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(71) Applicant(s):
Blackstar Amplification Ltd
(Incorporated in the United Kingdom)
Beckett House, 14 Billing Road,
NORTHAMPTON, NN1 5AN,
United Kingdom

(72) Inventor(s):
Bruce Keir

(74) Agent and/or Address for Service:
Blackstar Amplification Ltd
Beckett House, 14 Billing Road,
NORTHAMPTON, NN1 5AN,
United Kingdom

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(56) Documents Cited:
GB 2038584 A
GB 1508714 A
WO 2005/091807 A2
US 4403201 A
US 3914716 A

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UK CL (Edition X) **H3U, H3W**
INT CL **H03G, H03H**
Other: **WPI, EPODOC**

(54) Abstract Title**: Variable middle- or centre-dip frequency for an audio equalizer/amplifier**

(57) The passive equalization circuit or tone control for an audio amplifier intended for use with musical instruments has a means of continuously adjusting the middle- or centre-dip or cut frequency.
The amplifier is particularly intended for use with guitars.

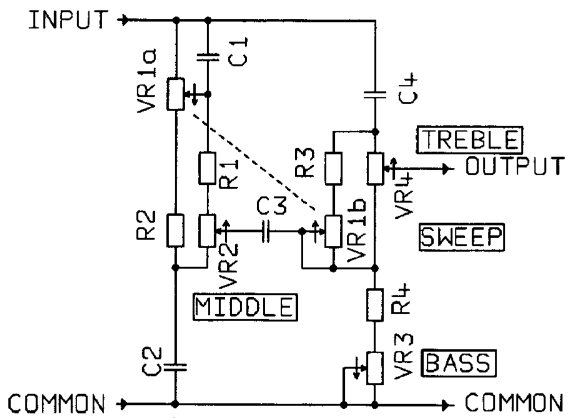

Figure 4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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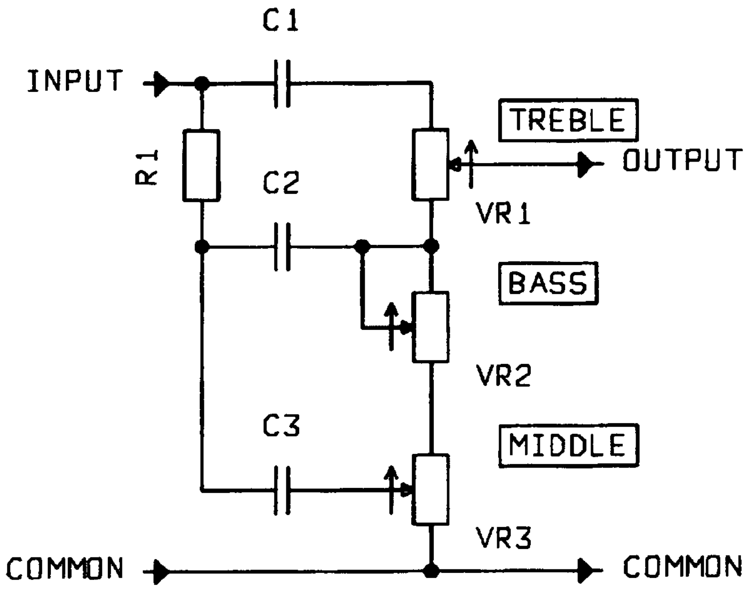
C1
INPUT
TREBLE
R1
C2
OUTPUT
VR1
BASS
VR2
C3
MIDDLE
VR3
COMMON
COMMON

Figure 1

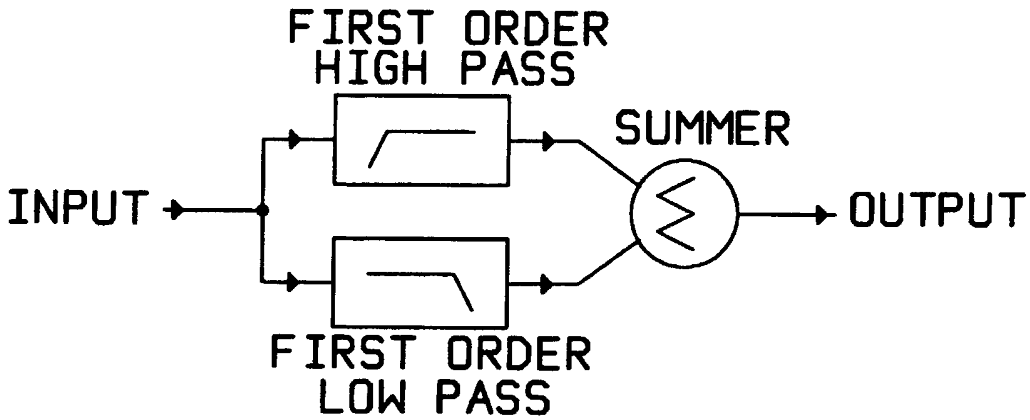
FIRST ORDER
HIGH PASS
SUMMER
INPUT
OUTPUT
FIRST ORDER
LOW PASS

Figure 2

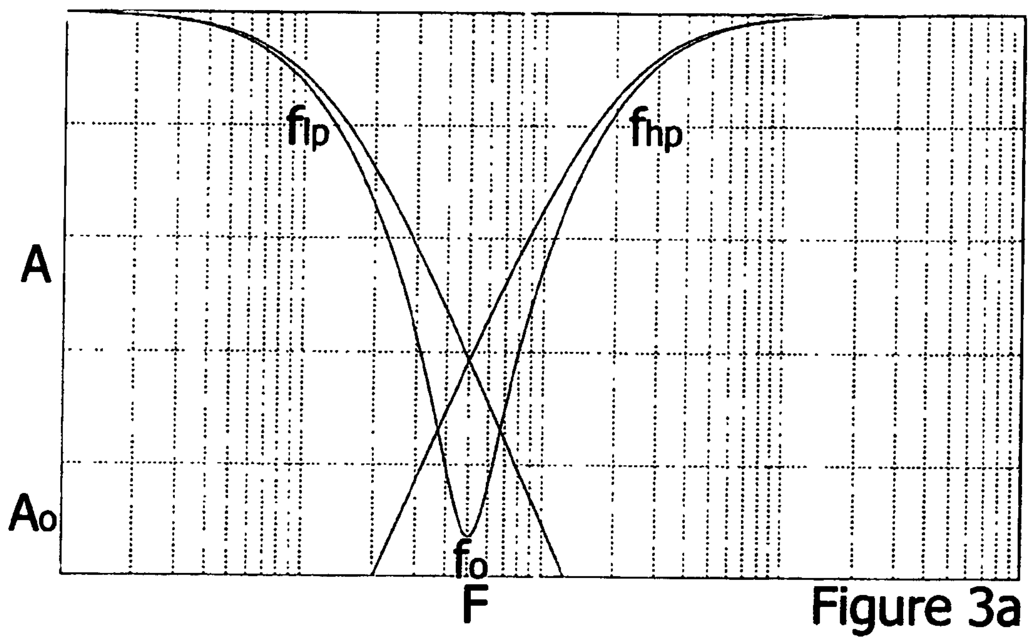

Figure 3a

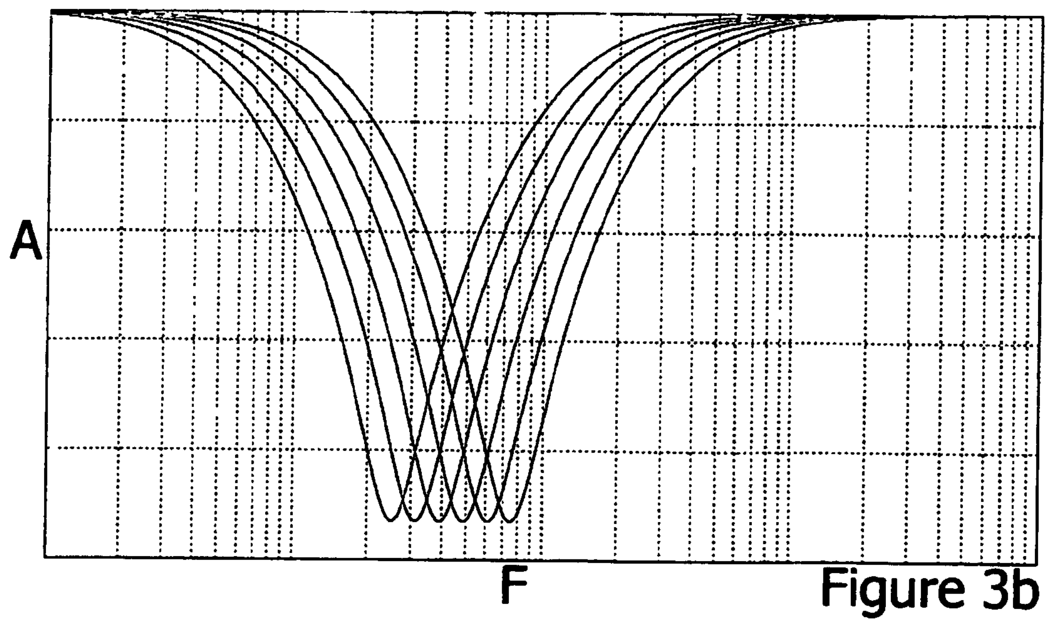

Figure 3b

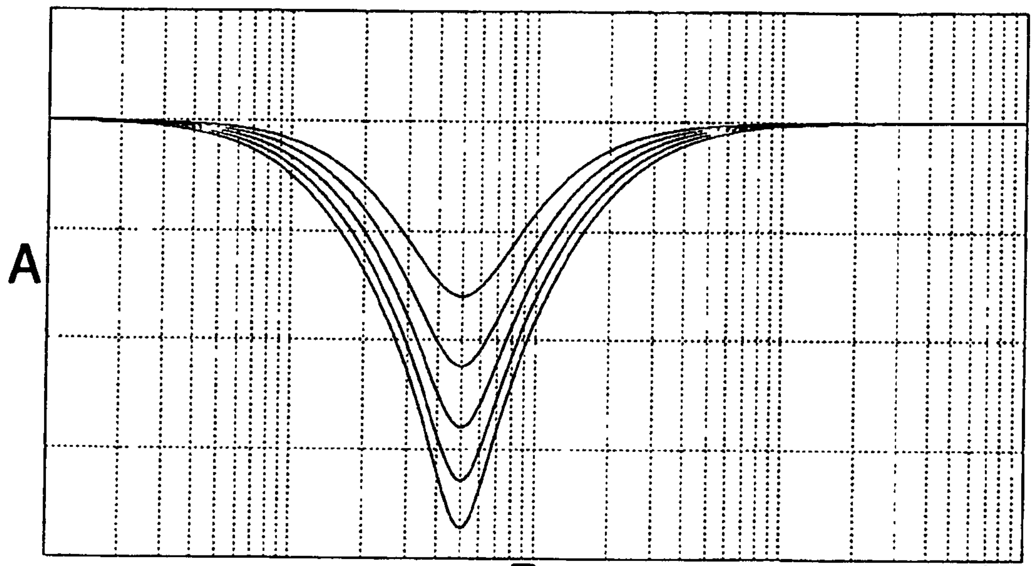

Figure 3c

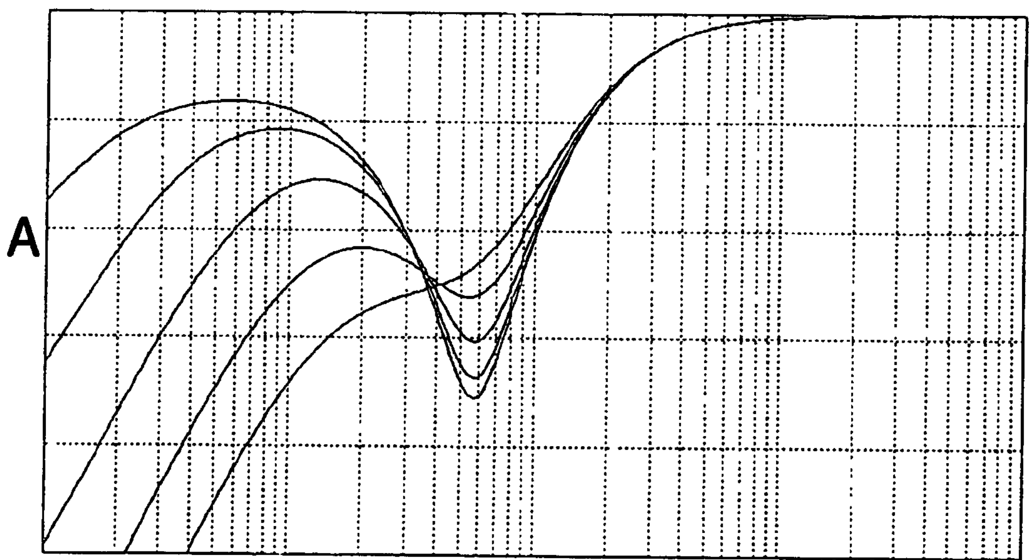

Figure 3d

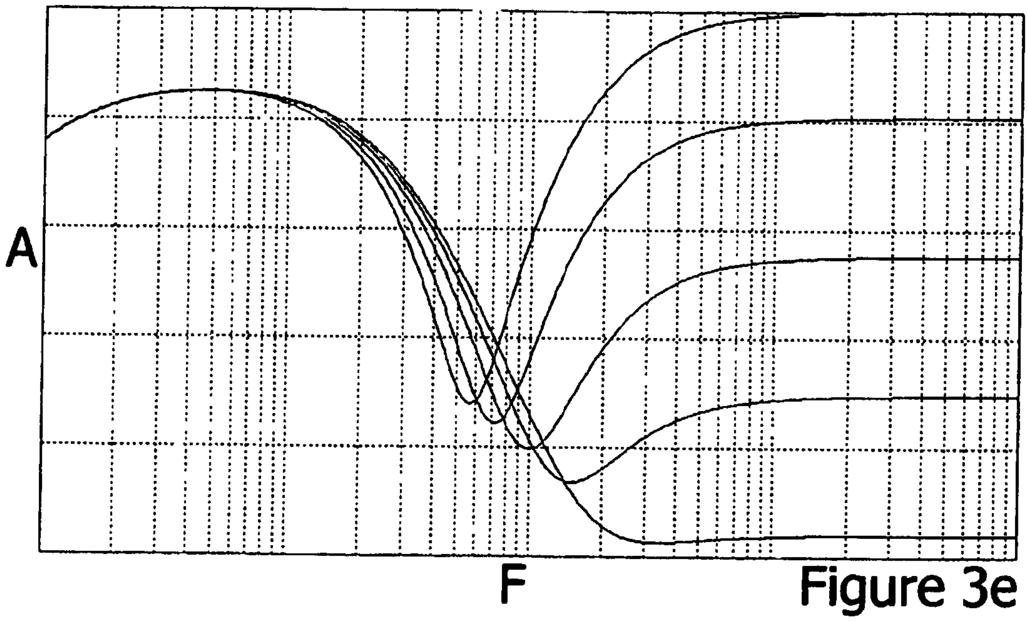

Figure 3e

Figure 3

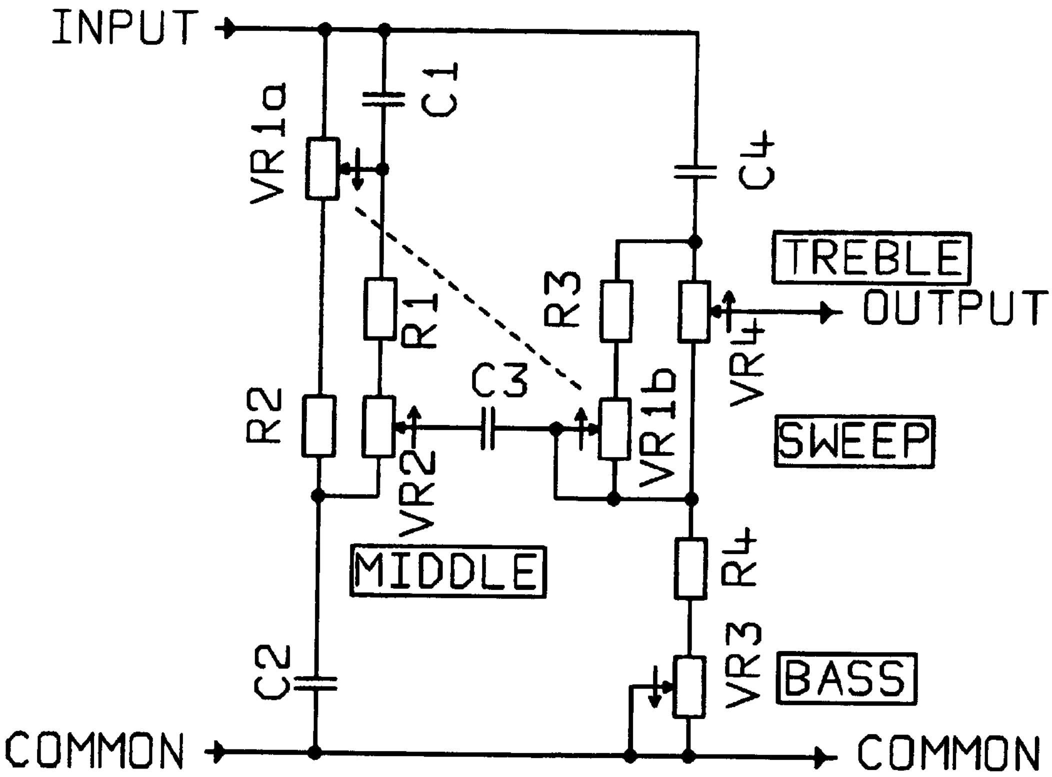
INPUT
C1
VR1a
C4
TREBLE
OUTPUT
R3
R1
VR4
C3
R2
VR1b
SWEEP
VR2
MIDDLE
R4
VR3
BASS
C2
COMMON
COMMON

Figure 4

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Audio Amplifier

This invention relates to an equalisation ("tone control") circuit for audio amplifiers for use with musical instruments.

Historically the first guitar amplifiers featured very primitive means of frequency equalisation (i.e. tone controls). This was originally a simple adjustable low pass filter, to attenuate high frequencies.

As guitar amplifier design evolved to meet the requirements of the musicians of the time, more complex equalisation circuits were developed to include bass, middle and treble controls.

These circuits were still relatively simple and had inherent drawbacks from an electrical performance point of view. In particular the middle control suffers interaction from both the treble and bass controls. This means that the frequency and depth of cut at middle frequencies varies with the setting of the treble and bass controls.

Although non-preferred from an engineering viewpoint, this interactive form of circuit is judged subjectively by guitarists to have a more "musical" response. Hence this type of circuit remains popular today and is used in the majority of guitar amplification designs, despite many attempts at improvement.

These simple circuits are termed "passive" as they do not include in their design any amplification devices. Inherent in these passive designs is attenuation of the middle frequencies ("middle cut") and this response is an essential part of the sound character of guitar amplifiers in general.

As guitar amplification designs evolved the manufacturers altered the values within the same passive equalisation circuit to produce various middle responses which in time became synonymous with the "sound" of their particular brand. It came to pass that each of these responses was better suited to particular playing styles or genres of music. Hence, certain brands became more prevalent in certain genres of music.

There have been numerous attempts to improve the flexibility of these designs.

To improve the flexibility of this circuit attempts have been made to shift the centre frequency of the mid cut by switching in additional components into the traditional circuit to change key values and achieve a "mid shift".

This form of circuit has the disadvantage of the response only being moved in steps and providing only "snapshots" of possible responses. Also, as the mid centre frequency is shifted there is also an unwanted change in the depth of mid cut, leading to an unnatural effect.

Alternatively, attempts have been made to utilise active equalisation circuits which allow the middle cut frequency to be altered continuously (i.e. not in steps), such as parametric equalisation circuits. These circuits have the drawback that they lack the interactivity of the various controls and hence the subjective musicality of the traditional passive circuits.

To overcome these disadvantages the present invention details a means of continuously adjusting the middle dip frequency of a passive equalisation network whilst retaining the interactivity between the controls and a constant depth of middle cut, and hence all the desirable attributes preferred by the practicising musician.

The present invention will allow the middle frequency of a passive equalisation circuit to be varied continuously whilst retaining the interactivity between the controls and the depth of middle cut. Rather than being limited to the "snapshots" of the possible responses available from the traditional network, the musician has access to all the responses in between.

Preferably, the circuit will have a bass, middle and treble control.

Preferably, the circuit will have a frequency control to adjust the middle cut frequency.

Preferably, the circuit will not require active electronic elements i.e. will be passive.

Preferably the circuit will automatically adjust the level of bass frequencies, in relation to middle and high frequencies, depending on the position of the mid dip frequency.

The invention will now be described by way of example with reference to the following drawings:

Figure 1 shows the prior art three band passive equalisation circuit used for example in electric guitar amplifiers.

Figure 2 is a simplified block diagram representation of the circuit detailed in figure 1.

Figure 3 is the typical amplitude versus frequency response of the circuit shown in Figure 2.

Figure 4 is a detailed schematic diagram of the present invention.

For the sake of this discussion it is assumed that the circuits in Figure 1 and 4 are driven from a low impedance source and drive a high impedance load introducing negligible loading. It is also assumed that the middle control in Figure 1 is fully counterclockwise.

In figure 1, a high pass filter formed by C1 and VR1 has its output at the wiper of VR1. Simultaneously, a low pass filter formed by R1 and C3 has its output coupled through C2 to the counterclockwise end of VR1 and hence to the wiper of VR1. Therefore the output of the circuit, at the wiper of the VR1, is the summation of a high pass and low pass response.

Figure 2 is a simplified block diagram representation of this scheme.

Figure 3a shows the resulting amplitude versus frequency response of such a circuit.

Figure 3a shows the resulting mid dip response created by the summation of the high pass and low pass responses previously discussed. The frequency of minimum amplitude f_o is determined by the cut off frequencies (f_{hp} and f_{lp}) of the high pass and low pass responses, as previously described.

It would be apparent to someone skilled in the art that if the cut-off frequencies (f_{hp} and f_{lp}) are increased or decreased in the same ratio then the frequency f_o will change by a corresponding amount.

The amount of attenuation at f_o is dependant on the ratio of the cut off frequencies (f_{hp} and f_{lp}) of the high pass and low pass filters. By suitable choices of the ratio of f_{hp} and f_{lp} the amount of attenuation at f_o can be set to any desired value.

The present invention, shown in Figure 4, retains the desired characteristics of the traditional circuit in Figure 1 but allows the frequency f_o to be continuously varied over any required range with no corresponding changing in depth of cut A_o. (Figure 3b)

As with the traditional circuit shown in Figure 1, the present invention, shown in Figure 4 is the summation of a high pass and low pass filter.

The low pass filter is formed by C2 and a resistance comprised of the combination of (VR2+R1) in parallel with (VR1a+R2). Resistor R2 limits the upper cut off frequency of the low pass filter.

The high pass filter is formed by C4 and a resistance comprised of the combination of VR4 in parallel with (VR1b+R3). Resistor R3 limits the upper cut off frequency of the high pass filter.

VR1a and VR1b is a tandem potentiometer and thus adjusting the frequency control varies the cut off frequencies f_{hp} and f_{lp} *in constant ratio*. This in turn varies the mid cut frequency f_o whilst maintaining the depth of middle cut A_o.

Capacitor C3 in conjunction with the series combination of (VR3+R4) forms a high pass filter. The cut off frequency of this high pass filter can be varied by the adjustment of the bass control VR3. Resistor R4 limits the upper cut off frequency of the high pass filter. (Figure 3d)

VR4, forming the treble control, allows the level of the high pass filter in relation to the low pass filter to be adjusted. (Figure 3e)

The level of bass frequencies in relation to middle and high frequencies is automatically adjusted by the combination of C1 and VR1a. With VR1a in the fully counterclockwise position C1 is completely short circuited and the input to the low pass filter previously described is not subject to attenuation of the bass frequencies. As VR1a is rotated in the clockwise direction, capacitor C1 in conjunction with the resistance of VR1a serves to attenuate bass frequencies thus adjusting the spectral balance in a way judged to be desirable by practicing musicians.

Rotation of VR2 in a clockwise direction adds an attenuated all pass function to the low pass filter previously described. This serves to limit the depth of the mid frequency attenuation A_o and thus provides a means of adjusting the level of the mid band frequencies. The value of R1 determines the minimum amount of mid frequency attenuation when VR2 is at its fully clockwise position. (Figure 3c)

It will be apparent to a person skilled in the field of digital processing techniques that the above analogue circuit description is capable of implementation using Digital Signal Processing (DSP) techniques in the digital domain.

Claims

1. An audio electronics circuit for continuously adjusting the middle dip frequency of a passive equalisation network.

2. A circuit according to claim 1, that maintains a constant depth of middle cut as the middle frequency is adjusted.

3. A circuit according to claim 1, with a means of adjusting the middle cut frequency.

4. A circuit according to claim 1, with a means of adjusting the amplitude of the bass frequencies with relation to the amplitude of the middle and treble frequencies.

5. A circuit according to claim 1, with a means of adjusting the amplitude of the middle frequencies with relation to the amplitude of the bass and treble frequencies.

6. A circuit according to claim 1, with a means of adjusting the amplitude of the treble frequencies with relation to the amplitude of the middle and bass frequencies.

7. A circuit according to claim 1, retaining the interactivity between the bass, middle and treble controls.

8. A circuit according to claim 1, which attenuates bass frequencies at higher settings of the middle dip frequency.

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Application No:	GB0702145.4	**Examiner:**	Peter Easterfield
Claims searched:	1 to 8	**Date of search:**	11 May 2007

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-3	US 4403201 A (YOKOYAMA) see fig 9
A	-	GB 2038584 A (PIONEER)
A	-	GB 1508714 A (PHILIPS)
A	-	US 3914716 A (KURATA)
A	-	WO 2005/091807 A2 (FENDER)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

H3U; H3W

Worldwide search of patent documents classified in the following areas of the IPC

H03G; H03H

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
H03H	0007/01	01/01/2006

Intellectual Property Office

For Creativity and Innovation

Subclass	Subgroup	Valid From
H03G	0005/02	01/01/2006