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(54) **RADIO BROADCASTING RECEIVING METHOD AND RECEIVER**

(57) The invention relates to a method for updating an available station list by a radio receiver in a radio data system (RDS) and a radio receiver thereof. A method of updating an available station list by a radio receiver in a radio data system (RDS) comprises receiving data blocks for a first radio program, one of the data blocks including a program identification (PI) code, checking if an available station list stored in a memory of the radio receiver contains an extended county code (ECC) for a second radio program, the list including items of a PI, a program service name (PS), and an ECC for at least one radio program, when the list contains the ECC, obtaining a PS of the first radio program based on the received PI code and the ECC of the second radio program, and updating the list so as to contain the PI and the PS of the first radio program.

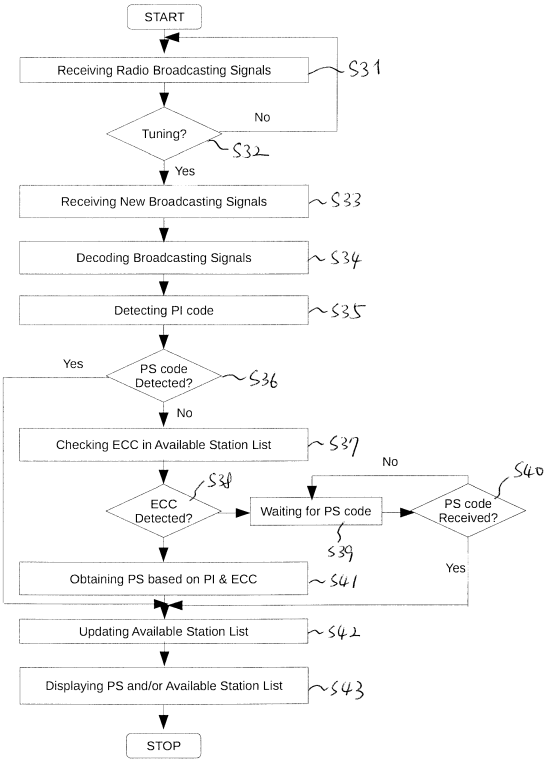

Fig. 3

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Description

[0001] The present invention relates to receiving radio broadcasting, in particular to a method for updating an available station list by a radio receiver in a radio data system (RDS) and a radio receiver thereof.

[0002] In the RDS, a country code which occupies the first most significant bit of a program identification (PI) code is allocated to each country for country identification purpose. In Europe, however, some countries share the same country code. For example, UK, Lithuania, and Croatia are using the same country code of "C" and France, Norway, Belarus, and Bosnia share the same country code of "F". Romania, Spain, and Sweden are also using the same country code of "E".

[0003] A confusion may happen from the fact that two or more countries are using the same country code. Namely, a wrong program service name (PS) can be obtained and displayed when a radio receiver tries to update a radio station list based on the PI and PS.

[0004] It would be therefore beneficial to provide a reliable solution to the problem arising from using an identical country code for two or more countries in the RDS.

[0005] According to an exemplary embodiment of the invention, a method of updating an available station list by a radio receiver in a radio data system (RDS) comprises receiving data blocks for a first radio program, one of the data blocks including a program identification (PI) code, checking if an available station list stored in a memory of the radio receiver contains an extended county code (ECC) for a second radio program, the list including items of a PI, a program service name (PS), and an ECC for at least one radio program, when the list contains the ECC, obtaining a PS of the first radio program based on the received PI code and the ECC of the second radio program, and updating the list so as to contain the PI and the PS of the first radio program.

[0006] A number of optional features are set out in the following. These features may be realized in particular embodiments, alone or in combination with any of the other features.

[0007] An embodiment of the method according to the present invention may further comprise displaying the updated available station list and/or the updated available station list on a display of the radio receiver.

[0008] An embodiment of the method according to the present invention may further comprise, when the list does not contain any ECC, receiving further data blocks, any of which including the PS of the first radio broadcasting program, and updating the list so as to contain the PI and the PS of the first radio broadcasting.

[0009] According to an embodiment of the present invention, a radio receiver to be used in a radio data system (RDS) comprises an antenna configured to receive radio broadcasting signals, a decoder configured to decode the received broadcasting signals so as to output data blocks for a first radio program, one of the data blocks including a program identification (PI) code, a memory configured to store an available station list which contains items of a PI, a program service name (PS), and an ECC for at least one radio program, a controller configured to: check if the list contains an extended county code (ECC) for a second radio program, when the list contains the ECC, obtain a PS of the first radio program based on the received PI code and the ECC of the second radio program, and update the list so as to contain the PI and the PS of the first radio program. In particular, the controller may further configured to, when the list does not contain any ECC, receive further data blocks, any of which including the PS of the first radio program, and update the list so as to contain the PI and the PS of the first radio program.

[0010] An embodiment of the receiver according to the present invention may further comprise a display configured to display the obtained PS and/or the updated list of the first radio program.

[0011] In particular, the PI identifies both a corresponding radio program and a country in which the program is broadcast.

[0012] Such method will provide the same characteristics and advantages as outlined with respect to the system above.

[0013] According to the embodiments of the present invention described herein, a problem resulting from using a same country code by two or more countries in the radio data system (RDS) can be solved and thus a correct program service name for a receiving radio program can be promptly obtained, updated, and displayed in a radio receiver.

[0014] In the following an exemplary embodiment of the invention is described with reference to the enclosed figures.

Fig. 1 is a schematic diagram depicting a configuration of a radio receiver according to an exemplary embodiment of the invention.

Fig. 2 is a schematic diagram illustrating a message format broadcast in a radio data system (RDS).

Fig. 3 is a flowchart showing an overall process according to an exemplary embodiment of the invention.

[0015] Fig. 1 is a schematic diagram depicting a configuration of a radio receiver according to an exemplary embodiment of the invention. The radio receiver shown in Fig. 1 may be arranged inside a vehicle.

[0016] Referring to Fig. 1, the radio receiver 1 comprises an antenna 10, a front end (F/E) 12, an intermediate frequency amplifier (IFA) 14, an signal meter (S meter) 16, a demodulator 20, an amplifier 22, a speaker 24, an RDS decoder 30, a controller 40, a display 60, a memory 50, and an operation unit 62.

[0017] In Fig. 1, the radio receiver 1 receives radio broadcasting signals through the antenna. The front end

(F/E) 12 is configured to extract desired broadcasting signals from the broadcasting signals received via the antenna 10 and to perform frequency conversion to generate an intermediate frequency signal (IF signal) corresponding to the broadcasting wave. The IFA 14 is configured to amplify the IF signal output from the F/E 12. The S meter 16 is configured to detect the signal intensity of the IF signal output from the IFA 14, that is, the field intensity of the broadcasting signal received by the F/E 12.

[0018] The demodulator 20 is configured to perform FM demodulation processing and stereo demodulation processing on the basis of the IF signal input from the IFA 14. RDS data including program identification data (PI code) and program contents identification data (PTY code) is superimposed on FM-demodulated data. An audio signal that is stereo-demodulated by the demodulator 20 is amplified by the amplifier 22, and audio sound is output from the speaker 24.

[0019] The RDS decoder 30 is configured to perform specific decoding processing for the data that is FM-demodulated by the demodulator 20 to restore the RDS data. The RDS decoder 30 is also configured to perform an operation for detecting an error of the RDS data while achieving block synchronization and for correcting the error. Normally, the operation for error detection and error correction of RDS data is performed independently of decoding processing for RDS data, and a unit for detecting and correcting an error is provided separately.

[0020] The controller 40 is configured to control overall operations of the radio receiver 1. The controller 40 may include a central processing unit (CPU), a random access memory (RAM) and/or a read only memory (ROM) and perform various operations by executing specific programs. For example, a tuning operation for selecting a program and receiving the program, a seek operation for performing frequency sweeping in one direction to search for a receivable broadcasting signal, an operation for creating and updating a broadcasting station list representing at least one broadcasting station which the receiver 1 has once received and an available station list representing receivable broadcasting signals, and the like are performed under the control of the controller 40. The memory 50 is configured to store information, programs, and/or instructions necessary for the controller 40 to control the radio receiver 1. The broadcasting station list and the available station list may also be stored in the memory 50. The operation unit 62 is for a user of the receiver 1 to manipulate operations of the receiver 1 and may include a button or dial for tuning operation frequencies of the receiver 1 and any other user interfaces for the user to input his or her operation instructions.

[0021] When a tuning instruction (instruction to perform switching of a program to be received) is input through the operation unit 62 by a user, the controller 40 performs, for the front end 12, setting of a reception frequency corresponding to a program to be received after switching. As described above, the broadcasting station list and the available station list are also created under the control of the controller 40. The broadcasting station list and the available station list include items of at least program identification data (PI), a program service name (PS), and an extended country code (ECC). The lists may further include reception frequencies corresponding to programs. The broadcasting station list may be updated whenever the receiver 1 starts receiving a new program. The available station list may be created at various times. For example, the available station list may be created at the time when a user inputs an instruction using the operation unit 62, at the time when the radio receiver 1 is activated, or at specific time intervals. The lists are stored in the memory 50. Alternatively, the broadcasting station list is stored in the memory 50 and the available station list may be temporarily stored in the RAM or ROM of the controller 40.

[0022] Fig. 2 is a schematic diagram illustrating a message format broadcast in a radio data system (RDS).

[0023] The RDS is a radio broadcasting technical standard which has been developed by the European Broadcasting Union (EBU) Member countries. The Specification of the RDS was initially published by the EBU in 1984 as doc. Tech 3244 and is also the subject of ITU-R Recommendation BS.643-2. The RDS is intended for application to VHF/FM sound broadcasts in the range of 87.5 MHz to 108.0 MHz which may carry either stereophonic or monophonic programs. The main objectives of the RDS are to enable improved functionality for FM receivers and to make them more user-friendly by using features such as Program Identification (PI), Program Service (PS) name display, and automatic tuning for portable and car radios. In the RDS, the amplitude of a subcarrier at 57 kHz, which is a third harmonic of a stereo pilot signal at 19 kHz, is modulated using a data signal representing data, such as filtered and two-phase coded program related information and traffic information, to obtain radio data (RDS data), and the amplitude-modulated subcarrier is frequency-modulated into a main carrier and is broadcast.

[0024] Referring to Fig. 2, RDS data is configured in units of groups, each of which including 104 bits. Each group contains four data blocks, Block 1, Block 2, Block 3, and Block 4. One block has an information word of 16 bits, and a check word and an offset word of 10 bits. As depicted in Fig. 2, the first five bits of the second block (Block 2) of every group are allocated to a five-bit code which identifies a type of the group and its version. Various types (0A-15B) of groups are defined in the RDS specification and each type of group contains different information each other. For example, the Group type 0A and 0B contains basic tuning and switching information and Group type 1A contains a program item number and slow labeling codes.

[0025] As shown in Fig. 2, a program identification (PI) code which identifies a country in which a radio program is broadcast and the program is placed in the first block (Block 1) of each and every group. The first most signif-

icant bit of the PI code carry the RDS country code. A program service (PS) code which identifies a broadcasting station name is arranged in the fourth block (Block 4) of a certain type of groups, i.e. group types 0A and 0B. An extended country code (ECC) which identifies the country together with the PI code is transmitted in Variant 0 of Block 3 in type 1A groups. In other words, the PS code and the ECC are included in a special type of groups only and thus a radio receiver cannot receive the PS code and the ECC as often as the PI code.

[0026] Fig. 3 is a flowchart showing an overall process according to an exemplary embodiment of the invention. Fig. 1 and Fig. 2 will also be referred to below to describe the embodiment of Fig. 3.

[0027] In Fig. 3, a radio receiver 1 is receiving radio broadcasting signals from a radio station at S31. The controller 40 of the receiver 1, at S32, monitors if a tuning instruction is input by a user of the receiver 1 via the operation unit 62. When the tuning instruction, i.e. an instruction to perform switching of a program to be received, is issued using the operation unit 62 by the user, the controller 40 performs, for the front end 12, setting of a reception frequency corresponding to a program to be received and thereby starts receiving new broadcasting signals for the program at S33. If there is no tuning instruction, the receiver 1 keeps listening radio broadcasting signals for the current program.

[0028] As described above with reference to Fig. 1, predefined data processing is performed on the received new radio broadcasting signals by the IFA 14, the demodulator 20, the amplifier 22, and the speaker 24 through which the user can hear the selected program. At S34, the RDS decoder 30 performs decoding with data transferred from the demodulator 20 so as to output a plurality of groups, each of which containing four data blocks (Block 1, Block 2, Block 3, Block 4), as depicted in Fig. 2. As described above, because each and every first block (Block 1) has a PS code, at S35, the receiver 1 can obtain the PI code easily and promptly. In the embodiment of Fig. 3, it is assumed that the obtained PI is "C123".

[0029] After detecting the PI code at S35, the controller 40 of the receiver 1 checks if a PS code has been detected at S36. As also described above, since only a small percentage of groups contain the PS code, it may take much more time to detect the PS code than the PI code. When the PS code has been detected before a predetermined time has passed after the PI code is obtained, at S42 and S43, the controller 40 updates a broadcasting station list and an available station list, and makes the display 60 display a broadcasting station name identified by the PS code. The available station list may also be displayed by the display 60.

[0030] Table 1 is an example of the broadcasting station list which contains items of a broadcasting station name (PS), a program identification (PI), and an extended country code (ECC). It is assumed that Table 1 is a broadcasting station list stored in the memory 50 of the receiver 1 before a new channel is selected by the user. The broadcasting station list contains a combination of PSs and Pis for radio programs which the receiver 1 has once received before. An ECC for a program is not always included in the broadcasting station list.

[Table 1]

PS	PI	ECC
BBC Radio 1	C112	-
BBC Radio 2	C122	E1
Heart London	C123	-
BBC Radio 3	C134	-
Classic FM	C222	-
Swindon Local	C234	-
...	...	...
Croatia News	C123	-

[0031] Table 1 contains two different PSs (i.e. "Heart London" and "Croatia News") which have the PI of "C123" which the controller 40 detected from the received data blocks at S35. It can happen because some countries share the same country code which is identified by the first most significant bit of the PI code. For example, UK and Croatia share the same country code of "C," and France and Norway share the same country code of "F".

[0032] Table 2 is an example of the available station list stored in the memory 50 of the receiver 1 and Table 2 contains a list of radio programs which the receiver 1 can receive at a current location. The available station list of Table 2 may be updated whenever the receiver 1 starts receiving a new program upon receiving a tuning instruction from the user.

[Table 2]

PS	PI	ECC
BBC Radio 1	C112	-
BBC Radio 2	C122	E1
BBC Radio 3	C134	-
Classic FM	C222	-
Swindon Local	C234	-

[0033] If the PI code and the PS code are obtained from the received data blocks for a predetermined time period, there is no problem to update the available station list. On the other hand, if the PS code has not been detected until the predetermined time has passed after the PI code is obtained, the controller 40 of the receiver 1 is configured to refer to the broadcasting station list of Table 1. However, as stated above, Table 1 contains two different PSs (i.e. "Heart London" and "Croatia News") cor-

responding to the received PI of "C123" and thus the controller 40 cannot identify which PS is correct among the two PSs contained in the broadcasting station list.

[0034] In order to prevent updating a wrong PS, the controller 40 checks whether or not the available station list contains an ECC for another program at S37. In the example of Table 2, the program having the PI of "C122" has an ECC of "E1," from which the controller can make a conclusion that a country identified by the received PI of "C123" is UK, not Croatia. It is possible because each country has only one ECC code. Thus, at S41, the controller 40 is able to obtain the PS based on the received PI and the ECC contained the available station list and then, at S42, the available station list is updated as shown in Table 3. At S43, the PS of "Heart London" is displayed by the controller 50 on the display 60. The updated available station list may be also displayed on the display 60 together with the PS or alone.

[Table 3]

PS	PI	ECC
Heart London	***C123***	-
BBC Radio 1	C112	-
BBC Radio 2	C122	E1
BBC Radio 3	C134	-
Classic FM	C222	-
Swindon Local	C234	-

[0035] If the available station list does not contain any ECC, at S39, the controller 40 waits for receiving a data block which contains the PS code and checks if the PS code is received at S40. When the PS code is received, the available station list is updated with the received PI code and PS code at S42 and then the updated list and/or the program name identified by the PS code are displayed by the display S42.

[0036] According to the embodiments of the present invention, a problem resulting from using a same country code by two or more countries in the radio data system (RDS) can be solved and thus a correct program service name for a receiving radio program can be promptly obtained, updated, and displayed in a radio receiver.

[0037] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adopt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention is not limited to the particular embodiments disclosed, but that the invention includes all embodiments falling within the scope of the claims.

Claims

1. A method of updating an available station list by a radio receiver (1) in a radio data system (RDS), the method comprising:

   receiving (S31-S35) data blocks for a first radio program, one of the data blocks including a program identification (PI) code:

   checking (S37) if an available station list stored in a memory (50) of the radio receiver (1) contains an extended county code (ECC) for a second radio program, the list including items of a PI, a program service name (PS), and an ECC for at least one radio program;
   when the list contains the ECC, obtaining (S41) a PS of the first radio program based on the received PI code and the ECC of the second radio program; and
   updating (S42) the list so as to contain the PI and the PS of the first radio program.

2. The method according to claim 1, wherein the PI identifies both a corresponding radio program and a country in which the program is broadcast.

3. The method according to claim 1 or 2, further comprising displaying the obtained PS on a display (60) of the radio receiver (1).

4. The method according to any of the preceding claims, further comprising displaying (S43) the updated available station list on the display (60) of the radio receiver (1).

5. The method according to any of the preceding claims, further comprising:

   when the list does not contain any ECC, receiving (S39) further data blocks, any of which including the PS of the first radio program; and
   updating the list so as to contain the PI and the PS of the first radio program.

6. The method according to any of the preceding claims, wherein the country code of the first radio program is confirmed by the ECC of the second radio program.

7. The method according to any of the preceding claims, wherein the first and second radio programs are different programs.

8. A radio receiver (1) to be used in a radio data system (RDS), the radio receiver comprising:

an antenna (10) configured to receive radio broadcasting signals;
a decoder (30) configured to decode the received broadcasting signals so as to output data blocks for a first radio program, one of the data blocks including a program identification (PI) code:

a memory (50) configured to store an available station list which contains items of a PI, a program service name (PS), and an ECC for at least one radio program; and
a controller (40) configured to:

check if the list contains an extended county code (ECC) for a second radio program;
when the list contains the ECC, obtain a PS of the first radio program based on the received PI code and the ECC of the second radio program; and
update the list so as to contain the PI and the PS of the first radio program.

9. The receiver according to claim 8, wherein the PI identifies both a corresponding radio program and a country in which the program is broadcast.

10. The receiver according to claim 8 or 9, further comprising a display (60) configured to display the obtained PS and/or the updated list of the first radio program.

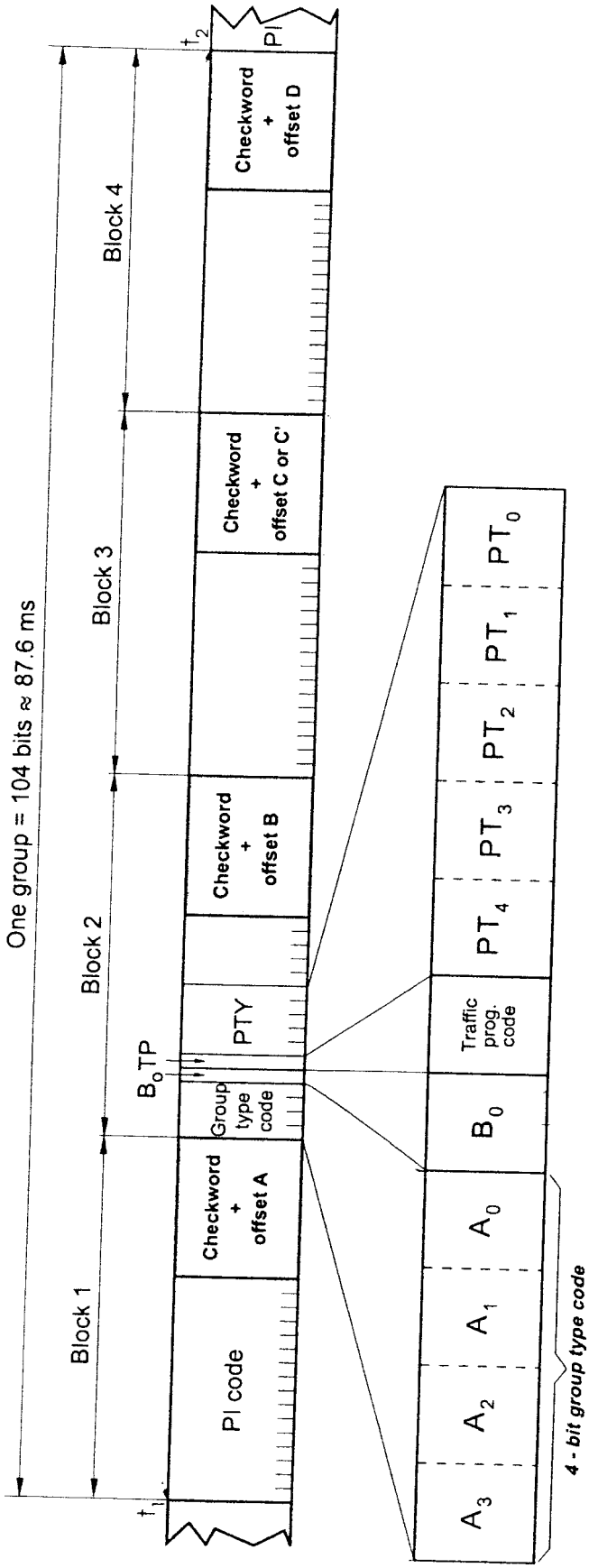
11. The receiver according to any of claims 8-10, wherein the controller (40) is further configured to:

when the list does not contain any ECC, receive further data blocks, any of which including the PS of the first radio program; and
update the list so as to contain the PI and the PS of the first radio program.

12. The receiver according to any of claims 8-11, wherein the country code of the first radio program is confirmed by the ECC of the second radio program.

13. The receiver according to any of claims 8-12, wherein the first and second radio programs are different programs.

Fig. 2


One group = 104 bits ≈ 87.6 ms
Block 1
Block 2
Block 3
Block 4
PI code
Checkword + offset A
Group type code
B0
TP
PTY
Checkword + offset B
Checkword + offset C or C'
Checkword + offset D
PI
t1
t2
A3
A2
A1
A0
B0
PT4
PT3
PT2
PT1
PT0
Traffic prog. code
4 - bit group type code

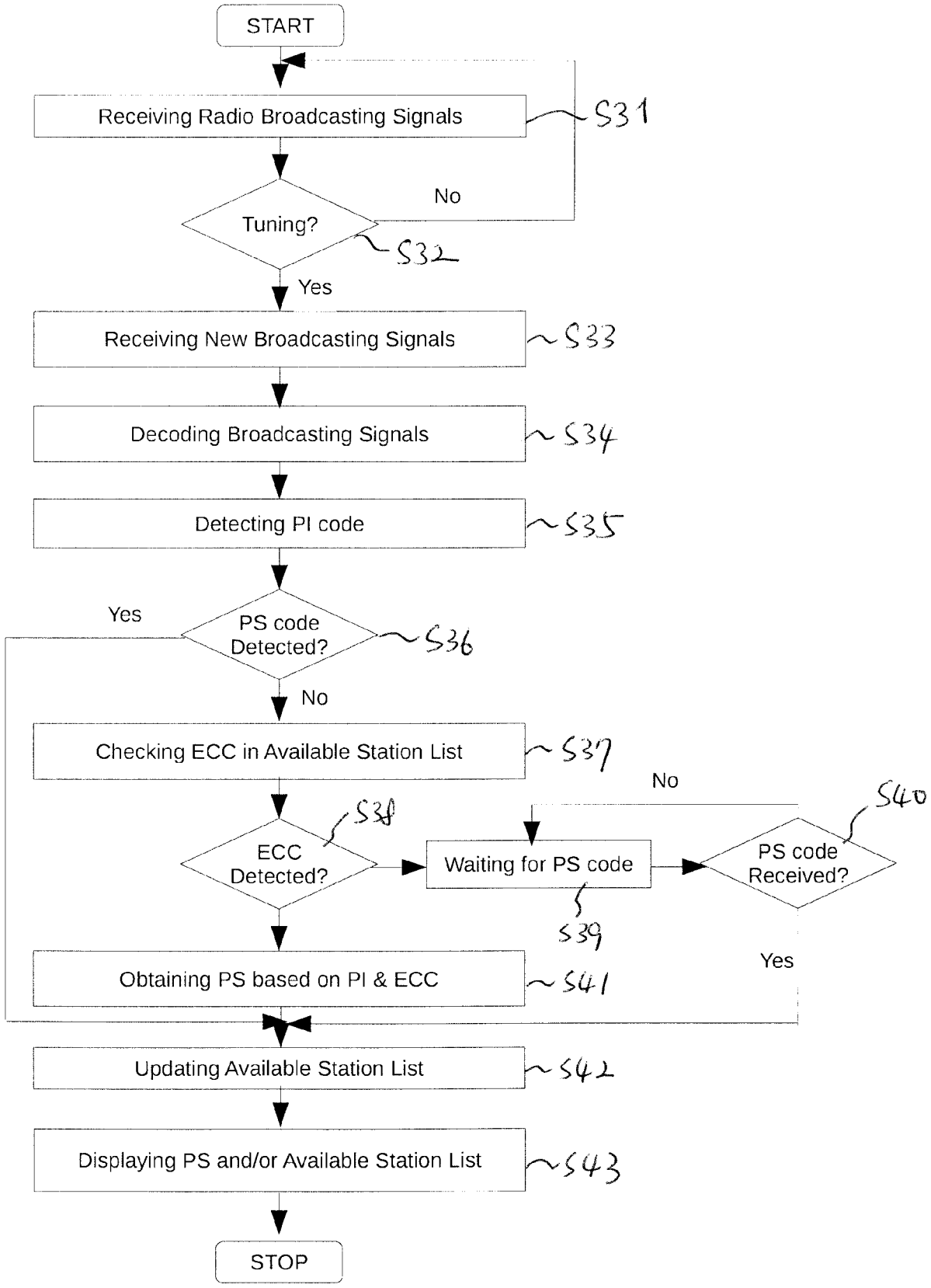

START
Receiving Radio Broadcasting Signals
S31
Tuning?
No
S32
Yes
Receiving New Broadcasting Signals
S33
Decoding Broadcasting Signals
S34
Detecting PI code
S35
Yes
PS code Detected?
S36
No
Checking ECC in Available Station List
S37
No
S40
S38
ECC Detected?
Waiting for PS code
PS code Received?
S39
Yes
Obtaining PS based on PI & ECC
S41
Updating Available Station List
S42
Displaying PS and/or Available Station List
S43
STOP

Fig. 3

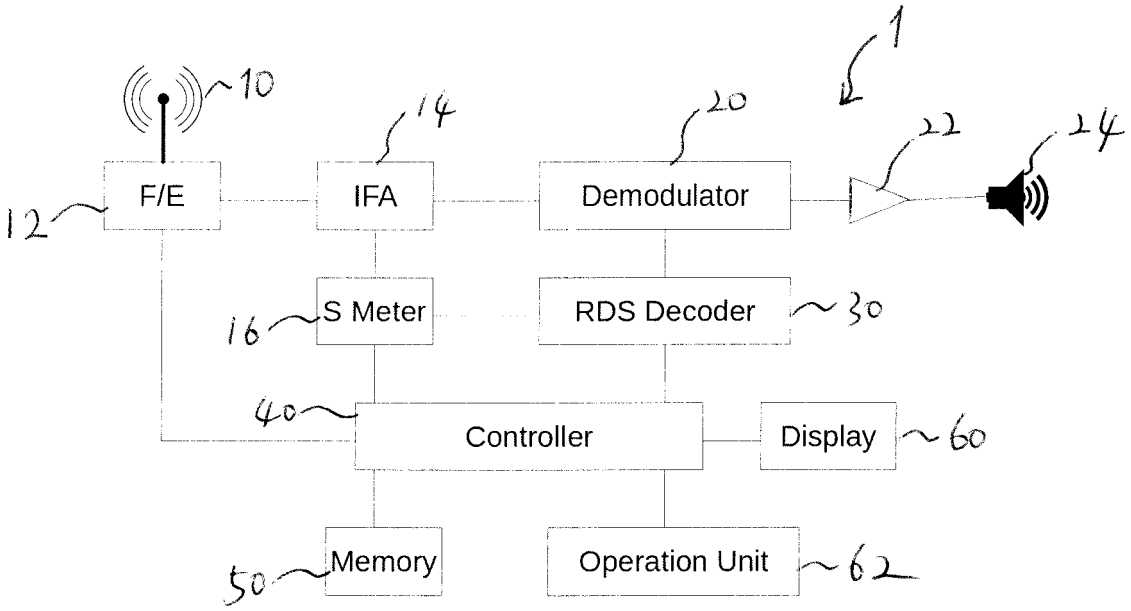

1
10
14
20
22
24
12
F/E
IFA
Demodulator
16
S Meter
RDS Decoder
30
40
Controller
Display
60
50
Memory
Operation Unit
62

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 2473

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 9 002 307 B2 (LUHTALA HARRI PETTERI [FI]; NOKIA CORP [FI]) 7 April 2015 (2015-04-07) * column 5, line 45 - column 10, line 59 *	1-13	INV. H04H60/44 ADD. H04H60/51
A	US 2010/197255 A1 (JAISIMHA SHREE [US] ET AL) 5 August 2010 (2010-08-05) * paragraphs [0032], [0059] - [0060] *	1-13	
A	EP 1 742 396 A2 (BOSE CORP [US]) 10 January 2007 (2007-01-10) * paragraphs [0056], [0057] *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

H04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 February 2019	Van Hoorick, Jan

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-02-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 9002307 B2	07-04-2015	US 2013344832 A1	26-12-2013
		WO 2012120334 A1	13-09-2012
US 2010197255 A1	05-08-2010	NONE	
EP 1742396 A2	10-01-2007	CN 1913404 A	14-02-2007
		EP 1742396 A2	10-01-2007
		JP 2007020165 A	25-01-2007
		US 2007010221 A1	11-01-2007

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