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(54) An apparatus and method for receiving a digital audio broadcast

(57) A desired service can be searched quickly. When a control unit checks the service configuration information in a DAB broadcast signal received at a DAB receiver unit in order to search a service, the control unit refers not only to the service configuration information of services now on air but also to the service configuration information after a configuration change indicated by the advance notice if it exists. If a desired service exists in the advance notice although it does not exist in the service configuration information of services now on air, the desired service is output when the configuration change occurs. If only the service configuration information of services now on air in the DAB broadcast signal is checked and if the desired service is DAB broadcast immediately thereafter, this service is missed. Such a miss can be avoided

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a broadcast receiving apparatus and method, and more particularly to a broadcast receiving apparatus and method for receiving a multiplexed broadcast such as a DAB (Digital Audio Broadcast) having a plurality of services (audio programs, information programs such as weather and traffic) multiplexed at one carrier frequency.

Related Background Art

[0002] DAB is used in practice in Europe, presenting radio programs of a high sound quality to mobile terminals. DAB has the merit that a number of audio programs, weather information, or traffic information can be received at any time.

[0003] Each broadcast channel of present DAB utilizes an empty frequency between reception frequencies assigned to respective channels of television broadcasting. A carrier frequency group corresponding to respective broadcast channels is called an ensemble. A plurality of services are multiplexed at each ensemble. As shown in Fig. 4, multiplexing broadcasting by one ensemble is constituted of a DAB transmission frame. An MSC (Main Information Channel) of the DAB transmission frame contains real data of each service, and an FIC (First Information Channel) contains DAB broadcasting management information such as ensemble identification information and service configuration information representative of the configuration of services contained in a broadcast.

[0004] DAB is allowed to optionally configure the configuration (the number of services, audio bit rate) of services during broadcasting. This is called an MRC (Multi Re-Configuration). The MRC function will be described with reference to Fig. 5. Services on air include services A, B and C and the configuration of the services A, B and C is changed at a timing t_s. The service configuration information contains only the configuration information of the services A, B and C now on air before a timing t_P which is 6 seconds before the configuration is changed. At the timing t_P, broadcast information includes service configuration information of the services now on air, advance notice information for notifying in advance the configuration information of services A, B and D after the configuration change, and remaining time information to the configuration change. After the configuration change, the advance notice information is not broadcast and there is only the service configuration information of the services A, B and D now on air. The details of the function of such MRC are described in Japanese Patent Laid-open Publication HEI-11-68597.

[0005] Fig. 6 shows the general structure of a DAB broadcast receiver. A DAB receiver unit 2 receives a DAB broadcast signal (multiplexed broadcast signal) from an antenna 1 by tuning in a desired ensemble in a DAB broadcast band by using a variable reception frequency. The DAB receiver unit 2 analyzes the DAB broadcast management information (service configuration information and the like) contained in FIC and outputs it, reproduces an audio signal of a music program desired by a user and outputs it, derives weather information or traffic information desired by a user and outputs it. A display unit 3 displays information on a selected service, weather information, traffic information or the like. An operation unit 4 is used for selecting a desired service. In response to a selection of a desired service by the operation unit 4, a control unit 5 controls each unit of the DAB broadcast receiving apparatus and operates to output audio sounds of a service desired by a user, weather information or traffic information.

[0006] Fig. 7 is a flow chart illustrating a conventional service search process to be executed by the control unit 5. When a desired service is selected by using the operation unit 4, the control unit 5 first controls the DAB receiver unit 2 which in turn tunes in a first ensemble frequency having the lowest frequency in a predetermined DAB broadcast band (Steps S10, S11). It is then checked whether the DAB receiver unit 2 receives a DAB broadcast signal (Step S12). If not, it is checked whether or not a tuning operation was performed up to the ensemble having the highest frequency in the DAB broadcast band (Step S13). If not, a tuning operation is performed for the next highest ensemble frequency (Steps S14, S11). It is checked whether or not the DAB receiver unit 2 received a DAB broadcast signal (Step S12). If received, the operation stands by until the DAB receiver unit 2 completes an analysis of the DAB broadcast management information (Step S15). It is checked from the analyzed result whether or not a desired service is now on air, by referring to the service configuration information of services now on air (Step S16). It not, the DAB receiver unit 2 is again controlled to tune in the next highest ensemble channel frequency (Steps S13, S14, S11). If it is judged at Step S16 that the desired service is now on air, the DAB receiver unit 2 is controlled to reproduce and output audio sounds if the desired service is an audio program, or to derive information if the desired service is weather information or traffic information and input it to the display unit 3 to display it (Step S17). In this manner, service desired by a user can be output.

[0007] While a certain DAB broadcast is received, if a desired service D selected by the operation unit 4 is checked whether it is now on air (Step S16) and if it is just three seconds before the desired service D is broadcast in DAB broadcasting (refer to t_x in Fig. 5), it is judged that the desired service D is not presently broadcast because only the services A, B and C are presently broadcast, so that the next ensemble is received. Searching the desired service is therefore mishit, and after search-

ing up to the highest ensemble frequency in the DAB broadcast band, the lowest ensemble frequency in the DAB broadcast is again searched. It takes therefore a long time to complete searching the desired service.

SUMMARY OF THE INVENTION

[0008] It is an object of the invention to solve the above problem and provide a broadcast receiving apparatus and method capable of searching a desired service at high speed.

[0009] According to one aspect of the present invention, there is provided a receiving apparatus having reception means for receiving a multiplexed broadcast having a plurality of services multiplexed at one carrier frequency, outputting an audio signal of a desired service or information, or deriving and outputting service configuration information, comprising: selection means for selecting a desired service to be searched; judgement means for judging whether the service configuration information output from the reception means contains an advance notice representative of a change to a new service configuration; and service search control means for controlling, when the selection means selects a desired service, the reception means to sequentially tune in a plurality of multiplexed broadcasts existing in a predetermined band, when the reception means receives a certain multiplexed broadcast, checking the service configuration information received from the certain multiplexed broadcast, if the service configuration information now on air contains the desired service, controlling the reception means to continue to tune in the certain multiplexed broadcast and reproduce and output the desired service, if the service configuration information now on air contains neither the desired service nor the advance notice information, controlling the reception means to tune in the next multiplexed broadcast, if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information does not contain the desired service, controlling the reception means to tune in the next multiplexed broadcast, and if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information contains the desired service, then controlling the reception means to continue to tune in the certain multiplexed broadcast and reproduce the desired service when the desired service starts being broadcast.

[0010] According to another aspect of the present invention, there is provided a broadcast receiving method for a broadcast receiving apparatus having reception means for receiving a multiplexed broadcast having a plurality of services multiplexed at one carrier frequency, outputting an audio signal of a desired service or information, or deriving and outputting service configuration information, the method comprising the steps of: when a desired service is selected, controlling the reception means to sequentially tune in a plurality of multiplexed broadcasts existing in a predetermined band; and when the reception means receives a certain multiplexed broadcast, checking the service configuration information received from the certain multiplexed broadcast, if the service configuration information now on air contains the desired service, controlling the reception means to continue to tune in the certain multiplexed broadcast and reproduce and output the desired service, if the service configuration information now on air contains neither the desired service nor the advance notice information, controlling the reception means to tune in the next multiplexed broadcast, if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information does not contain the desired service, controlling the reception means to tune in the next multiplexed broadcast, and if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information contains the desired service, then controlling the reception means to continue to tune in the certain multiplexed broadcast and reproduce the desired service when the desired service starts being broadcast.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a block diagram showing the structure of a DAB broadcast receiving apparatus according to an embodiment of the invention.

Fig. 2 is a flow chart illustrating a service search process to be executed by a control unit shown in Fig. 1.

Figs. 3A and 3B are diagrams illustrating the service search process to be executed by the DAB broadcast receiving apparatus shown in Fig. 1.

Fig. 4 is an illustrative diagram of a DAB transmission frame.

Fig. 5 is an illustrative diagram showing a service re-configuration function in a DAB broadcast.

Fig. 6 is a block diagram showing the structure of a conventional, general DAB broadcast receiving apparatus.

Fig. 7 is a flow chart illustrating a service search process to be executed by a control unit shown in Fig. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Fig. 1 is a block diagram showing the structure of a DAB broadcast receiving apparatus according to an embodiment of the invention. In Fig. 1, similar constituent elements to those shown in Fig. 6 are represented by identical reference numerals.

[0013] Referring to Fig. 1, a DAB receiver unit 2 tunes in a desired ensemble in the DAB broadcast band by using a variable reception frequency to thereby receive a DAB broadcast signal (multiplexed broadcast signal). The DAB receiver unit 2 analyzes the DAB broadcast management information contained in FIC and outputs it, reproduces an audio signal of a music program desired by a user and outputs it, derives weather information, traffic information or the like desired by a user and outputs it. A display unit 3 displays information on a selected service, weather information, traffic information or the like. An operation unit 4 is used for selecting a desired service. In response to a selection of a desired service by the operation unit, a control unit 5A controls each unit of the DAB broadcast receiving apparatus and operates to output audio sounds of a service desired by a user, weather information or traffic information.

[0014] The control unit 5A checks the service configuration information received at the DAB receiver unit 2 in order to search a service. In this case, the control unit 5A checks whether a desired service exists or not, by referring not only to the service configuration information of services now on air but also to the service configuration information after the configuration change indicated by advance notice information if this information exists. If the desired service is not contained in the service configuration information of services now on air but is contained in the advance notice information, the desired service is output when the configuration is changed.

[0015] Other structures are quite the same as those shown in Fig. 6.

[0016] Fig. 2 is a flow chart illustrating a service search process to be executed by the control unit 5, and Figs. 3A and 3B are diagrams illustrating the service search process. With reference to Fig. 2 and Figs. 3A and 3B, the operation of the embodiment will be described.

[0017] When a desired service, e.g., a service D, is selected by using the operation unit 4, the control unit 5A first controls the DAB receiver unit 2 which in turn tunes in a first ensemble frequency having the lowest frequency in a predetermined DAB broadcast band (Steps S10, S11). It is then checked whether the DAB receiver unit 2 received a DAB broadcast signal (Step S12). If not, it is checked whether or not a tuning operation was performed up to the ensemble having the highest frequency in the DAB broadcast band (Step S13). If not, a tuning operation is performed for the next highest ensemble frequency (Steps S14, S11). It is checked again whether or not the DAB receiver unit 2 received a DAB broadcast signal (Step S12). If received, the operation stands by until the DAB receiver unit 2 complete an analysis of the DAB broadcast management information (Step S15). It is checked from the analyzed result whether or not a desired service is now on air, by referring to the service configuration information of services now on air (Step S16). It is assumed in this case that as shown in Fig. 3A, services E, F and G are presently broadcast at the second ensemble and that the configuration does not change during a certain period. If the judgement at Step S16 is made at a predetermined timing, the judgement at Step S16 is negated. Next, it is checked whether the DAB broadcast management information contains advance notice information of a service configuration change (Step S18). If not, the DAB receiver unit 2 is controlled to tune in the second highest ensemble frequency (Steps S13, S14, S11).

[0018] It is again checked whether the DAB receiver unit 2 received a DAB broadcast signal (Step S12). If received, the operation stands by until the DAB receiver unit 2 complete an analysis of the DAB broadcast management information (Step S15). It is checked from the analyzed result whether or not a desired service is now on air, by referring to the service configuration information of services now on air (Step S16). It is assumed in this case that as shown in Fig. 3B, services H, I and J are presently broadcast at the third ensemble and that the advance notice information and remaining time information to the configuration change are also broadcast. If the judgement at Step S16 is made at a timing t_x, the judgement at Step S16 is negated. Next, it is checked whether the DAB broadcast management information contains advance notice information of the service configuration change (Step S18). In this case, the advance notice information exists. It is then checked whether the service configuration after the configuration change indicated by the advance notice information contains the desired service (Step S19). If not, the DAB receiver unit 2 is again controlled to tune in the next highest ensemble frequency (Steps S13, S14, S11). However, in this case, the judgement at Step S19 is affirmed. Next, it is repetitively checked whether new DAB broadcast management information is received at the DAB receiver unit 2 and whether the remaining time to the configuration change becomes zero. The judgement at Step S20 is affirmed when the configuration change occurs (at timing t_s shown in Fig. 3B). At this time, the DAB receiver unit 2 is controlled to reproduce and output audio sounds if the desired service is an audio program, or to derive information if the desired service is weather information or traffic information and input it to the display unit 3 to display it (Step S17). In this manner, service desired by a user can be output quickly.

[0019] According to this embodiment, when the control unit 5A checks the service configuration information in a DAB broadcast signal received at the DAB receiver unit 2 in order to search a service, the control unit 5A refers not only to the service configuration information of services now on air but also to the service configuration information after a configuration change indicated by the advance notice information if it exists. If a desired service exists in the advance notice information although it does not exist in the service configuration information of services now on air, the desired service is output when the configuration change occurs. If only the

service configuration information of services now on air in the DAB broadcast signal is checked and if the desired service is DAB broadcast immediately thereafter, this service is missed. Such a miss can be avoided and the desired service search can be completed quickly.

[0020] In the above-described embodiment, receiving a DAB broadcast practically used in Europe has been described illustratively. The invention is not limited only to a DAB broadcast, but various other types of multiplexing broadcasting may also be used.

[0021] According to the invention, when the service configuration information of multiplexing broadcasting is checked to search a desired service, not only the service configuration information now on air but also the advance notice information broadcast before a configuration change is checked. A search miss can therefore be avoided and a desired service search can be completed quickly.

Claims

1. A broadcast receiving apparatus having reception means for receiving a multiplexed broadcast having a plurality of services multiplexed at one carrier frequency, outputting an audio signal of a desired service or information, or deriving and outputting service configuration information, comprising:

   selection means for selecting a desired service to be searched;
   judgement means for judging whether the service configuration information output from said reception means contains an advance notice representative of a change to a new service configuration; and
   service search control means for controlling, when said selection means selects a desired service, said reception means to sequentially tune in a plurality of multiplexed broadcasts existing in a predetermined band, when said reception means receives a certain multiplexed broadcast, checking the service configuration information received from the certain multiplexed broadcast, if the service configuration information now on air contains the desired service, controlling said reception means to continue to tune in the certain multiplexed broadcast and reproduce and output the desired service, if the service configuration information now on air contains neither the desired service nor the advance notice information, controlling said reception means to tune in the next multiplexed broadcast, if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information does not contain the desired service, controlling said reception means to tune in the next multiplexed broadcast, and if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information contains the desired service, then controlling said reception means to continue to tune in the certain multiplexed broadcast and reproduce the desired service when the desired service starts being broadcast.

2. A broadcast receiving method for a broadcast receiving apparatus having reception means for receiving a multiplexed broadcast having a plurality of services multiplexed at one carrier frequency, outputting an audio signal of a desired service or information, or deriving and outputting service configuration information, the method comprising the steps of:

   when a desired service is selected, controlling said the reception means to sequentially tune in a plurality of multiplexed broadcasts existing in a predetermined band; and
   when said reception means receives a certain multiplexed broadcast, checking the service configuration information received from the certain multiplexed broadcast, if the service configuration information now on air contains the desired service, controlling said reception means to continue to tune in the certain multiplexed broadcast and reproduce and output the desired service, if the service configuration information now on air contains neither the desired service nor the advance notice information, controlling said reception means to tune in the next multiplexed broadcast, if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information does not contain the desired service, controlling said reception means to tune in the next multiplexed broadcast, and if the service configuration information now on air does not contain the desired service, but contains the advance notice information and the advance notice information contains the desired service, then controlling said reception means to continue to tune in the certain multiplexed broadcast and reproduce the desired service when the desired service starts being broadcast.

FIG. 1

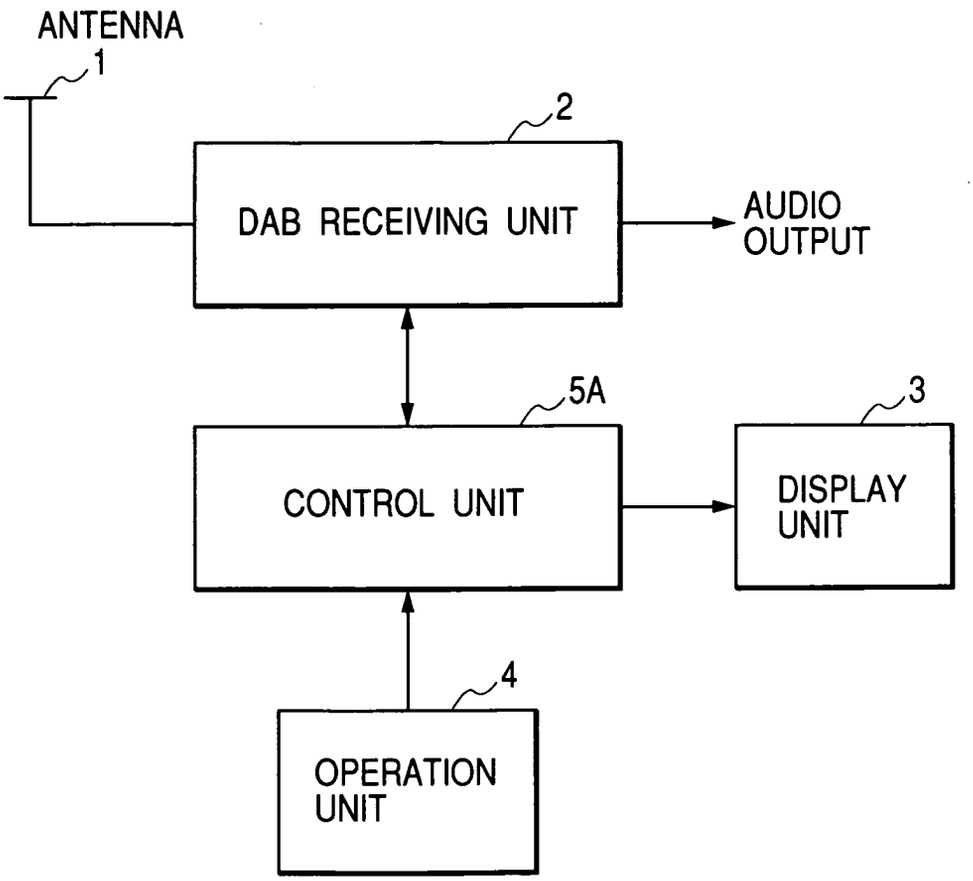

ANTENNA
1
2
DAB RECEIVING UNIT
AUDIO OUTPUT
5A
3
CONTROL UNIT
DISPLAY UNIT
4
OPERATION UNIT

FIG. 2

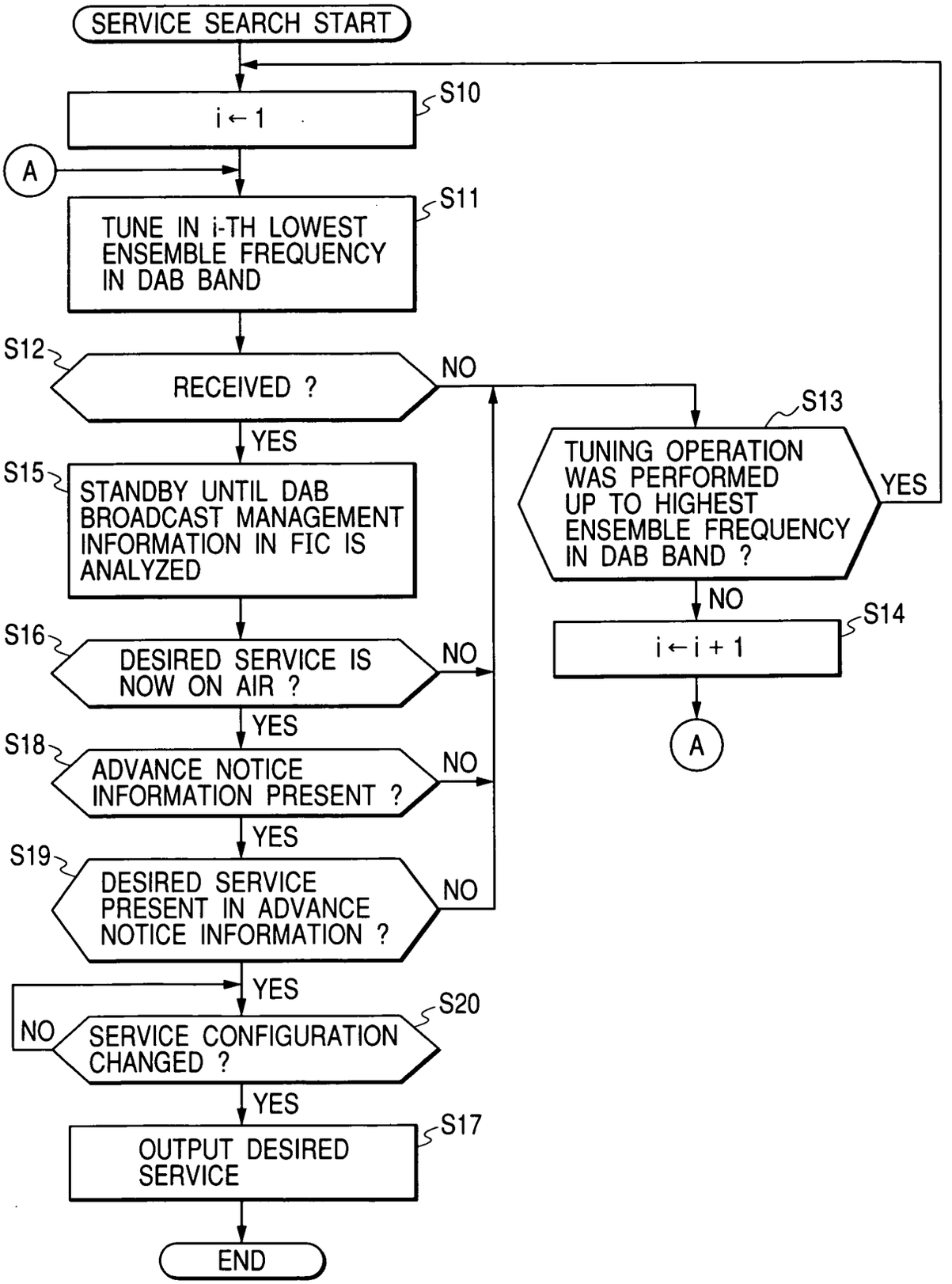

SERVICE SEARCH START
i ← 1
S10
A
TUNE IN i-TH LOWEST ENSEMBLE FREQUENCY IN DAB BAND
S11
S12
RECEIVED ?
NO
YES
S13
TUNING OPERATION WAS PERFORMED UP TO HIGHEST ENSEMBLE FREQUENCY IN DAB BAND ?
YES
NO
S14
i ← i + 1
A
S15
STANDBY UNTIL DAB BROADCAST MANAGEMENT INFORMATION IN FIC IS ANALYZED
S16
DESIRED SERVICE IS NOW ON AIR ?
NO
YES
S18
ADVANCE NOTICE INFORMATION PRESENT ?
NO
YES
S19
DESIRED SERVICE PRESENT IN ADVANCE NOTICE INFORMATION ?
NO
YES
S20
NO
SERVICE CONFIGURATION CHANGED ?
YES
S17
OUTPUT DESIRED SERVICE
END

FIG. 3A

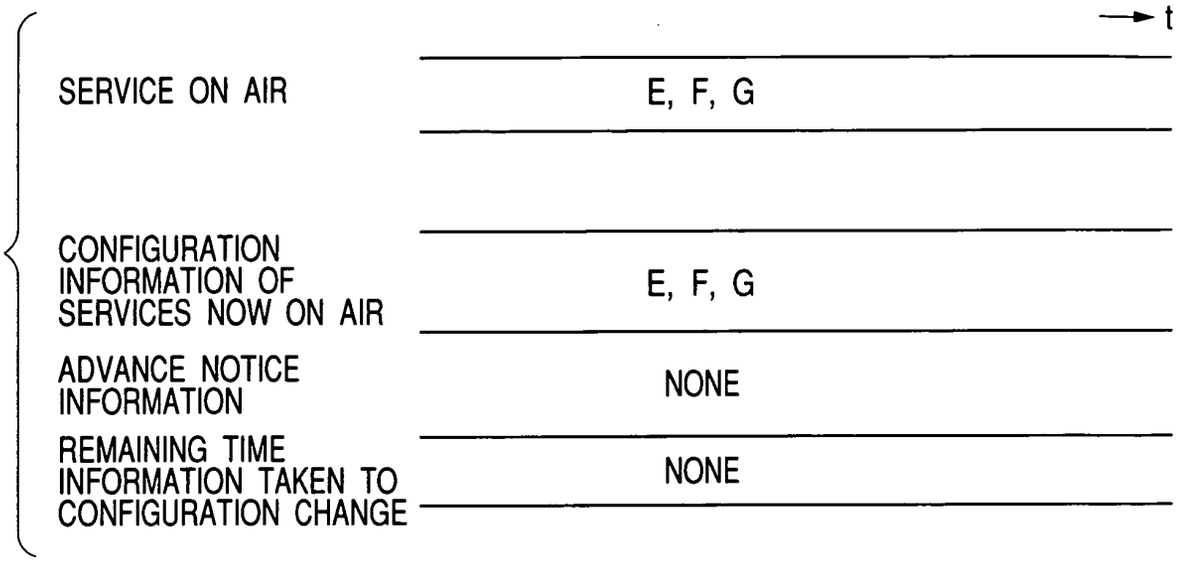

t
SERVICE ON AIR
E, F, G
CONFIGURATION INFORMATION OF SERVICES NOW ON AIR
E, F, G
ADVANCE NOTICE INFORMATION
NONE
REMAINING TIME INFORMATION TAKEN TO CONFIGURATION CHANGE
NONE

FIG. 3B

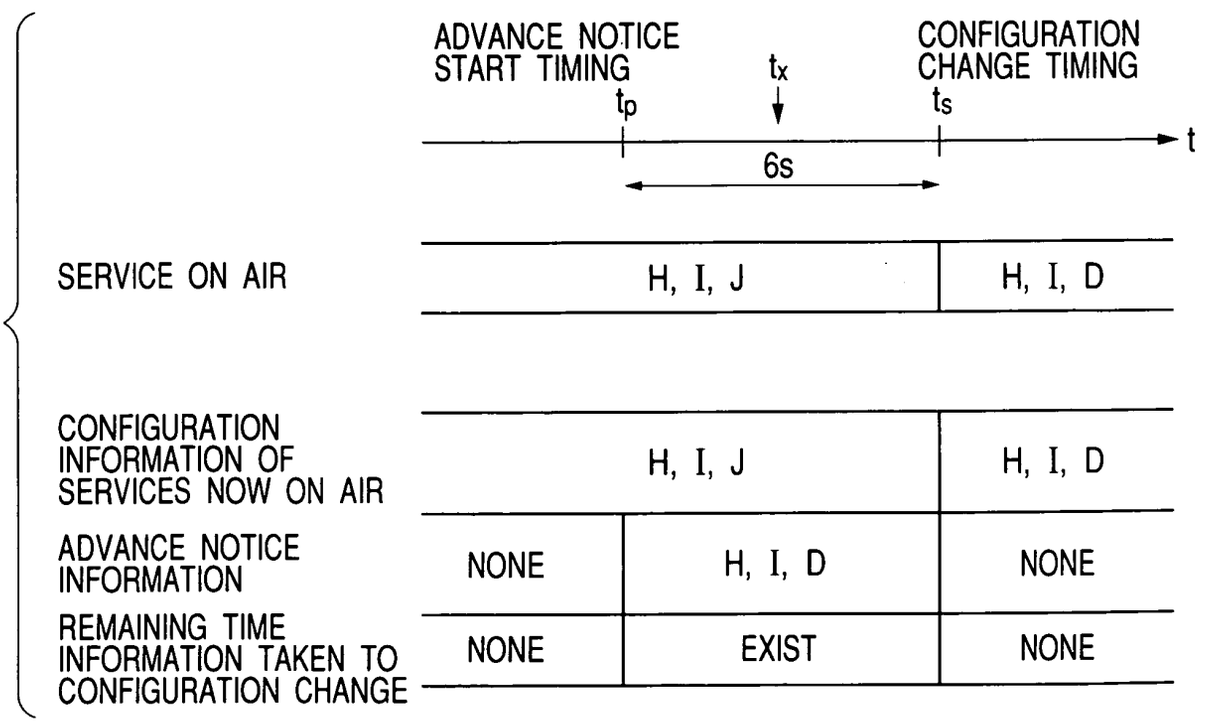

ADVANCE NOTICE START TIMING
tp
tx
CONFIGURATION CHANGE TIMING
ts
t
6s
SERVICE ON AIR
H, I, J
H, I, D
CONFIGURATION INFORMATION OF SERVICES NOW ON AIR
H, I, J
H, I, D
ADVANCE NOTICE INFORMATION
NONE
H, I, D
NONE
REMAINING TIME INFORMATION TAKEN TO CONFIGURATION CHANGE
NONE
EXIST
NONE

FIG. 4

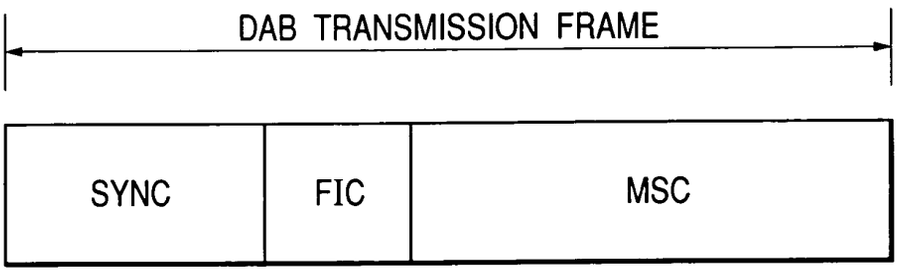

DAB TRANSMISSION FRAME
SYNC
FIC
MSC

FIG. 5

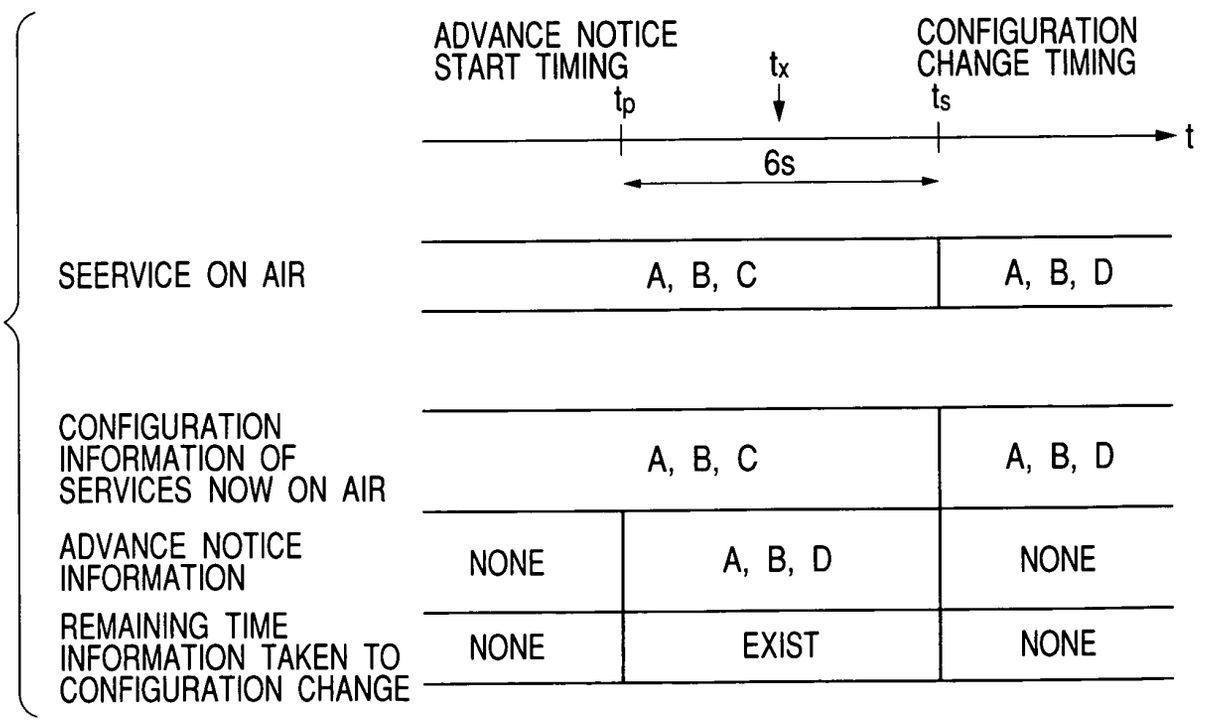

ADVANCE NOTICE START TIMING
tp
tx
CONFIGURATION CHANGE TIMING
ts
t
6s
SEERVICE ON AIR
A, B, C
A, B, D
CONFIGURATION INFORMATION OF SERVICES NOW ON AIR
A, B, C
A, B, D
ADVANCE NOTICE INFORMATION
NONE
A, B, D
NONE
REMAINING TIME INFORMATION TAKEN TO CONFIGURATION CHANGE
NONE
EXIST
NONE

FIG. 6

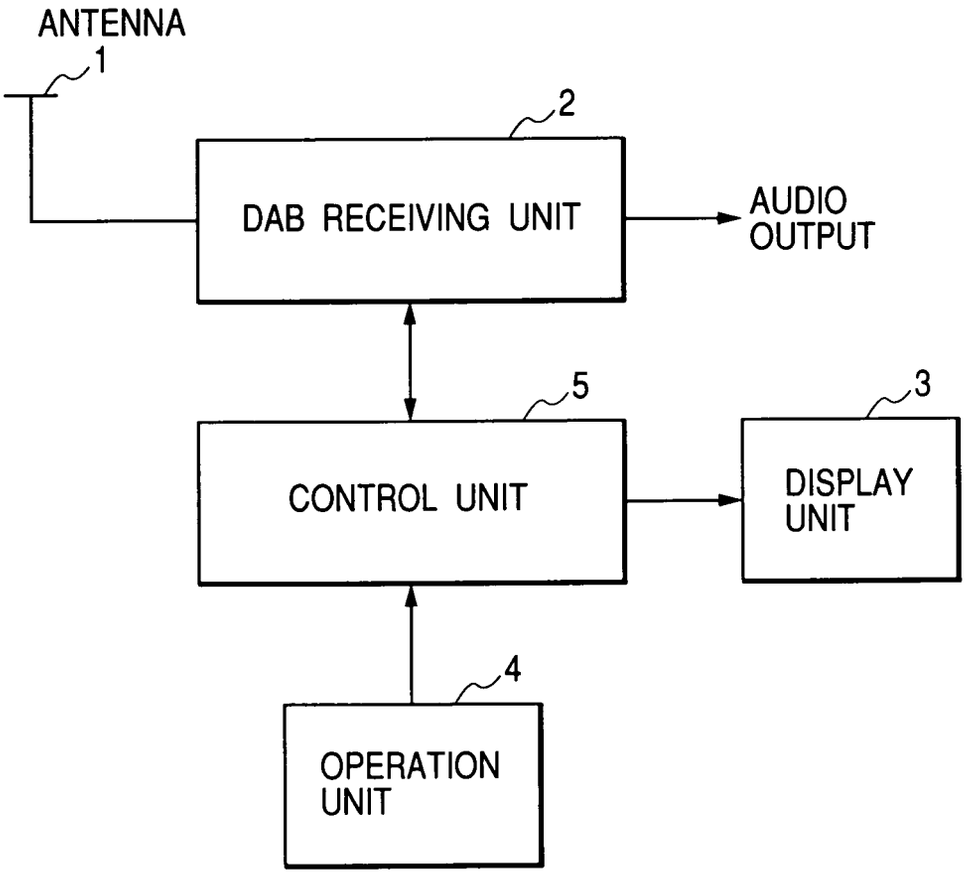
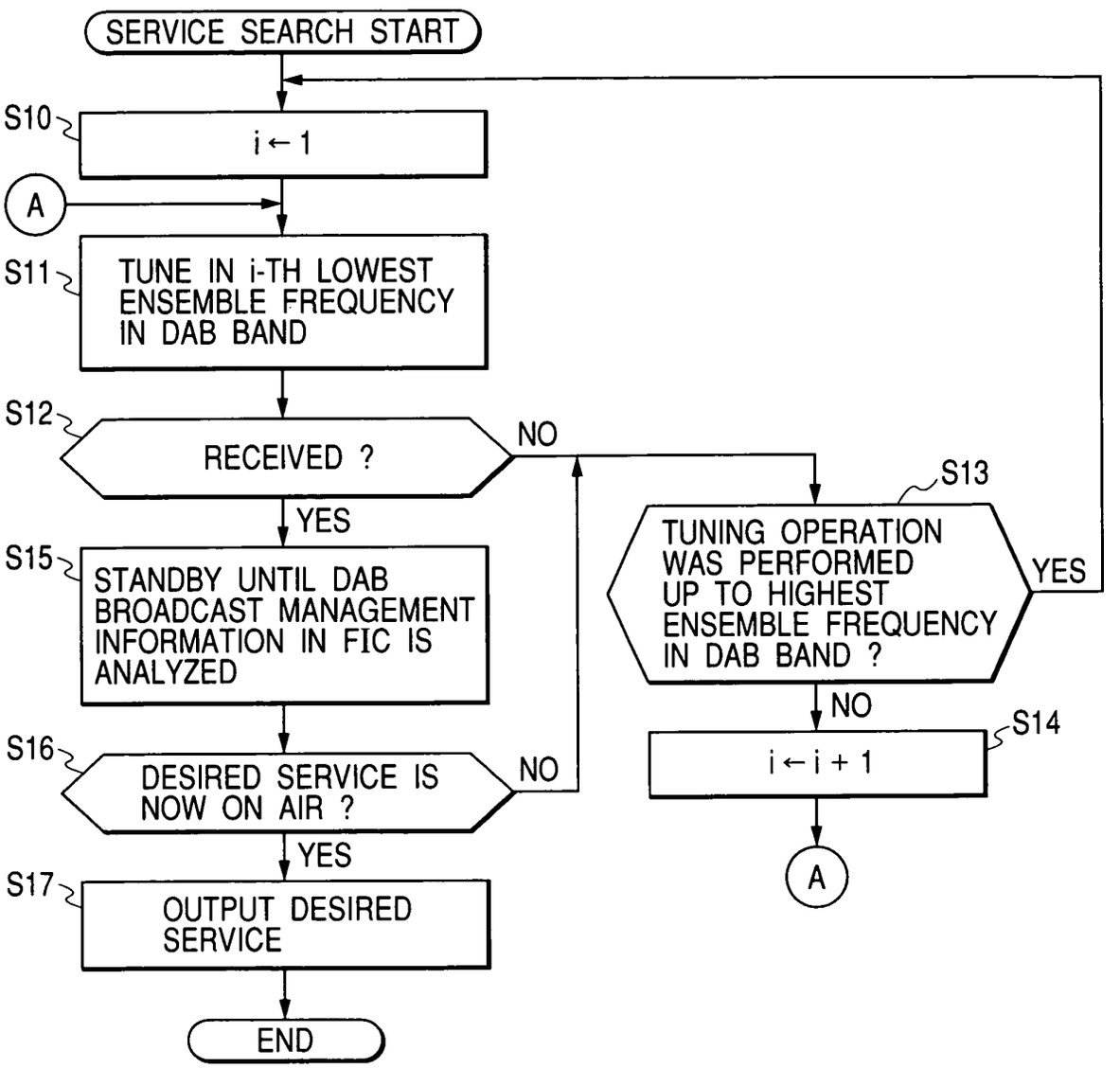

ANTENNA
1
2
DAB RECEIVING UNIT
AUDIO OUTPUT
5
3
CONTROL UNIT
DISPLAY UNIT
4
OPERATION UNIT

FIG. 7


SERVICE SEARCH START
S10
i ← 1
A
S11
TUNE IN i-TH LOWEST ENSEMBLE FREQUENCY IN DAB BAND
S12
RECEIVED ?
NO
YES
S13
TUNING OPERATION WAS PERFORMED UP TO HIGHEST ENSEMBLE FREQUENCY IN DAB BAND ?
YES
NO
S14
i ← i + 1
A
S15
STANDBY UNTIL DAB BROADCAST MANAGEMENT INFORMATION IN FIC IS ANALYZED
S16
DESIRED SERVICE IS NOW ON AIR ?
NO
YES
S17
OUTPUT DESIRED SERVICE
END

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 00 2228

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 2002/045430 A1 (KAMEI TAKAYUKI) 18 April 2002 (2002-04-18) * paragraph [0002] * * paragraph [0036] * * paragraph [0038] * * paragraphs [0044] - [0049] * -----	1,2	H04H1/00
Y	DE 100 37 940 A (PIONEER CORP) 8 February 2001 (2001-02-08) * column 1, lines 35-40 * * column 2, lines 18-20 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 June 2004	Torcal Serrano, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 00 2228

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01-06-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002045430 A1	18-04-2002	JP 2002124885 A	26-04-2002
		EP 1204231 A1	08-05-2002
DE 10037940 A	08-02-2001	JP 2001044867 A	16-02-2001
		DE 10037940 A1	08-02-2001

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82