



(51) International Patent Classification:

H04S 3/02 (2006.01) H04R 5/04 (2006.01)
H04R 7/06 (2006.01) H04R 3/12 (2006.01)

(21) International Application Number:

PCT/FI2017/050105

(22) International Filing Date:

17 February 2017 (17.02.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

20165142 24 February 2016 (24.02.2016) FI

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM,

DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

— with international search report (Art. 21(3))

(54) Title: SOUND REPRODUCING SYSTEM

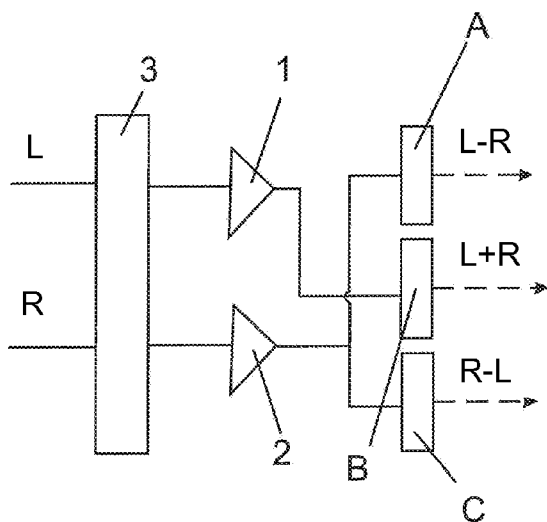


Fig. 1

(57) Abstract: The invention relates to a sound reproducing system and method for converting an input left audio signal (L) and an input right audio signal (R) into a stereo sound image. The sound reproducing system comprises a converter (3), at least two amplifiers (1, 2) and a panel sound element (4), which panel sound element (4) comprises a left playing area (A), a center playing area (B), and a right playing area (C), and in which sound reproducing system the converter (3) is adaptable to modify the left audio signal (L) and the right audio signal (R) by means of a matrix into the sum (L+R) of the left and right audio signal, the difference (L-R) of the left and right audio signal, and the difference (R-L) of the right and left audio signal; at least two amplifiers (1, 2) are adaptable to amplify the left and right audio signals (L) and (R), or their sum (L+R) and differences (L-R) and (R-L); and the center playing area (B) of the panel sound element (4) is adaptable to receive the sum (L+R), the left playing area (A) is adaptable to receive the difference (L-R), and the right playing area (C) is adaptable to receive the difference (R-L) to form a stereo sound image.

WO 2017/144774 A1

Sound reproducing system

Background of the invention

The invention relates to a sound reproducing system in which the audio input signal to the system is converted into a stereo sound image.

5 In a three-loudspeaker system, the stereo sound image is traditionally so produced that the sum $R+L$ of the input left and right channels is fed to the center speaker, the difference $L-R$ of the left and right channel is fed to the left side speaker, and the difference $R-L$ of the right and left channel is fed to the right side speaker. In a system, the outermost speakers are placed at an angle in relation to the center speaker. In order to work, such a system requires around it room reflections, in which case the system does not work very well in a free field or asymmetric space. In another system, the speakers are placed parallel, side by side, but far from each other. The above systems are not implemented with panel sound elements and their purpose is not to act as a very directional sound source, 10 which is why the speakers are not dimensioned or positioned close enough to each other. As a result, the systems in question easily suffer from frequency-dependent stereo image distortion.

Brief description of the invention

It is therefore the object of the invention to develop a sound reproducing system and a method for converting the audio signals input into the sound producing system into a stereo sound image so that the aforementioned problems may be solved. The object of the invention is achieved by a method and system which are characterized by what is disclosed in the independent claims. Preferred embodiments of the invention are disclosed in the dependent claims.

25 The invention is based on a sound reproducing system which comprises a converter for modifying the input audio signals, at least two amplifiers for amplifying the audio signals, and a panel sound element for receiving said modified audio signals to form a stereo sound image.

In the device and method of the invention, a panel sound element is used, which enables the forming of a wide, directional stereo sound image extending outside of the physical borders of the element. The panel sound element comprises three playing areas positioned adequately close to each other, whereby the passive area left at the junctions of the areas is formed as small as possible due to the minor frame structure and mounting requirements. In addition, the width of the playing areas matches the distance between the ears, 35

whereby the stereo sound image will not be distorted. The sound can also be made to reproduce uniform on the entire surface of the panel sound element, so on the line of the junctions the frequency response and phase are favourable to form the right kind of wavefront.

5 **Brief description of the figures**

The invention will now be described in more detail in connection with preferred embodiments and with reference to the accompanying drawings, in which:

- Figure 1 shows a schematic diagram of a sound reproducing system;
- 10 Figure 2 shows a panel sound element seen from the front;
- Figure 3 shows the panel sound element from the above;
- Figure 4 shows schematically a method for converting the signals into a stereo sound image.

Detailed description of the invention

15 Figure 1 shows a schematic diagram of a sound reproducing system, in which the left audio signal L and the right audio signal R input to the system may be converted into a stereo sound image. The sound reproducing system comprises a converter 3, at least two amplifiers 1, 2 and a panel sound element 4 (Figure 2), which may comprise a left playing area A, a center playing area B, and
20 a right playing area C.

By means of the converter 3, the left audio signal L and the right audio signal R may be modified with a matrix into a sum $L+R$ of the left and right audio signal. In addition, the converter 3 allows the modification of the input left and right audio signals L, R into a difference $L-R$ of the left and right audio signal, and
25 into the difference $R-L$ of the right and left audio signal. The converter 3 is advantageously an MS matrix.

The amplifiers 1, 2 of the sound reproducing system may be adapted to amplify the sum $L+R$ of the right and left audio signal, the difference $L-R$ of the left and right audio signal, and the difference $R-L$ of the right and left audio signal.

30 The center playing area B of the panel sound element 4 in the sound reproducing system may be adapted to receive the sum $L+R$ of the left and right audio signal, the left playing area A may be adapted to receive the difference $L-R$ of the left and right audio signal, and the right playing area C may be adapted to receive the difference $R-L$ of the right and left channel to form a stereo sound
35 image.

As Figure 1 indicates, the input of the first amplifier 1 may be connected to the first output of the converter 3, and the input of the second amplifier 2 may be connected to the second output of the converter 3. The first amplifier 1 may in this case amplify the sum $L+R$ of the left and right audio signal output from the first output of the converter 3. The second amplifier 2 may amplify the difference $L-R$ of the left and right audio signal and the difference $R-L$ of the right and left audio signal output from the second output of the converter 3.

The panel sound element 4 may be connected to the amplifiers 1, 2 so that the input of the center playing area B may be connected to the output of the first amplifier 1. The inputs of the left and right playing areas A, C may be connected to the output of the second amplifier 2. In this case, the center playing area B may be adapted to produce the sum $L+R$ of the left and right audio signal from the audio signal of the output of the first amplifier 1. The left playing area A may be adapted to produce the difference $L-R$ of the left and right audio signal from the audio signal of the output of the first amplifier 2. The right playing area C may be adapted to produce the difference $R-L$ of the right and left audio signal from the audio signal of the output of the first amplifier 2.

The sound reproducing system according to an embodiment comprises the converter 3, at least two amplifiers 1, 2, and panel sound element 4 of Figure 1. In this embodiment, the converter 3 for producing the sum or difference of the left and right audio signal L, R may be placed after the amplifiers 1, 2. In such a case, the first amplifier 1 may be adapted to amplify the left audio signal L and the second amplifier 2 may be adapted to amplify the right audio signal R . The first input of the converter 3 may be connected to the output of the first amplifier 1 and the second input of the converter 3 may be connected to the output of the second amplifier 2. Both outputs of the converter 3 may for their part be connected to the panel sound element 4. In the same manner, phasing may take place before or after the amplifiers 1, 2. In the sound reproducing system according to the above embodiments, the summing, differencing and phasing of the left and right audio signals L, R may be carried out analogically or digitally.

Figure 2 shows a panel sound element 4 seen from the front; The panel sound element 4 may comprise a left playing area A, a center playing area B, and a right playing area C. The playing areas A, B, C may be positioned in parallel very close to each other in the same plane. Advantageously the playing areas A, B, C are located less than 1 cm from each other, or in contact with each other. The

junctions D, E of the playing areas A, B, C may be positioned close to the average distance between human ears, so the width t of the center area is advantageously 10 to 25 cm. The proportions of the left and right playing area A, C, such as width and height, are advantageously the same as those of the center playing area B.

5 Figure 3 shows a panel sound element 4 seen from the above. To form a stereo sound image, the sounds positioned at the center may be reproduced from the center playing area B, only, whereby the sound signal $R+L$ passes freely to the observer's 7 both ears. To form the stereo sound image on the left side, the center playing area B and the left playing area A may be adapted to play in the
10 same phase, and the right playing area C to play in the anti-phase, whereby an acoustic center point 5 may be formed on the line of the junction D of the center and left playing area A, B. To form the stereo sound image on the right side, the center playing area B and the right playing area C are adapted to play in the same phase, and the left playing area A to play in the anti-phase to form an acoustic
15 center point 6 on the line of the junction E of the center and right playing area B, C. When the observer 7 now positions himself in the middle of the sound field of the system and as the ears are positioned in the sound field produced by the junctions D, E of the playing areas, the stereo sound image may be detected on the line of the junctions D, E.

20 Figure 4 shows an example of converting a left audio signal L and a right audio signal R input to a sound reproducing system into a stereo sound image. The sound reproducing system comprises a converter 3, at least two amplifiers 1, 2 and a panel sound element 4, which panel sound element 4 comprises a left playing area A, a center playing area B, and a right playing area C.

25 In the method, the left audio signal L and the right audio signal R are modified 41 in the converter 3 by means of a matrix into the sum $L+R$ of the left and right audio signal, the difference $L-R$ of the left and right audio signal, and the difference $R-L$ of the left and right audio signal. Further in the method as least two amplifiers 1, 2 are adapted 42 to amplify the left audio signal L and the right audio
30 signal R; or the sum $L+R$ of the left and right audio signal, the difference $L-R$ of the left and right audio signal, and the difference $R-L$ of the left and right audio signal. Further in the method, the center playing area B is adapted 43 to receive the sum $L+R$ of the left and right audio signal. In addition, the left playing area A is adapted to receive the difference $L-R$ of the left and right audio signal, and the right
35 playing area C is adapted to receive the difference $R-L$ of the right and left audio signal to form a stereo sound image.

A person skilled in the art will find it obvious that, as technology advances, the basic idea of the invention may be implemented in many different ways. The invention and its embodiments are thus not restricted to the above-described examples but may vary within the scope of the claims.

Claims

1. A sound reproducing system for converting an input left audio signal (L) and an input right audio signal (R) into a stereo sound image, said sound reproducing system comprising a converter (3), at least two amplifiers (1, 2) and
5 a panel sound element (4), which panel sound element (4) comprises a left playing area (A), a center playing area (B), and a right playing area (C), and in which sound reproducing system

the converter (3) is adaptable to modify the left audio signal (L) and the right audio signal (R) by means of a matrix into the sum (L+R) of the left and
10 right audio signal, the difference (L-R) of the left and right audio signal, and the difference (R-L) of the left and right audio signal,

at least two amplifiers (1, 2) are adaptable to amplify the left audio signal (L) and the right audio signal (R); or the sum (L+R) of the left and right audio signal, the difference (L-R) of the left and right audio signal, and the
15 difference (R-L) of the right and left audio signal, and

the center playing area (B) of the panel sound element (4) is adaptable to receive the sum (L+R) of the left and right audio signal, the left playing area (A) is adaptable to receive the difference (L-R) of the left and right audio signal, and the right playing area (C) is adaptable to receive the difference (R-L) of the right
20 and left channel to form a stereo sound image.

2. A sound reproducing system as claimed in claim 1, in which the converter (3) for summing, differencing and phasing the left and right audio signal (L, R) is located before and/or after the amplifiers (1, 2).

3. A sound reproducing system as claimed in claim 1 or 2, in which
25 the first amplifier (1) is adaptable to amplify the sum (L+R) of the left and right audio signal output from the first output of the converter (3), and the second amplifier (2) is adaptable to amplify the difference (L-R) of the left and right audio signal and the difference (R-L) of the right and left audio signal output from the second output of the converter (3), and

the center playing area (B) is adaptable to produce the sum (L+R) of the left and right audio signal from the audio signal of the output of the first amplifier (1), the left playing area (A) is adaptable to produce the difference (L-R) of the left and right audio signal from the audio signal of the output of the second amplifier (2), and the right playing area (C) is adaptable to produce the difference
35 (R-L) of the right and left audio signal from the audio signal of the output of the second amplifier (2).

4. A sound reproducing system as claimed in any one of claims 1 to 3, in which the left, center, and right playing area (A, B, C) are close to each other and in the same plane.

5. A sound reproducing system as claimed in any one of claims 1 to 4, in which the proportions of the left and right playing area (A, C) are the same as those of the center playing area (B).

6. A sound reproducing system as claimed in any one of claims 1 to 5, in which the width t of the center playing area (B) is 10 to 25 cm.

7. A method for converting a left audio signal (L) and a right audio signal (R) input to a sound reproducing system into a stereo sound image, said system comprising a converter (3), at least two amplifiers (1, 2) and a panel sound element (4), which panel sound element (4) comprises a left playing area (A), a center playing area (B), and a right playing area (C), and in which method

the left audio signal (L) and the right audio signal (R) are modified in the converter (3) by means of a matrix into the sum (L+R) of the left and right audio signal, the difference (L-R) of the left and right audio signal, and the difference (R-L) of the right and left audio signal,

at least two amplifiers (1, 2) are adapted to amplify the left audio signal (L) and the right audio signal (R); or the sum (L+R) of the left and right audio signal, the difference (L-R) of the left and right audio signal, and the difference (R-L) of the right and left audio signal,

the center playing area (B) is adapted to receive the sum (L+R) of the left and right audio signal, the left playing area (A) is adapted to receive the difference (L-R) of the left and right audio signal, and the right playing area C is adapted to receive the difference (R-L) of the right and left audio signal to form a stereo sound image.

8. A method as claimed in claim 7, comprising

adapting the center playing area (B) and the left playing area (A) to play in the same phase, and the right playing area (C) to play in the anti-phase to form an acoustic center point (5) on the line of the junction D of the center and left playing area (A, B),

adapting the center playing area (B) and the right playing area (C) to play in the same phase, and the left playing area (A) to play in the anti-phase to form an acoustic center point (6) on the line of the junction (E) of the center and right playing area (B, C) to detect a stereo sound image on the line of the junctions (D, E).

9. A method as claimed in claim 7 or 8, in which the summing, differencing, and phasing of the left and right audio signal (L, R) are implemented before and/or after amplification.

5 10. A method as claimed in any one of claims 7 to 9, in which the summing, differencing, and phasing of the left and right audio signal (L, R) are implemented analogically or digitally.

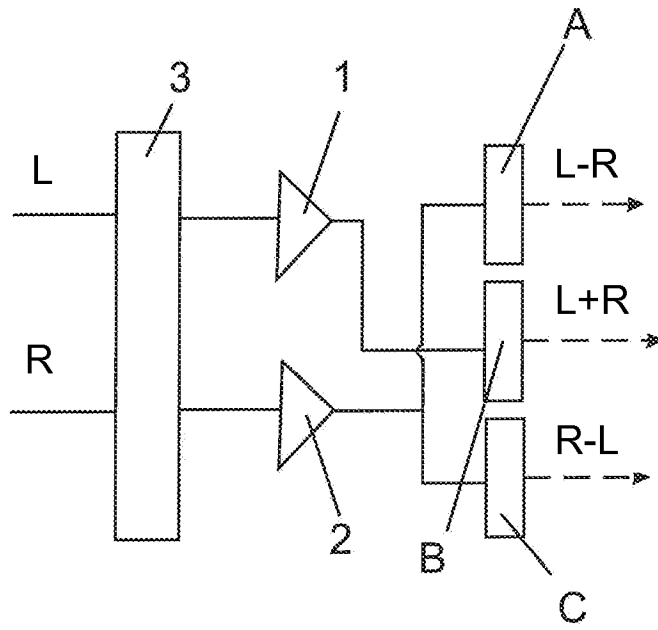


Fig. 1

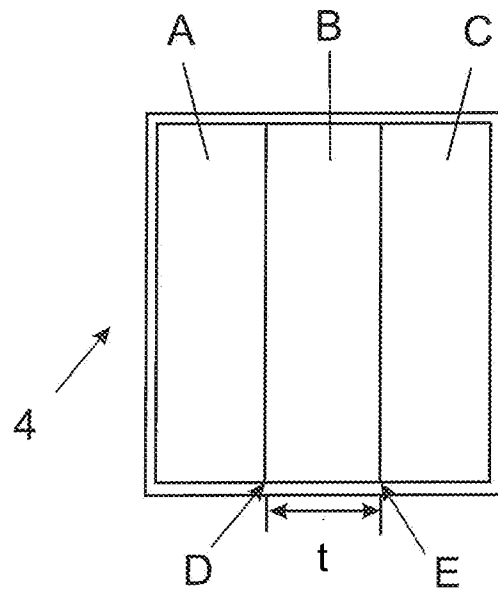


Fig. 2

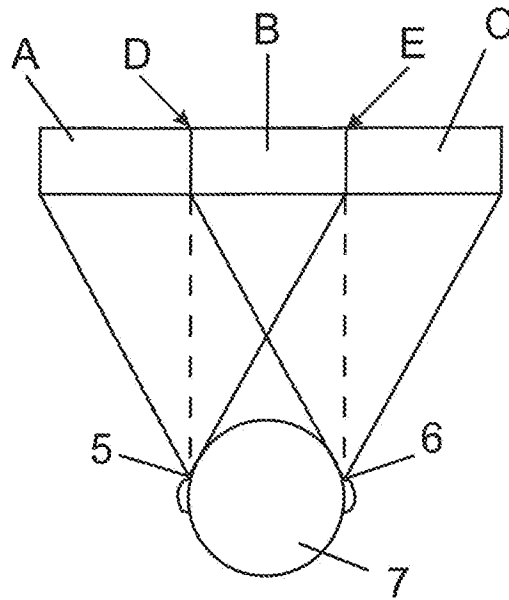


Fig. 3

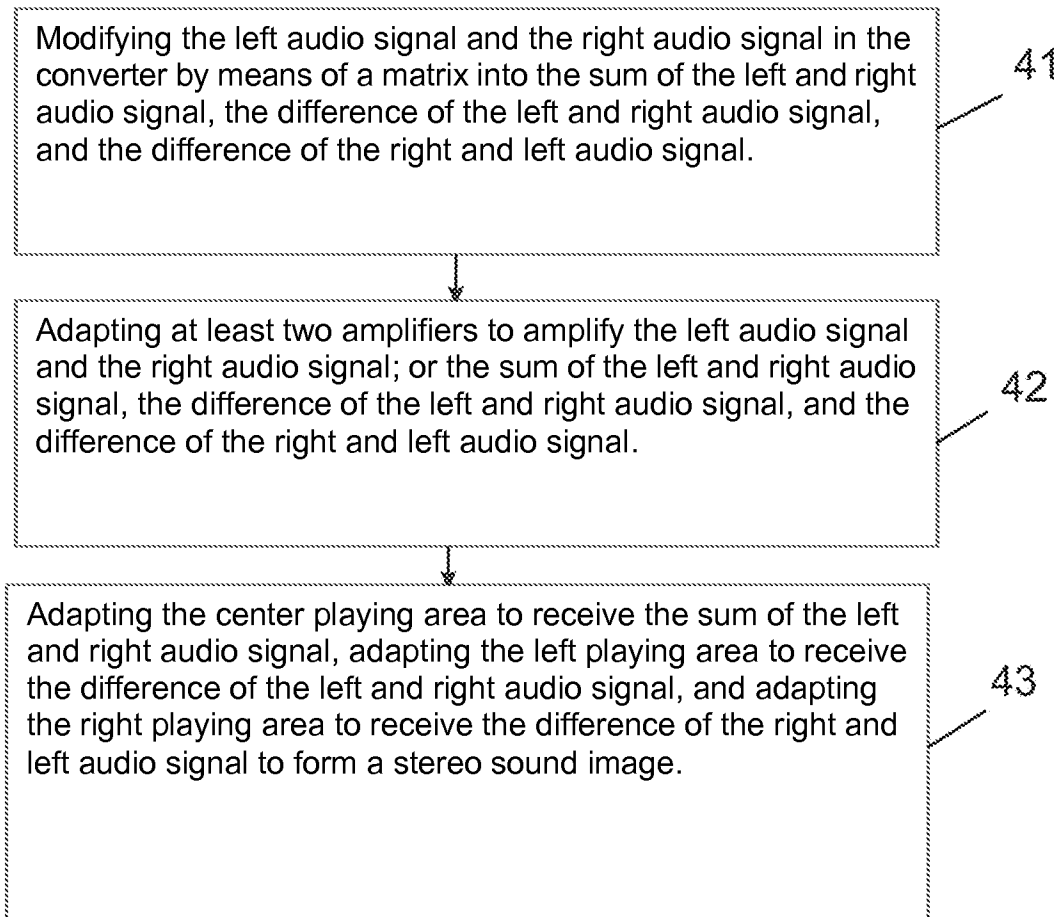


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2017/050105

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04R, H04S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used)

EPODOC, WPIAP, EPO-Internal full-text databases, BIOSIS, COMPDX, EMBASE, INSPEC, MEDLINE, NPL, TDB, XP3GPP, XPAIP, XPESP, XPETSI, XPI3E, XPIEE, XPIETF, XPIOP, XPIPCOM, XPJPEG, XPMISC, XPOAC, XPRD, XPTK

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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 Further documents are listed in the continuation of Box C.
 See patent family annex.

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Date of the actual completion of the international search 16 May 2017 (16.05.2017)	Date of mailing of the international search report 18 May 2017 (18.05.2017)
Name and mailing address of the ISA/FI Finnish Patent and Registration Office P.O. Box 1160, FI-00101 HELSINKI, Finland Facsimile No. +358 9 6939 5328	Authorized officer Antti Salmela Telephone No. +358 9 6939 500

INTERNATIONAL SEARCH REPORT

International application No.

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CLASSIFICATION OF SUBJECT MATTER

IPC
H04S 3/02 (2006.01)
H04R 7/06 (2006.01)
H04R 5/04 (2006.01)
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INTERNATIONAL SEARCH REPORT
Information on Patent Family Members

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