numeral **10** and a common terminal at numeral **12**. This common terminal may be at ground potential or it may be at a higher D.C. potential such as would be typical in transistor circuitry. In this latter case, the common line might typically be at a value of about 12 volts D.C. (filtered). Hereafter, any connection to a line at this potential will be referred to as to "common." The signal is supplied between terminals **10** and **12** across the volume control potentiometer **14** which has a tap **16** about halfway across and a slider **18**, such that the output may be connected to succeeding stages between slider **18** and terminal **12**. The location of tap **16** may be selected to afford a desired amount of "bass boost." Also connected between terminals **10** and **12**, in parallel with potentiometer **14**, is a tone control potentiometer **20** having a slider **22**. A resistor **24** is connected between slider **22** and the volume control tap **16**. Connected to a junction **26** between the slider **22** and resistor **24** and the common line is a capacitor **28**.

When the tone control slider **22** is at the lower end of the potentiometer **20**, the capacitor **28** is effectively short circuited and the tone control is ineffective. As the slider is moved upwardly along the potentiometer **20**, the proportionate amount of signal voltage drop across capacitor **28** increases, thus causing proportionally greater "bass boost" and increasing "treble cut." With the slider **22** at the top of potentiometer **20** the "bass boost" is at a maximum and the treble is attenuated to the maximum extent. This characteristic is shown in the graph (FIG. 2) wherein decibels gain or loss from 1000 c.p.s. at the normal position is plotted vertically vs. frequency, the latter being plotted on a logarithmic scale horizontally. The solid curve shows the response characteristic of a typical automobile broadcast receiver without any tone control action (slider **22** at the bottom of the tone control potentiometer). It is apparent that there is some attenuation at the low frequency end of the spectrum, followed by a slight boost in the mid-range and a significant attenuation with increasing frequencies above about 1000 c.p.s. With the slider **22** moved to its middle position (50%) the amount of "boost" at the lower frequencies is considerably greater than for the normal condition and the attenuation at the frequencies above about 600 c.p.s. is slight, as shown in the dotted line. Moving the slider **22** to the top of potentiometer **20** results in a characteristic such as that shown in the dashed line, wherein the "boost" of signals below about 600 c.p.s. is very substantial and the attenuation of the treble above about 600 c.p.s. is even greater. A typical prior art tone control circuit with at least two capacitors in two separate branches would provide another bend in the response curve at the high frequency end, thus substantially reducing the rate of attenuation at these frequencies, but with the amount of "bass boost" and "treble cut" usually required this ability is not significantly useful for automobile radios. The characteristic shown in FIG. 2 is entirely satisfactory for this purpose and is made possible by means of our circuit which provides both "bass boost" and "treble cut" in substantial amounts with a single capacitor. Where really substantial production runs are encountered, this simplified tone control circuit provides a very worthwhile saving in production cost while providing all the necessary functions of the conventional circuits. The substantial linearity in the amount of "bass boost" afforded over the range of the tone control potentiometer provides another significant advantage. It is also apparent that the D.C. impedance change with setting changes is minimized because the effective amount of resistance in the circuit does not vary greatly.

A modified form of our tone control circuit is shown in FIG. 3. This circuit is essentially the same as that of FIG. 1, except that it is modified to use a step control switch. In this circuit a volume control potentiometer **30** is connected between an input terminal **32** and a common voltage line **34**. The output of the circuit is taken between the common line **34** and the slider **36** of potentiometer **30**. A resistor **38** is connected to a tap **40** on potentiometer **30** and at its opposite end has connections with a capacitor **42** and the movable contact **44** of a multiposition switch **46**. Stationary contact number **1** of switch **46** is directly connected to the common line **34**, stationary contact number **2** is open, stationary contact number **3** is connected to the input terminal **32** through a resistor **48**, and stationary contact **4** is connected directly to the input terminal **32**.

When the movable switch member **44** is on contact number **1**, as shown, the capacitor **42** is essentially short circuited and the circuit is basically that when the slider **22** of FIG. 1 is at the bottom. The tone control circuit is ineffective. With member **44** on contact **2**, the bottom half of the potentiometer **30** is shunted by resistor **38** and capacitor **42** and this provides a partial "bass boost" position with little "treble cut." When member **44** engages contact **3**, the circuit is essentially that of FIG. 1 as illustrated and provides partial "bass boost" and partial "treble cut." When member **44** engages contact **4**, the circuit is essentially the same as that of FIG. 1 when the slider **22** is at the top of potentiometer **20**, thus providing full "bass boost" and full "treble cut."

A slightly different step control arrangement is shown in FIG. 4. In this circuit the volume control potentiometer **50** is connected between input terminal **52** and the common voltage line **54**. The output appears between the slider **56** of potentiometer **50** and the common line **54**. A multiposition switch **58** having two shorting sections **60** and **62** provides selectable connections among a plurality of stationary contacts **1** through **6**. Contact **1** is connected to common, contact **2** is open, contact **3** is connected to a tap **64** of potentiometer **50** through a resistor **66**, contact **4** is connected to common through a capacitor **68**, contact **5** is connected to the input terminal through a resistor **70** and contact **6** is directly connected to the input terminal.

The normal position is as shown. Terminals **1** and **3** are connected through shorting section **62** and this connects resistor **66** to common and leaves capacitor **68** disconnected. A partial "bass boost" position is afforded when switch **58** is rotated counterclockwise one notch, thus causing shorting section **62** to connect contacts **2, 3** and **4**. This produces the same circuit as that produced in FIG. 3 when member **44** engages contact **2**. Rotation of switch **58** another notch counterclockwise causes the shorting section **62** to effectively connect resistor **66**, capacitor **68** and resistor **70** to a common junction, thus producing an arrangement like that in FIG. 3 when movable contact **44** engages contact **3**. This gives full "bass boost" and partial "treble cut." A fourth position is produced by rotating the switch **58** an additional notch which causes shorting section **62** to connect contacts **4, 5** and **6** together and shorting section **64** to connect contacts **1** and **3** together. This provides an arrangement where the lower half of potentiometer **50** is shunted by resistor **66** and capacitor **68** shunt the entire resistance network, thus providing a full "treble cut" position without "bass boost" which has special utility in suppressing noise without affecting intelligibility.

Although only a limited number of embodiments have been shown and described herein, modification within the scope of the present invention will be apparent to those skilled in the art.

We claim:

1. A tone control circuit for an audio amplifier consisting of an input terminal, a tapped volume control potentiometer connected between said input terminal and a common terminal, a resistor having one side connected to said tap, and capacitance means connected between the opposite side of said rresistor and common:

tone selecting means including resistance means connectable in parallel with said volume control potentiometer between said input and common, and switching means capable of selecting from among a plurality of positions connected to the junction between said resistor and said capacitance means which, when in a first position provides a short circuit connection across said capacitance means, when in a second position disconnects said resistance means from said circuit, when in a third position connects said resistance means across at least part of said potentiometer, and when in a fourth position connects said junction with said input terminal.

2. A tone control circuit for an audio amplifier consisting of an input terminal and a common terminal, a tapped volume control potentiometer connected between said input terminal and said common terminal, a resistor having one side connected to said tap, capacitance means having one side connected to common and resistance means having one side connected to said input terminal:

tone selecting means including multiposition switching means which, when in a first position connects said resistor to common, when in a second position connects the opposite sides of said resistor and capacitance means together, when in a third position connects the opposite sides of said resistor, said resistance means and said capacitance means together, and when in a fourth position connects the opposite side of said capacitance means to said input terminal and the opposite side of said resistor to said common terminal.

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