



- (51) International Patent Classification:
H04R 25/00 (2006.01) *G10L 25/18* (2013.01)
- (72) Inventor; and
(71) Applicant: **RIBIC, Zlatan** [AT/AT]; Anton Baumgartner-
str. 44/A8/052, 1230 Wien (AT).
- (21) International Application Number:
PCT/AT2018/060141
- (74) Agent: **BABELUK, Michael**; Florianigasse 26/3, 1080
Wien (AT).
- (22) International Filing Date:
10 July 2018 (10.07.2018)
- (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, JO, 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.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
A 50569/2017 10 July 2017 (10.07.2017) AT
- (71) Applicant: **ISUNIYE LLC** [US/US]; 15270 Sobey Road,
Saratoga, California 95070-6239 (US).

(54) Title: SIMPLE CONTROL OF MANY PARAMETERS

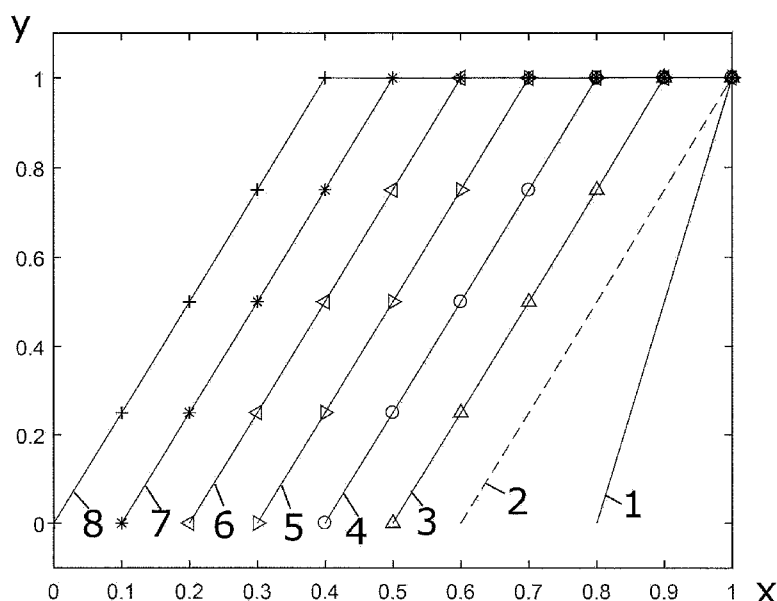


Fig. 1

(57) Abstract: The invention relates to a process for modifying an audio signal that comprises the following steps: a. Determining a compression parameter (y) of the audio signal that should be modified; b. Fractionizing the audio signal into different frequency bands; c. Obtaining the values of the compression parameter (y) for each frequency band; d. Compressing at least a part of the frequency bands as a function of the determined compression parameter (y); The invention also relates to a device for modifying an audio signal comprising at least one fractionizing unit (11) for fractionizing an incoming audio signal into different frequency bands, a plurality of compression units (12) for compression of at least a part of the frequency bands depending on a determined compression parameter (y) and a control unit (13) for determining the values of a compression parameter (y) by means of a specific I/O function (1-8) for each frequency band and using a single control parameter (x) as input value. The object of the invention, to simplify the process of

(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).

Published:

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

adjustment of the modification of the audio signal, is met by obtaining the values of the compression parameter (y) by I/O functions (1-8) for each frequency band by using a single control parameter (x) as input value, or by the fact that the control unit (13) controls all compression units (12).

Simple control of many parameters

The present invention relates to a process for modifying an audio signal that comprises the following steps:

- a. Determining a compression parameter of the audio signal that should be modified;
- b. Fractionizing the audio signal into different frequency bands;
- c. Obtaining the values of the compression parameters for each frequency band;
- d. Compressing at least a part of the frequency bands as a function of the determined compression parameter.

The invention also relates to a device for modifying an audio signal comprising at least one fractionizing unit for fractionizing an incoming audio signal into different frequency bands, a plurality of compression units for compressing at least a part of the frequency bands as a function of a determined compression parameter and a control unit for determining the values of the compression parameter by means of a specific I/O function for each frequency band and using a single control parameter as input value.

In many fields of the economy and industry, audio signals have to be modified in order to fit specific applications. Especially hearing aid devices amplify and alter audio signals in order to improve perception by hearing-impaired individuals and increase their understanding of spoken words. Most modern instruments use multichannel compression with at least one compression parameter per channel, e.g. compression ratio, time constants (or variables), gain, etc. Even if only a few channels with different frequency bands are used, a large amount of adjustable parameters can be defined. Many users of such hearing devices are unable to understand all technical details of all adjustments available and are overwhelmed by the task of adjusting it fast in a good manner. Even experts in the field of audio

signal modification often have difficulties finding the right adjustment due to the large amount of possible parameters to be modified.

Therefore it is an object of the invention to simplify the process of adjusting the modification of the audio signal.

According to the invention, this objective is achieved by the process according to claim 1 or by the device according to claim 6.

By using a single control parameter for all frequency bands, the adjustment of this control parameter can alter all values of the compression parameter of the bands. This means that the compression of different frequency bands can be altered in a different way by only changing one control parameter. This simplifies the modification of the audio signal significantly and can also be done by a layman without any knowledge of signal modification. The exact extent of this adjustment is determined by I/O functions (Input-Output functions) of the frequency bands. Each I/O function can have a different form and determines the manner of compression made for a specific frequency band.

The value of the control parameter can be adjusted in steps or continuously, depending on the embodiment. It can be easier for the user if an embodiment is provided that offers for example only 10 different values for the control parameter to simplify the adjustment.

The compression parameter selected can be any parameter that alters the manner of compression or that relates to compression, like for example the amplitude range that is compressed. Normally, the compression takes place in a certain amplitude range, while outside of this amplitude range a different modification is made. For example, louder sounds with higher amplitudes may be amplified linearly or very high amplitudes may even be reduced, and lower sounds may be damped in order to inhibit amplifying of unwanted signals. But also, the audio signal can be compressed within two or more different amplitude ranges, and the compression characteristics can differ in between these ranges.

In a preferred embodiment, a characteristic gain of the compression is chosen as the compression parameter. This characteristic gain can be the gain that is set in the range of compression if it is a linear gain, or it can, for example be the mean

gain of the amplitude range in which the compression is performed. Another characteristic gain can be the gain at an amplitude where the gain changes from one linear phase to another linear phase. In this case, it can be advantageous if not the absolute gain is used but the change of gain is used as compression parameter. It can also be advantageous to use the gain at the amplitude where the compression stops or begins.

In an alternative embodiment, the compression parameter is a characteristic amplitude in which the gain changes. This could be an amplitude where the compression stops and an amplitude range with linear gain or no gain begins, or the amplitude where the gain of the compression changes could also be a good choice of compression parameter, as these amplitudes mark a significant change in the way the signal is amplified. But it shall be noted that apart from certain amplitudes or gains many other compression parameters can be chosen, for example the curvature of the compression curve or the magnitude of a jump in the curve.

In a further embodiment of the invention, for every value of the control parameter the value of the compression parameter of a frequency band is higher than or the same as the values of the compression parameter of all frequency bands covering lower frequencies. As hearing loss normally starts with having problems noticing high frequencies before experiencing problems with lower frequencies, this is preferred, as the values of the compression parameter of the frequency bands change in an ascending manner depending on the frequencies covered by the frequency band. It can be especially beneficial if at lower values of the control parameter the values of the compression parameter of some lower frequencies are set to a minimum while only the values of the compression parameter of some frequency bands covering higher frequencies are altered by changing between these low values of the control parameter. Also, or in addition to this it can be beneficial to set the values of the compression parameter of frequency bands covering high frequencies to a maximum when high values of the control parameter are set and only the values of the compression parameter of some frequency bands covering lower frequencies are altered by changing between these high values of the control parameter. This can be determined by adjusting the I/O functions of the frequency bands.

If two possible compression parameters should be modified in a simple way it can be advantageous if the values of two compression parameters are obtained by using two control parameters. In that case the audio signal can be modified by changing two different compression parameters to different extents depending on the frequency bands, but the modification can still be made quickly without difficulty or professional knowledge. Of course, the values of three or more compression parameters can be obtained by using three or more control parameters, although an increasing number of control parameters means an increasing number of possibilities at modifying the audio signal. Therefore the number should be chosen depending on the knowledge of the user and the circumstances the process is used in.

The objective can also be solved by a device previously described in which the control unit controls all compression units. The control unit can receive the single control parameter from a switch with various settings. There can be a specified number of settings or an infinite number. Depending on the setting, the control parameter can be chosen by a user. This one control parameter then sets the values of the compression parameter of all compression units by their specific I/O functions and transmits them to the respective compression units. Therefore the user can modify the audio signal significantly and to different extents within different frequency bands by setting just one switch.

Brief description of the drawings:

Fig. 1 is a graphic illustrating the I/O functions of an embodiment of the invention;

Fig. 2 is a schematic diagram of an embodiment of the invention.

Detailed description of the drawings:

Fig. 1 shows I/O functions of a preferred embodiment. An inputted audio signal is fractionized into eight frequency bands, therefore eight I/O functions 1-8 are shown. The I/O functions 1-8 have essentially the same form but are shifted relative to each other along the x-axis that represents the value of the control parameter x . The frequency bands are distributed over the frequency spectrum of the audio signal that is hearable for individuals with normal hearing abilities so that the first frequency spectrum covers the lowest hearable frequencies and the eighth

frequency band covers the highest hearable frequencies. In a preferred embodiment, the frequency bands are set to cover all frequencies within the hearable frequency spectrum, therefore they can overlap with each other. The scope of the frequency bands can be chosen differently. For each frequency band a I/O function is assigned, whereby the first I/O function 1 is assigned to the first frequency band, the second I/O function 2 to the second frequency band and so on. The I/O functions 1-8 shown define the values of the compression parameter y as a function of control parameter x . In the shown embodiment, the control parameter x can only be chosen among eleven different values, ranging between 0 and 1. At the value 0 of the control parameter x , the determined values of the compression parameter y are determined by the I/O functions 1-8 and in this case are 0 for all I/O functions 1-8. This marks a default setting, where the compression is done in the same way on a basic level for all frequencies. If the value of the control parameter x is changed, for example to 0.4, the value of the compression parameter y of the eighth frequency band is already at the maximum, 1, as determined by I/O function 8. At the same time, the value of the compression parameter y of the seventh frequency band is only at 0.8 while the values of the compression parameter y of the third, second and first frequency bands are still 0.

Fig. 2 shows a preferred embodiment of a device according to the invention in a schematic block diagram. A fractionizing unit 11, e.g. a filter, receives an incoming audio signal via an input 10 and fractionizes the audio signal into three frequency bands. Each of these frequency bands is sent to one of three compression units 12. A control unit 13 is connected to a switch 14 that has different settings and determines the value of a control parameter x as a function of the setting. A user can change the setting of the switch and thereby modify the control parameter x . Using the inputted value of the control parameter x the control unit 13 calculates three different values of a compression parameter y , based on three I/O functions, and sends them to the compression units 12. Each compression unit 12 compresses the frequency band provided to it by using the incoming value of the compression parameter y to determine the manner of the compression. Thus every frequency band can be modified in a different way but just setting one single switch 14. The modified frequency bands are summed up via a summing device 15 thus providing the modified audio signal at output 16.

C L A I M S

1. A process for modifying an audio signal that comprises the following steps:
 - a. Determining a compression parameter (y) of the audio signal that should be modified;
 - b. Fractionizing the audio signal into different frequency bands;
 - c. Obtaining the values of the compression parameter (y) for each frequency band;
 - d. Compressing at least a part of the frequency bands as a function of the determined compression parameter (y);characterized in that
 - e. The values of the compression parameter (y) are obtained by I/O functions (1-8) for each frequency band by using a single control parameter (x) as input value.
2. The process of claim 1, characterized in that the compression parameter (y) is a characteristic gain of the compression.
3. The process of claim 1, characterized in that the compression parameter (y) is a characteristic amplitude at which the gain changes.
4. The process of one of the previous claims, characterized in that for every value of the control parameter (x) the value of the compression parameter (y) of a frequency band is higher or the same as the values of the compression parameter (y) of all frequency bands covering lower frequencies.
5. The process of one of the previous claims, characterized in that the values of two compression parameters (y) are obtained by using two control parameters (x).

6. A device for modifying an audio signal comprising at least one fractionizing unit (11) for fractionizing an incoming audio signal into different frequency bands, a plurality of compression units (12) for compression of at least a part of the frequency bands depending on a determined compression parameter (y) and a control unit (13) for determining the values of a compression parameter (y) by means of a specific I/O function (1-8) for each frequency band and using a single control parameter (x) as input value, characterized in that the control unit (13) controls all compression units (12).

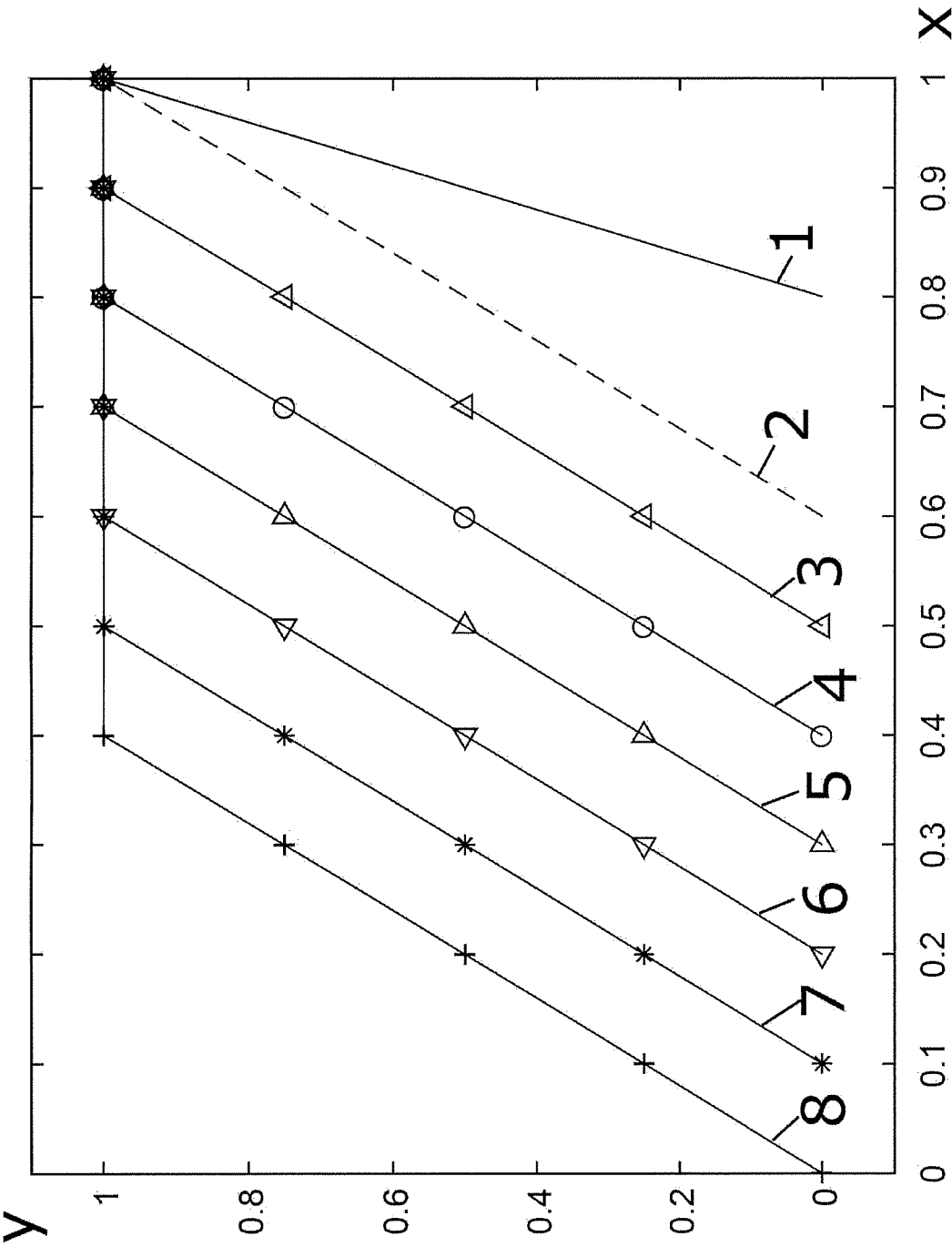


Fig. 1

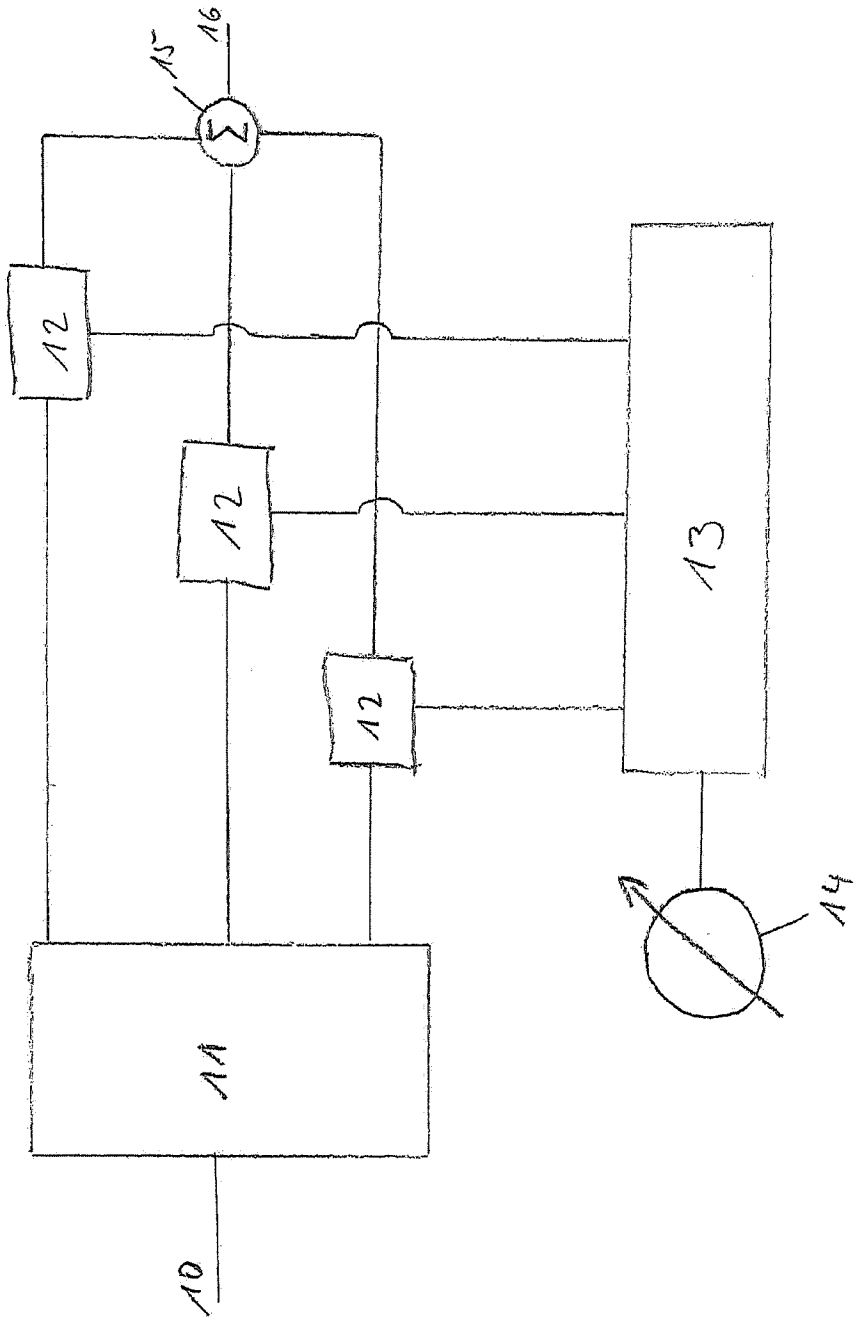


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/AT2018/060141

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04R25/00 G10L25/18
ADD.

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)
H04R G10L

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/143898 A1 (PHONAK AG [CH]; BAECHLER HERBERT [CH]; GLATT RAOUL [CH]) 3 December 2009 (2009-12-03)	1,5,6
Y	abstract; figure 13	2,3
A	page 48, line 27 - page 53, line 28 ----- -/--	4



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

12 September 2018

Date of mailing of the international search report

19/09/2018

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Képesi, Marián

INTERNATIONAL SEARCH REPORT

International application No

PCT/AT2018/060141

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BRENNAN R ET AL: "A flexible filterbank structure for extensive signal manipulations in digital hearing aids", CIRCUITS AND SYSTEMS, 1998. ISCAS '98. PROCEEDINGS OF THE 1998 IEEE INTERNATIONAL SYMPOSIUM ON MONTEREY, CA, USA 31 MAY-3 JUNE 1998, NEW YORK, NY, USA, IEEE, US, vol. 6, 31 May 1998 (1998-05-31), pages 569-572, XP010289846, DOI: 10.1109/ISCAS.1998.705338 ISBN: 978-0-7803-4455-6	1,5,6
Y	abstract; figures 1-2	2,3
A	column 1 - column 5	4
X	----- WO 2011/000973 A2 (PHONAK AG [CH]; KURMANN RETO [CH]; SCHMITT NICOLA [CH]; KUEHNEL VOLKER) 6 January 2011 (2011-01-06)	1,5,6
Y	abstract; figures 1, 2	2,3
A	page 8 - page 11	4
Y	----- US 2013/308806 A1 (SOHN JUNIL [KR] ET AL) 21 November 2013 (2013-11-21)	2,3
A	abstract; figures 1-3 paragraph [0001] - paragraph [0031]	1,4-6
A	----- SCHNEIDER T ET AL: "A multichannel compression strategy for a digital hearing aid", IEEE INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, 1997. ICASSP-97, MUNICH, GERMANY 21-24 APRIL, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC; US, US, vol. 1, 21 April 1997 (1997-04-21), pages 411-414, XP010226222, DOI: 10.1109/ICASSP.1997.599660 ISBN: 978-0-8186-7919-3 abstract; figures 1, 2 column 1 - column 3 -----	1-6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/AT2018/060141

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009143898	A1	03-12-2009	DK 2304972 T3 17-08-2015
			DK 2369859 T3 13-03-2017
			EP 2304972 A1 06-04-2011
			EP 2369859 A2 28-09-2011
			US 2011150256 A1 23-06-2011
			WO 2009143898 A1 03-12-2009
WO 2011000973	A2	06-01-2011	CN 103155598 A 12-06-2013
			CN 106851512 A 13-06-2017
			DK 2628318 T3 13-02-2017
			EP 2628318 A2 21-08-2013
			US 2013223662 A1 29-08-2013
			WO 2011000973 A2 06-01-2011
US 2013308806	A1	21-11-2013	NONE