

TITLE OF THE INVENTION

POST-AMPLIFICATION STEREOPHONIC TO SURROUND SOUND
DECODING CIRCUIT

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FIELD OF THE INVENTION

The present invention relates to stereophonic surround sound decoding circuits. More specifically, the present invention relates to a post-amplification stereophonic to surround sound decoding circuit to be installed between the outputs of a conventional stereophonic amplifier and conventional loudspeakers.

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BACKGROUND OF THE INVENTION

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While monophonic sound is still widely used in amplitude modulation (AM) radio and in telephone networks, stereophonic sounds are now considered the standard in high fidelity (HI-FI) applications.

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Stereophonic sound systems aim at reproducing two different sound channels, via loudspeakers, in such a way that the sounds reaching each ear of the listener give the impression to the listener that he is brought at the location of the sound recording. Of course, the realism of this impression depends on many factors such as, for example, the relative position of the listener with respect to the loudspeakers and the quality of the recording.

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Surround sound systems have been introduced in consumer electronics to create what is now called home theatres where the listener is submitted to different sounds coming from remote locations in the room. Standard home theater surround sound systems are equipped with five loudspeakers each reproducing a different sound channel.

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The surround sound decoding circuits used in surround sound systems may generally be divided into two major types, i.e., pre-amplification decoding circuits and post-amplification decoding circuits.

5 Surround sound systems using pre-amplification decoders receive a conventional low level two-channel stereophonic sound signal and expend it to a five-channel surround sound. Each of these five channels is amplified separately and then supplied to a predetermined loudspeaker. The five channels are generally determined as follows:

- 10 a main left channel corresponds to the left channel of the stereophonic sound signal and is reproduced by a front left loudspeaker;
- a main right channel corresponds to the right channel of the stereophonic sound signal and is reproduced by a front right loudspeaker;
- 15 a secondary left channel (also called the left surround channel) is decoded by subtracting the main right channel from the main left channel and is reproduced by a rear left loudspeaker;
- 20 a secondary right channel (also called the right surround channel) is decoded by subtracting the main left channel from the main right channel and is reproduced by a rear right loudspeaker; and
- 25 a central channel is decoded by adding the main left channel and the main right channel, and is reproduced by a central loudspeaker usually mounted on top of the television screen.

30 A major drawback of the surround sound systems using pre-amplification decoders is that a five-channel amplifier is necessary to reproduce the surround sound since the power amplification is done after the decoding of the surround sound from the stereophonic sound. Users of this technology

must therefore acquire a dedicated power amplifier, which increases the total cost of the system.

5 Post-amplification surround sound decoders usually solve the above-mentioned drawback of the pre-amplification decoders by providing an apparatus that may be installed between the left and right power amplified stereophonic signal outputs of a conventional stereophonic amplifier and the five loudspeakers mentioned hereinabove. The stereophonic to surround sound decoding is therefore done after the power amplification which allows the
10 use of a conventional stereophonic amplifier.

 United States Patent N° 5,265,166, issued on November 23, 1993 to Madnick *et al.* and entitled: "MULTI-CHANNEL SOUND SIMULATION SYSTEM", describes such a post-amplification stereophonic to surround sound
15 decoder. The system disclosed by Madnick *et al.* suffers major drawbacks generally leading to a decrease in the quality of sound reproduction and to an increased complexity of the load imposed on the stereophonic amplifier. As will be easily understood by one skilled in the art, the return to the ground of the negative terminal of the rear loudspeakers causes the power output to "see" an
20 impedance other than the conventional 8 ohms speaker impedance. Furthermore, the return to the ground of the negative terminal of the central loudspeaker via an inductance will also increase the complexity of the load of the power amplifier which will inevitably lead to an increase in sound distortion and an overall general decrease in the sound reproduction. It is also to be
25 noted that the combination, via resistors, of the right and left channels to generate the central channel will decrease the clarity of the sound reproduction of the main right and left channels since there are no provisions to prevent some "bleeding" of the right channel in the left channel and vice-versa.

30 United States Patent N° 5,497,425, issued on March 5, 1996 to Robert J. Rapoport and entitled: "MULTI-CHANNEL SURROUND SOUND SIMULATION DEVICE", describes a hybrid stereophonic to surround sound decoder provided with features from both the pre-amplification and post-

amplification decoding schemes described hereinabove. The system proposed by Rapoport has many drawbacks. For example, a supplementary power amplifier must be provided to amplify the central channel before the reproduction by the central loudspeaker. Furthermore, the drawbacks
5 discussed hereinabove with respect to the system of Madnick *et al.* generally apply to the system of Rapoport since the design philosophy is similar.

SUMMARY OF THE INVENTION

10 An object of the present invention is therefore to provide an improved post-amplification stereophonic to surround sound decoding apparatus free of the above-mentioned drawbacks of the prior art.

 More specifically, in accordance with the present invention, there
15 is provided a post-amplification stereophonic to surround sound decoding circuit comprising:

 an input for receiving a power amplified stereophonic signal including a left channel signal and a right channel signal;

 a first output configured to be connected to a secondary left
20 loudspeaker;

 a second output configured to be connected to a secondary right loudspeaker;

 a third output configured to be connected to a central loudspeaker;

25 secondary channels decoding means for decoding a secondary left channel signal and a secondary right channel signal from the left and right channel signals of the power amplified stereophonic signal; the secondary left channel signal being supplied to the first output and the secondary right channel signal being supplied to the second output; and

30 central channel decoding means for decoding a central channel signal from the left and right channel signals of the power amplified stereophonic signal; the central channel decoding means including first and second decoupling means respectively decoupling the left and right channel



signals; the central channel decoding means including means for combining the left and right decoupled channel signals into the central channel signal; the central channel signal being supplied to the third output;
whereby the decoupling means of the central channel decoding means allow
5 the left and right channel signals of the power amplified stereophonic signal to be combined without modifying the original left and right channel signals.

According to another aspect of the present invention, there is provided a post-amplification stereophonic to surround sound decoding circuit
10 comprising:

an input for receiving a power amplified stereophonic signal including a left channel signal and a right channel signal;
a first output configured to be connected to a secondary left
loudspeaker;
15 a second output configured to be connected to a secondary right loudspeaker;
a third output configured to be connected to a central loudspeaker;
a fourth output configured to be connected to a main left
20 loudspeaker;
a fifth output configured to be connected to a main right loudspeaker;
secondary channels decoding means for decoding a secondary left channel signal and a secondary right channel signal from the left and right
25 channel signals of the power amplified stereophonic signal; the secondary left channel signal being supplied to the first output and the secondary right channel signal being supplied to the second output;
central channel decoding means for decoding a central channel signal from the left and right channel signals of the power amplified
30 stereophonic signal; the central channel decoding means including first and second decoupling means respectively decoupling the left and right channel signals; the central channel decoding means including means for combining the

left and right decoupled channel signals into the central channel signal; the central channel signal being supplied to the third output; and

main channels volume control means for controlling the amplitude of (a) a left channel signal supplied to the fourth output from the left channel signal and (b) a right channel signal supplied to the fifth output from the right channel signal;

whereby the decoupling means of the central channel decoding means allow the left and right channel signals of the power amplified stereophonic signal to be combined without modifying the original left and right channel signals.

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According to yet another aspect of the present invention, there is provided a central channel decoding circuit for a post-amplification stereophonic to surround sound decoding apparatus comprising:

an input for receiving a power amplified stereophonic signal including a left channel signal and a right channel signal;

an output configured to be connected to a central loudspeaker; and

central channel decoding means for decoding a central channel signal from the left and right channel signals of the power amplified stereophonic signal; the central channel decoding means including first and second decoupling means respectively decoupling the left and right channel signals; the central channel decoding means including means for combining the left and right decoupled channel signals into the central channel signal; the central channel signal being supplied to the output;

whereby the decoupling means of the central channel decoding means allow the left and right channel signals of the power amplified stereophonic signal to be combined without modifying the original left and right channel signals.

Other objects and advantages of the present invention will become more apparent to one skilled in the art upon reading of the following non restrictive description of a preferred embodiment thereof, given by way of example only with reference to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the appended drawings:

5 Figure 1 illustrates, in a block diagram, a post-amplification stereophonic to surround sound decoding circuit according to an embodiment of the present invention; the decoding circuit being connected to a stereophonic power amplifier and to five loudspeakers;

10 Figure 2 illustrates, in a schematic view, the post-amplification stereophonic to surround sound decoding circuit of figure 1; and

 Figure 3 illustrates, in a schematic view, an alternate embodiment of the central channel decoding circuit illustrated in figure 2.

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DESCRIPTION OF THE PREFERRED EMBODIMENT

 Turning now to figures 1 and 2 of the appended drawings, a post-amplification stereophonic to surround sound decoding circuit 10 will be
20 described.

 The decoding circuit 10 illustrated in figure 1 is shown connected to a stereophonic power amplifier 12. The decoding circuit 10 includes a left input 14, a right input 16 and a ground connection 18 respectively connected
25 to a left output 20, a right output 22 and a ground connection 24 of the stereophonic power amplifier 12. Of course, the connections 20, 22 and 24 of the power amplifier 12 are usually connected to two conventional main left and main right loudspeakers.

30 The decoding circuit 10 also includes a two terminal main left loudspeaker output 26, 27 connected to a main left loudspeaker 28, a two terminal main right loudspeaker output 30, 31 connected to a main right loudspeaker 32, a two terminal secondary left loudspeaker output 34, 35

connected to a secondary left loudspeaker 36, a two terminal secondary right loudspeaker output 38, 39 connected to a secondary right loudspeaker 40 and a two terminal central loudspeaker output 42, 43 connected to a central loudspeaker 44.

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The decoding circuit 10 includes a main channels volume control circuit 46, a secondary channels decoding circuit 48 and a central channel decoding circuit 50.

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As can be seen from figure 1, the main channels volume control circuit 46 interconnects the inputs 14, 16 and 18 and the main loudspeakers outputs 26, 27, 30 and 31; the secondary channels decoding circuit 48 interconnects the inputs 14 and 16 and the secondary loudspeakers outputs 34, 35, 38 and 39; and the central channel decoding circuit 50 interconnects the

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inputs 14, 16 and 18 and the central loudspeaker outputs 42 and 43.

Turning now to figure 2 of the appended drawings, the circuits 46, 48 and 50 will be described in greater details.

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The main channels volume control circuit 46 includes a variable resistor 52 connected to the left input 14 and to the output 26 to the main left loudspeaker and a variable resistor 54 connected to the right input 16 and to the output 30 to the main right loudspeaker. By varying the value of the resistors 52 and 54, one modifies the amplitude of the signal supplied to the main loudspeakers, thus varying the volume of the sound reproduced by the main loudspeakers, since the portion of the power amplified signal dissipated as heat in the resistors is modified. As can be seen from figure 2, the ground connections 27 and 31 are interconnected and connected to the ground input connection 18.

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It is to be noted that the variable resistors 52 and 54 could be advantageously embodied together in a stereophonic L-pad (with no ground connection) and having an appropriate power rating. If this is the case, the user

will be faced with only one volume control for the two main loudspeakers. Alternatively, the variable resistors could also be embodied by a plurality of discrete high quality resistors (not shown) and switches (not shown) or by a high power levels variable resistance integrated circuit (not shown).

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It is therefore to be noted that the term "variable resistor" is to be construed, herein and in the appended claims, as any electronic element or arrangement of resistive and/or other electronic elements allowing the modification of a resistance between two points of an electrical circuit.

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The secondary channels decoding circuit 48 includes a first capacitor 56 connected to the left input 14 and to the output 34 to the secondary left loudspeaker, a second capacitor 58 connected to the right input 16 and to the output 38 to the secondary right loudspeaker and a variable resistor 60 connected to the ground output connection 35 to the secondary left loudspeaker and to the output ground connection 39 to the secondary right loudspeaker. It is to be noted that the ground output connections 35 and 39 are not connected to the input ground connection 18.

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As it will be apparent to one skilled in the art, the connection of the variable resistor 60 between the output ground connections 35 and 39 causes the secondary loudspeakers to reproduce respective secondary channel signals that are obtained by a subtraction of the signal supplied to the inputs 14 and 16. More specifically, the secondary left channel signal reproduced by the secondary left loudspeaker is the signal supplied to the left input 14 minus the signal supplied to the right input 16. Similarly, the secondary right channel signal reproduced by the secondary right loudspeaker is the signal supplied to the right input 16 minus the signal supplied to the right input 14. Since the secondary channels decoding circuit 48 is not connected to the ground, the secondary left and right channel signals are equal since the subtraction of the input 14 from the input 16 is equal to the subtraction of the input 16 from the input 14. Furthermore, since capacitors 56 and 58 are, in a sense, decoupling capacitors and since the secondary channels decoding circuit 48 is not

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connected to the ground, the interconnection of the ground connections 35 and 39 will have no ill effect on the signals supplied to the main channels volume control circuit 46 and to the central channel decoding circuit 50 since the capacitors 56 and 58 prevent the signal supplied to the input 14 to "bleed" in the signal supplied to the input 16 and vice-versa.

By varying the value of the resistor 60, one modifies the amplitude of the signal supplied to the secondary loudspeakers, thus varying the volume of the sound reproduced by the secondary loudspeakers, since the portion of the power amplified signal dissipated as heat in the resistors is modified.

It has been found advantageous to select the value of the capacitors 56 and 58 so that a high-pass filter of about 100 Hz is created with respect to the impedance of the secondary loudspeakers.

The central channel decoding circuit 50 includes a first fixed value resistor 62 connected to the left input 14, a first capacitor 64 connected to the first resistor 62, a second fixed value resistor 66 connected to the right input 16, a second capacitor 68 connected to the second resistor 66 and a variable resistor 70 interconnecting both capacitors 64 and 68 to the output 42 to the central loudspeaker. The ground connection 43 is connected to the ground input connection 18.

The signal supplied to the central loudspeaker output 42 is therefore the addition of the signal supplied to the left and right inputs 14 and 16 by the power amplifier 12.

It is to be noted that since the capacitors 64 and 68 are, in a sense, decoupling capacitors, the interconnection of the output of these capacitors to cause the addition of the left and right inputs 14 and 16 will have no ill effect on the signals supplied to the main channels volume control circuit 46 and to the secondary channels decoding circuit 48.

It has been found advantageous to select values of the fixed resistors 62 and 66 so that each is equivalent to half the nominal impedance of the main loudspeakers. It has also been found advantageous to select the values of the capacitors 64 and 68 so that a high-pass filter of about 100 Hz is created with respect to the impedance of the central loudspeaker.

Again, by varying the value of the resistor 70, one modifies the amplitude of the signal supplied to the central loudspeaker, thus varying the volume of the sound reproduced by the central loudspeakers, since the portion of the power amplified signal dissipated as heat in the resistor is modified.

It is to be noted that the variable resistors 60 and 70 could be advantageously embodied in separate monophonic L-pads (with no ground connections) and having an appropriate power ratings. Alternatively, the variable resistors 60 and 70 could also be embodied by a plurality of discrete high quality resistors (not shown) and switches (not shown) or by high power levels variable resistance integrated circuits (not shown).

Turning now to figure 3 of the appended drawings, an alternate central channel decoding circuit 150 will be briefly described. The major difference between the decoding circuit 150 and the decoding circuit 50 of figure 2 consists in the replacement of the variable resistor 70 provided downstream from the interconnection of the left and right inputs by a pair of variable resistors 170, 170' respectively provided between the fixed value resistors 62, 66 and the capacitors 64, 68, thus upstream from the interconnection of the left and right inputs. The decoding circuit 150 improves the impedance and frequency stability as well as allowing more usable power to be supplied to the central loudspeaker.

Again, it is to be noted that the variable resistors 170 and 170' could be advantageously embodied together in a stereophonic L-pad (with no ground connection) and having an appropriate power rating. Alternatively, the variable resistors could also be embodied by a plurality of discrete high quality

resistors (not shown) and switches (not shown) or by a high power levels variable resistance integrated circuit (not shown).

Returning to figure 2, it is to be noted that the impedance of the
5 post-amplification stereophonic to surround sound decoding circuit 10 "seen"
by the outputs 20, 22 and 24 of the power amplifier 12 is essentially similar to
the impedance of the main loudspeakers since the decoding circuits 48 and 50
use decoupling capacitors and are therefore virtually "invisible" as far as
impedance is concerned. Indeed, the impedances of the decoding circuits 48
10 and 50 are so much higher than the impedance of the main loudspeakers 28
and 32 that the connection of the circuits 48 and 50, generally in parallel,
therewith will not modify significantly the impedance seen by the outputs 20, 22
and 24 of the power amplifier.

15 As can be seen from figure 2, fuses 72, 74 and 76 are provided
between the inputs 14, 16 and 18 and the circuits 46, 48 and 50 as protection.
It is also to be noted that an on/off switch (not shown) could advantageously be
provided to disconnect the circuits 48 and 50 from the inputs 14, 16 and 18
when the user wants to use only the main loudspeakers and does not want to
20 hear a surround sound.

It has been found that non-polarized capacitors are required for
the decoding circuits of the present invention. Of course, as will be easily
understood by one skilled in the art, matched pairs of polarized capacitors could
25 be substituted.

It is to be noted that even though the circuits 46, 48 and 50 have
been described as separate circuits, these circuits may advantageously be
embodied together onto a printed circuit board (not shown).

30 As will be understood by one skilled in the art, the circuits 46, 48
and 50 illustrated in figure 2 and described hereinabove are given by way of
example only and could be modified without departing from the scope of the

present invention. It is also to be noted that each circuit includes volume controls accessible to the user to modify the volume of each of the three groups of loudspeakers, i.e., the main loudspeakers, the secondary loudspeakers and the central loudspeaker. Indeed, it has been found that some users prefer to

5 hear the surround channels (reproduced by the secondary loudspeakers) and the central channel (reproduced by the central loudspeaker) at a greater or lesser volume than is considered optimal. Furthermore, since the decoding circuit 10 may be connected to a number of different stereophonic power amplifiers and to a number of different loudspeakers, the separate volume

10 controls help compensate for these differences. However, a simpler and less expensive post-amplification stereophonic to surround sound decoding circuit could be done by removing the variable resistors 52, 54, 60 and 70 (or, alternatively 170, 170'). Similarly, the fuses 72, 74 and 76 could be removed from the circuit since they are provided only for overload protection. It will be

15 noted that such a simplified circuit (not shown) would be less versatile since the user would have no independent control on the three groups of loudspeakers.

It is to be noted that even though the post-amplification stereophonic to surround sound decoding circuit 10 described hereinabove

20 includes outputs to the main left and main right loudspeakers, it would be within the skills of one knowledgeable in the art to design a decoding apparatus (not shown) not including these outputs if the decoder was intended to be used with a power amplifier provided with two pairs of left-right outputs. Indeed, one pair of outputs could be directly connected to the main left and main right

25 loudspeakers, while the other pair of outputs could be supplied to the decoding apparatus to yield the secondary left, secondary right and central outputs as described hereinabove. Of course, such a decoding apparatus would be less versatile since no independent control on the signal supplied to the main loudspeakers would be provided and since the circuit would be only usable on

30 the above-mentioned type of power amplifiers or with multiple integrated amplifiers provided with a common floating ground..

It is also to be noted that the post-amplification stereophonic to surround sound decoding circuit 10 may advantageously be packaged in an enclosure provided with adequate connectors for the input and outputs of the circuit 10 to yield a post-amplification stereophonic to surround sound decoding apparatus. The actuators of the variable resistors 52, 54, 60 and 70 are advantageously positioned so as to be accessible to the user. Alternatively, the decoding circuit 10 could be installed in a conventional power amplifier to yield a surround power amplifier without requiring five amplification channels.

It is finally to be noted that the output pairs 34, 35; 38, 39; and 42, 43 could be provided with adequate switching elements (not shown) allowing the polarity of these output pairs to be inverted. Indeed, selective inversion of these output pairs would allow the listener to tailor the surround sound reproduction.

As will be apparent to one skilled in the art, the post-amplification stereophonic to surround sound decoding circuit of the present invention has many advantage over the stereophonic to surround sound of the prior art, such as:

- the decoding is done downstream from the power amplification, allowing the user to keep his conventional stereophonic power amplifier;
- the decoding circuit is compatible with every conventional consumer and professional loudspeaker;
- the decoding circuit is compatible with every conventional consumer and professional audio power amplifier;
- the decoding circuit allows the user to control his listening experience by independently varying the volume of the three groups of loudspeakers;
- the decoding is compatible with every known two channels mixed encoding standards such as, for example, the home theater surround sound developed by Dolby laboratories, the Pro-Logic™ technique and the THX™ technique developed by Lucas Arts Entertainment Co.;

the decoding circuit does not require an additional power source;

the decoding circuit offers a wide bandwidth to the center and surround channels;

5 the decoding circuit may easily be designed to allow unusual and complex loudspeaker impedance load;

the decoding circuit may easily be designed to handle high power signals by providing components having an adequate power rating;

10 the decoding circuit may easily be designed for different applications such as, for example, multimedia computing, automobile sound systems, virtual reality applications; and

the decoding circuit may easily be designed with a computer-controlled interface, to control the separate volumes, for example, if the particular decoding circuit is intended to be used by a computer controlled application.

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Although the present invention has been described hereinabove by way of a preferred embodiment thereof, this preferred embodiment can be modified at will, without departing from the spirit and nature of the subject invention as defined in the appended claims.

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WHAT IS CLAIMED IS:

1. A post-amplification stereophonic to surround sound decoding circuit comprising:
- 5 an input for receiving a power amplified stereophonic signal including a left channel signal and a right channel signal;
- a first output configured to be connected to a secondary left loudspeaker;
- a second output configured to be connected to a secondary right
- 10 loudspeaker;
- a third output configured to be connected to a central loudspeaker;
- secondary channels decoding means for decoding a secondary left channel signal and a secondary right channel signal from the left and right
- 15 channel signals of the power amplified stereophonic signal; said secondary left channel signal being supplied to said first output and said secondary right channel signal being supplied to said second output; and
- central channel decoding means for decoding a central channel signal from the left and right channel signals of the power amplified
- 20 stereophonic signal; said central channel decoding means including first and second decoupling means respectively decoupling the left and right channel signals; said central channel decoding means including means for combining said left and right decoupled channel signals into said central channel signal; said central channel signal being supplied to said third output;
- 25 whereby said decoupling means of said central channel decoding means allow the left and right channel signals of the power amplified stereophonic signal to be combined without modifying the original left and right channel signals.
2. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 1, wherein said central channel decoding means
- 30 further includes means for controlling the amplitude of said central channel signal.

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3. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 2, wherein said amplitude controlling means includes at least one variable resistor.

5 4. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 1, wherein said first and second decoupling means of said central channel decoding means respectively include first and second capacitors.

10 5. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 4, wherein said first decoupling means include a first resistor connected in series with said first capacitor and so connected to said input as to receive said left channel signal; said second decoupling means include a second resistor connected in series with said second capacitor and
15 so connected to said input as to receive said right channel signal; said first and second capacitors being interconnected to combine the decoupled left channel signal and the decoupled right channel signal into said central channel signal.

20 6. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 1, wherein said secondary channels decoding means include first and second decoupling means respectively decoupling said left and right channel signals.

25 7. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 6, wherein said first and second decoupling means of said secondary channels decoding means respectively include first and second capacitors; said first capacitor being connected between said input and said first output; said second capacitor being connected between said input and said second output.

30 8. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 6, wherein each said first and second outputs includes a ground connection; said secondary channels decoding means further

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includes a variable resistor connected in series between said ground connections of said first and second output.

5 9. A post-amplification stereophonic to surround sound decoding circuit comprising:

an input for receiving a power amplified stereophonic signal including a left channel signal and a right channel signal;

a first output configured to be connected to a secondary left loudspeaker;

10 a second output configured to be connected to a secondary right loudspeaker;

a third output configured to be connected to a central loudspeaker;

15 a fourth output configured to be connected to a main left loudspeaker;

a fifth output configured to be connected to a main right loudspeaker;

20 secondary channels decoding means for decoding a secondary left channel signal and a secondary right channel signal from the left and right channel signals of the power amplified stereophonic signal; said secondary left channel signal being supplied to said first output and said secondary right channel signal being supplied to said second output;

25 central channel decoding means for decoding a central channel signal from the left and right channel signals of the power amplified stereophonic signal; said central channel decoding means including first and second decoupling means respectively decoupling the left and right channel signals; said central channel decoding means including means for combining said left and right decoupled channel signals into said central channel signal; said central channel signal being supplied to said third output; and

30 main channels volume control means for controlling the amplitude of (a) a left channel signal supplied to the fourth output from the left channel signal and (b) a right channel signal supplied to the fifth output from the right channel signal;





whereby said decoupling means of said central channel decoding means allow the left and right channel signals of the power amplified stereophonic signal to be combined without modifying the original left and right channel signals.

5 10. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 9, wherein said central channel decoding means further includes means for controlling the amplitude of said central channel signal.

10 11. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 10, wherein said amplitude controlling means includes at least one variable resistor.

15 12. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 9, wherein said first and second decoupling means of said central channel decoding means respectively include first and second capacitors.

20 13. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 12, wherein said first decoupling means include a first resistor connected in series with said first capacitor and so connected to said input as to receive said left channel signal; said second decoupling means include a second resistor connected in series with said second capacitor and so connected to said input as to receive said right channel signal; said first and second capacitors being interconnected to combine the decoupled left channel signal and the decoupled right channel signal into said central channel signal.

25 14. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 9, wherein said secondary channels decoding means include first and second decoupling means respectively decoupling said left and right channel signals.





15. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 14, wherein said first and second decoupling means of said secondary channels decoding means respectively include first and second capacitors; said first capacitor being connected
5 between said input and said first output; said second capacitor being connected between said input and said second output.

16. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 14, wherein each said first and second
10 outputs includes a ground connection; said secondary channels decoding means further includes a variable resistor connected in series between said ground connections of said first and second output.

17. A post-amplification stereophonic to surround sound decoding circuit as defined in claim 9, wherein said main channels volume control means include (a) a first variable resistor so connected to both said
15 fourth output and said input as to supply said left channel signal to said fourth output, and (b) a second variable resistor so connected to both said fifth output said input as to supply said right channel signal to said fifth output

20 18. A central channel decoding circuit for a post-amplification stereophonic to surround sound decoding apparatus comprising:

an input for receiving a power amplified stereophonic signal including a left channel signal and a right channel signal;

25 an output configured to be connected to a central loudspeaker;
and

central channel decoding means for decoding a central channel signal from the left and right channel signals of the power amplified stereophonic signal; said central channel decoding means including first and
30 second decoupling means respectively decoupling the left and right channel signals; said central channel decoding means including means for combining said left and right decoupled channel signals into said central channel signal; said central channel signal being supplied to said output;

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whereby said decoupling means of said central channel decoding means allow the left and right channel signals of the power amplified stereophonic signal to be combined without modifying the original left and right channel signals.

5 19. A central channel decoding circuit as defined in claim 18, further comprising means for controlling the amplitude of said central channel signal.

10 20. A central channel decoding circuit as defined in claim 19, wherein said amplitude controlling means includes at least one variable resistor.

15 21. A central channel decoding circuit as defined in claim 18, wherein said first and second decoupling means respectively include first and second capacitors.

20 22. A central channel decoding circuit as defined in claim 21, wherein said first decoupling means include a first resistor connected in series with said first capacitor and so connected to said input as to receive said left channel signal; said second decoupling means include a second resistor connected in series with said second capacitor and so connected to said input as to receive said right channel signal; said first and second capacitors being interconnected to combine the decoupled left channel signal and the decoupled right channel signal into said central channel signal.

25 23. A central channel decoding circuit as defined in claim 22, further comprising means for controlling the amplitude of said central signal, said amplitude controlling means includes at least one variable resistor.

30 24. A central channel decoding circuit as defined in claim 23, wherein said at least one variable resistor includes a variable resistor provided between said interconnection of said first and second capacitors and said output.



25. A central channel decoding circuit as defined in claim 23, wherein said at least one variable resistor includes (a) a first variable resistor interconnected in series between said first resistor and said first capacitor, and a second variable resistor interconnected in series between said second resistor and said second capacitor.
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