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(54) **Receiver for receiving multiplexed broadcast programmes, comprising audio data and supplementary broadcast data**

(57) A DAB radio (10) receives audio data, service label data as string data, and data for judging abridgement of each character of the service data. Each service label can be displayed properly on a display unit (32). An abridged representation judging unit (50) judges whether each service label is displayed in an abridged representation or in a full representation, in accordance with the conditions of a maximum display size of the display unit, a user selection of representations, or the like. If it is judged that the service label is displayed in the abridged representation, a representation control unit 52 forms a service label in the abridged representation in accordance with abridgement judging data to thereby display an abridged service label on the display unit (32).

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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to a broadcasting receiver for receiving a broadcasting radio wave, for example, a digital audio broadcasting (DAB) radio wave, constituted of a plurality of multiplexed broadcasting programs each containing audio data and string data such as ensemble label data and service label data.

#### 2. Description of the Related Art

Much attention has been paid to DAB as a radio broadcasting system which can deal with sound quality degradation to be caused by radio interference between an increased number of FM broadcasting stations or with difficulty of good quality reception at mobile terminals. DAB has been developed by EUREKA (European leading-edge technology development project) and some specifications have already been presented. DAB adopts  $\pi/4$  shift DQPSK-OFDM as a modulation scheme and features in resistance against the influence of fading and multipath. DQPSK-OFDM is an abbreviation of Differential Quadrature Phase Shift Keying - Orthogonal Frequency Division Multiplex. DAB also adopts high efficiency audio coding MPEG layer II and can realize stereo broadcasting and data broadcasting of six programs at a transmission bandwidth of 1.5 MHz.

A DAB radio as a broadcasting receiver has speakers for reproducing audio signals and a display unit for displaying string data such as ensemble label data and service label data sent at the same time when audio data is transmitted. The ensemble label data indicates the name of each ensemble, and the service label data indicates the name of each broadcast station. One ensemble generally contains six stereo broadcasting radio waves. There is a small display unit with a small maximum display size and a large display unit. Even a large size display unit has a limited screen size so that a means is necessary for proper display various data on the display unit.

If a small display with a small maximum display size is used, the full contents of an ensemble label and service label cannot be displayed in some cases. Even if a large display unit with a large maximum display size is used, if other data such as the name of a music program is displayed in addition to the ensemble label and service label, it becomes necessary in some cases to reduce the display area for the ensemble and service labels in order to display such other data.

### SUMMARY OF THE INVENTION

It is an object of the present invention to provide a broadcasting receiver for receiving a broadcasting radio

wave of a plurality of multiplexed broadcasting programs each containing audio data, string data such as ensemble label data and service label data, and abridged representation information of the string data, the radio being capable of properly displaying the string data on a display unit.

A broadcasting receiver (10) of this invention receives a broadcasting radio wave of a plurality of multiplexed broadcasting programs each containing audio data, string data (character string as an aggregation of characters, numerals and symbols), and abridged representation information of the string data. This broadcasting radio (10) comprises the following two constituents (a) and (b):

(a) abridged representation judging means (50) for judging whether the string data is displayed in an abridged representation; and

(b) representation control means (52) for displaying the string data on a display unit (32) in the abridged representation in accordance with the abridged representation information, when the abridged representation judging means (50) judges that the string data is displayed in the abridged representation.

The abridged representation information may include not only abridgement judging information of each character of the string data, but also information indicating to display the string data up to its predetermined byte and omit the string data after this predetermined byte for the abridged representation.

The abridged representation judging means (50) judges from a predetermined judgement criterion whether the string data is displayed in the abridged representation. In accordance with the judgement results made by the abridged representation judging means (50), the representation control means (52) controls the display of the string data on the display unit (32), and if the abridged representation judging means (50) judges that the string data is displayed in the abridged representation, the control means displays the string data on the display unit (53) in the abridged representation. As above, in accordance with the operation conditions, the representation of the string data on the display unit (32) is switched between an abridged representation and a full representation to thereby allow the string data to be properly displayed on the display unit (32).

According to another aspect of the broadcasting receiver (10) of the invention, the abridged representation judging means (50) judges in accordance with a display space for the string data on the display unit (32).

The string data is displayed on the display unit (32) in the abridged representation in the case wherein the display unit (32) has a small display space for the string data. This case corresponds to a small maximum display size of the display unit (32) and to a user request of displaying the string data in a small display space. Con-

versely, the string data is displayed on the display unit (32) in the full representation in the case wherein the display unit (32) has a large display space for the string data. This case corresponds to a large maximum display size of the display unit (32) and to a user request of displaying the string data in a large display space.

According to another aspect of the broadcasting receiver (10) of this invention, if a plurality of data sets of the string data are to be displayed on the display unit (32), the abridged representation judging means (50) judges that at least one data set affixed with the abridged representation information is omitted in displaying.

Even if the maximum display size of the display unit (32) is large, the display space of the display unit (32) may become insufficient for the display of a plurality of data sets of the string data. In such a case, the abridged representation judging means (50) judges that at least one data set affixed with the abridged representation information among the plurality of data sets to be displayed is omitted in displaying. In accordance with this judgement, the representation control means (52) controls to display the string data on the display unit (32) in the abridged representation. Accordingly, the display space of the string data can be reduced and the reserved display space is allocated to the display of other data. In this manner, the limited display space of the display unit (32) can be efficiently used and a plurality of data sets can be displayed on the display unit (32) at a time.

According to another aspect of the broadcasting receiver (10) of this invention, the abridged representation information includes abridgement judging data of each character of the string data, and the representation control means (52) forms an abridged representation of the string data in accordance with the abridgement judging data, if the abridged representation is to be performed.

A discriminator as above is affixed to each character of the string data for the judgement whether the character can be omitted in the abridged representation. Accordingly, the representation control means (52) can easily form an abridged representation of the string data in accordance with the discriminator.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a flow chart illustrating a service label representation switching routine.

Fig. 2 is a flow chart illustrating a service label representation switching routine when a 16-digit display unit is used.

Fig. 3 is a diagram showing examples of a service label displayed on a display unit.

Fig. 4 is a diagram showing examples of specific character string and character flag set loaded in a character field and a character flag field shown in Fig. 9.

Fig. 5 shows the configuration of a vehicle mount

DAB radio system.

Fig. 6 is a diagram showing the format of a DAB transmission frame.

Fig. 7 is a diagram showing the structure of FIB.

Fig. 8 is a diagram showing the structure of FIG shown in Fig. 7 and having a FIG type 1.

Fig. 9 is a diagram showing the structure of a type 1 field of FIG shown in Fig. 8 and having an extension number 1.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the invention will be described with reference to the accompanying drawings.

Fig. 5 is a diagram showing the system configuration of a vehicle mount DAB radio 10. This DAB radio 10 has a main system 12 and a separate remote controller including a DAB control microcomputer 26 and the like. The main system 12 has a DAB system microcomputer 14 and its memory 16, and operates to designate one ensemble among a plurality of multiplexed radio broadcasting waves (ensembles) and to send designated information to a radio frequency (RF) block 18. An ensemble stands for a radio broadcasting wave modulated through DQPSK-OFDM, has a bandwidth of 5 MHz and generally contains six broadcasting programs. If each ensemble is called a main channel, each broadcasting radio wave is called a subchannel. The RF block 18 derives RF signals from the ensemble designated by the DAB system microcomputer 14, and sends the derived RF signals to a demodulating block 20. The demodulating block 20 demodulates the RF signals sent from the RF block 18, and the demodulated signals are decoded by a channel decoding block 22. In the above manner, the channel decoding block 22 acquires all digital signals of one ensemble designated by the DAB system microcomputer 14 and sent to the RF block 18. Of digital signals decoded by the channel decoding block 22, audio data is sent from the channel decoding block 22 to an audio decoding block 24, and data other than the audio data, including PTY data (corresponding to program type data), ensemble label data, sample label data and the like, is sent from the channel decoding block 22 to the DAB system microcomputer 14. The audio decoding block 24 decodes audio data of a subchannel designated by the DAB system microcomputer 14 among the audio data input from the channel decoding block 22, and drives right and left speakers (not shown) by the decoded audio data. The DAB control microcomputer 26 has a memory 28 to transfer data to and from the DAB system microcomputer 14 of the main system 12. The DAB control microcomputer 26 receives a user instruction from a key unit 30, and supplies predetermined data to a display unit 32 to display necessary information and present it to a user.

Fig. 6 shows the format of a transmission frame of DAB. A transmission frame is constituted of a synchro-

nization channel, a fast information channel (FIC) and a main service information channel (MSC) in this order from the top of the frame. FIC has a plurality of fast information blocks (FIB). MSC has a plurality of common interleaved frames (CIF). DAB is provided with specifications from mode 1 to mode 3. Each mode has a different duration of one transmission frame and different numbers of FIB's and CIF's per one transmission frame. For example, in the mode 1, the duration of one transmission frame is 96 ms and the numbers of FIB's and CIF's per one transmission frame are 12 and 4, respectively.

Fig. 7 shows the structure of FIB. Each FIB has 256 bits in total, including a FIB data field of 30 bytes in a front area and a cyclic redundancy check (CRC) word of 6 bits in a back area. The FIB data field includes, in the order from the top of this field, a plurality of first information groups (FIG), one end marker and one padding field (bits 0 are inserted so as to completely fill the FIG data field of 30 bytes). Each FIG is a useful data field which is constituted of a FIG type field, a length field (indicating the bit length of the next FIG data field) and the FIG data field in this order from the top of FIG. The FIG type and length constitute a FIG header.

Fig. 8 shows the structure of FIG shown in Fig. 1, this FIG being of a type 1 (001 in 3-bit binary notation). The FIG data field includes, in the order from the top, a character set (Charset) field, an OE field (storing a flag indicating whether information in the next type 1 field belongs to the subject ensemble or another ensemble), an extension field (storing one of eight extension numbers of the FIG type 1) and the type 1 field.

Fig. 9 shows the structure of the type 1 field shown in Fig. 8, the type 1 field having the extension number 1. The type 1 field having the extension number 1 is service label data, and includes from the top of this field a service identifier (Sid) field of 16 bits, a character field of 16 bytes (= 16 x 8 bits) and a character flag field of 16 bits.

Fig. 4 shows specific data of a character string and a character flag set loaded in the character field and the character flag field shown in Fig. 9. In this example, the character string is "BBC\_Radio\_1\_DAB\_" wherein "\_" is a space. Each character is made of an ASCII code of one byte. The character flag set is "1111100000110001". Each bit of the character flag set indicates whether or not the character at the same byte number as the bit number of the character flag can be omitted when an abridged representation is used. A bit "1" indicates that the corresponding character cannot be omitted in the abridged representation, and a bit "0" indicates that the corresponding character can be omitted in the abridged representation. Therefore, the character string in a 16-digit full representation is "BBC\_Radio\_1\_DAB\_", and that in an 8-digit abridged representation, the character string is "BBC\_R1\_". The above description for the service label can also be applied to the ensemble label.

Fig. 1 is a flow chart illustrating a service label representation switching routine. Although the description for Figs. 1 and 2 is applied to the service label, the ensemble label can be processed in a similar manner. At Step S100 it is checked whether an operation mode is a service label display mode. If YES, the flow advances to Step S102, whereas if NO, the flow escapes from this routine. At Step S102 it is checked whether the number of selected digits for the display of a service label on the display unit 32 is 8 or 16. In this case, if an 8-digit small display unit 32 is used, there is no room to select the representation type, but the service label is displayed on the display unit in 8 digits by all means. On the other hand, if a 16-digit large display unit 32 is used, switching between the 8-digit and 16-bit representations becomes possible depending upon a user selection and a predetermined condition. If the 16-bit representation is selected, the flow advances from Step S102 to Step S106, whereas if the 8-bit representation is selected, the flow advances from Step S102 to Step S104. At Step S104 a 16-digit service label is converted into in an 8-digit service label in accordance with its character flag set. At Step S106, the service label is output to the display unit 32. An abridged representation judging means 50 judges whether a service label as string data is displayed in the abridged representation or in the full representation, and this operation corresponds to Step S102. In accordance with the judgement results made by the abridged representation judging means 50, a representation control means 52 converts, in the case of the abridged representation, the service label as string data into the 8-digit service label, for example, "BBC\_R1\_", in accordance with its character flag set, and outputs it to the display unit 32. In the case of the full representation, the service label is not converted but this label itself, for example, "BBC\_Radio\_1\_DAB\_", is output to the display device 32. The operation of the representation control means 52 corresponds to Steps 102, 104 and 106.

Fig. 2 is a flow chart illustrating a service label representation switching routine when a 16-digit large display unit 32 is used. Instead of Step S102 shown in Fig. 1, Step S110 is used. At Step S110 it is judged whether data other than the full-representation data is displayed on the display unit 32. The other data may be a present time, the name of a music program presently produced from the speakers of the DAB radio 10, and the like. If the other data is also displayed, the flow advances to Step 104, whereas if not, the flow advances to Step S106. Fig. 3 shows examples of various service labels displayed on the display unit 32. If data other than the service label is not displayed on the display unit 32, the service label is displayed in the full representation at the digit numbers 1 to 16. If a present time is displayed (Example 1) or the name of a music program is displayed (Example 2), the abridged service label is displayed on the display unit 32 at the digit numbers 1 to 8 and the other data such as a present time or a music

program name is displayed at the digit numbers 9 to 16. In the example shown in Fig. 2, the abridged representation means 50 determines either the full representation or abridged representation of the service label, in accordance with whether data other than the service label is displayed on the display unit 32. The operation of the abridged representation means 50 corresponds to Step S110. In accordance with the judgement results made by the abridged representation judging means 50, a representation control means 52 converts, in the case of the abridged representation, the service label as string data into the 8-digit service label, for example, "BBC\_R1\_\_", in accordance with its character flag set, and outputs it to the display unit 32. In the case of the full representation, the service label is not converted but this label itself, for example, "BBC\_Radio\_1\_DAB\_", is output to the display device 32. The operation of the representation control means 52 corresponds to Steps 102, 104 and 106.

representation of the string data in accordance with the abridgement judging data, when the abridged representation is to be performed.

### Claims

1. A broadcasting receiver (10) for receiving a broadcasting radio wave of a plurality of multiplexed broadcasting programs each containing audio data, string data and abridged representation information of the string data, comprising:
  - (a) abridged representation judging means (50) for judging whether the string data is displayed in an abridged representation; and
  - (b) representation control means (52) for displaying the string data on a display unit (32) in the abridged representation in accordance with the abridged representation information, when said abridged representation judging means (50) judges that the string data is displayed in the abridged representation.
2. A broadcasting receiver according to claim 1, wherein said abridged representation judging means (50) judges in accordance with a display space for the string data on the display unit (32).
3. A broadcasting receiver according to claim 1 or 2, wherein when a plurality of data sets of the string data are to be displayed on the display unit (32), said abridged representation judging means (50) judges that at least one data set affixed with the abridged representation information is omitted in displaying.
4. A broadcasting receiver according to any one of claims 1 to 3, wherein the abridged representation information includes abridgement judging data of each character of the string data, and said representation control means (52) forms an abridged

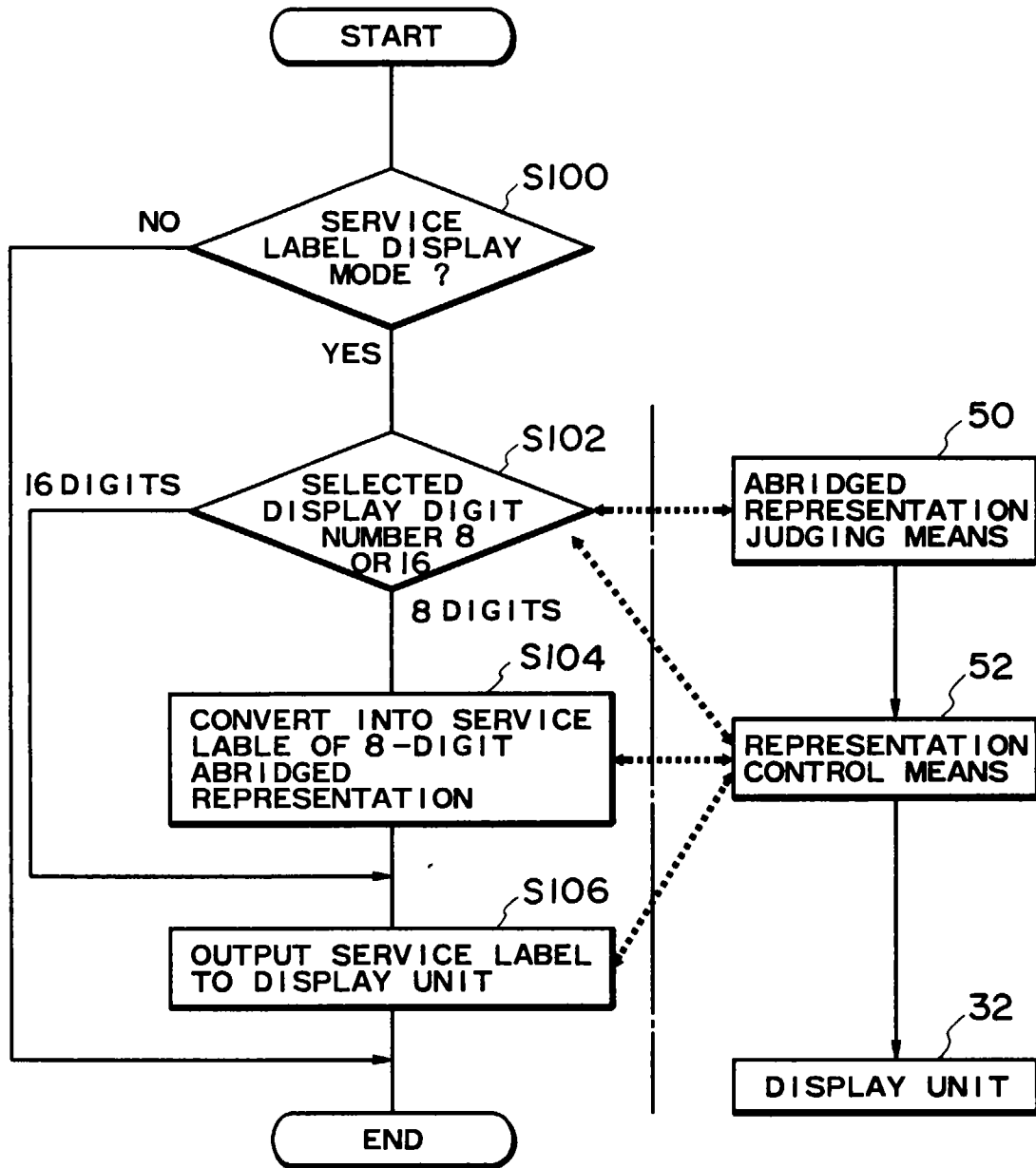


FIG. 1

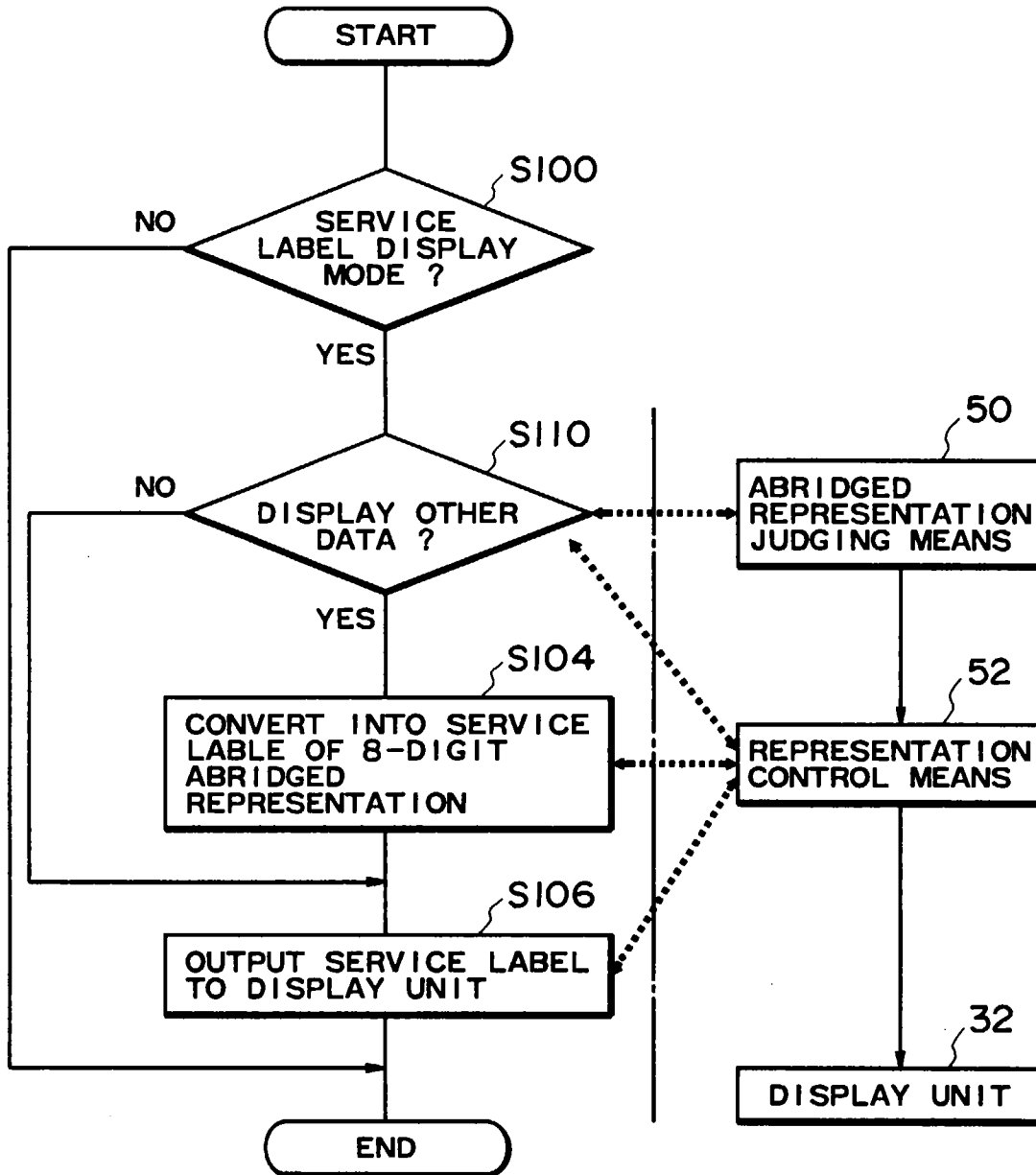


FIG. 2

DIGIT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FULL REPRESENTATION	B B C R A D I O								1 D A B							

ABRIDGED REPRESENTATION: EXAMPLE 1	B B C R 1								1 0 : 3 4							
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ABRIDGED REPRESENTATION: EXAMPLE 2	B B C R 1								L E T I T B							
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**FIG. 3**

BYTE OR BIT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CHARACTER	B	B	C		R	A	D	I	O		1		D	A	B	
CHARACTER FLAG	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	1

**FIG. 4**

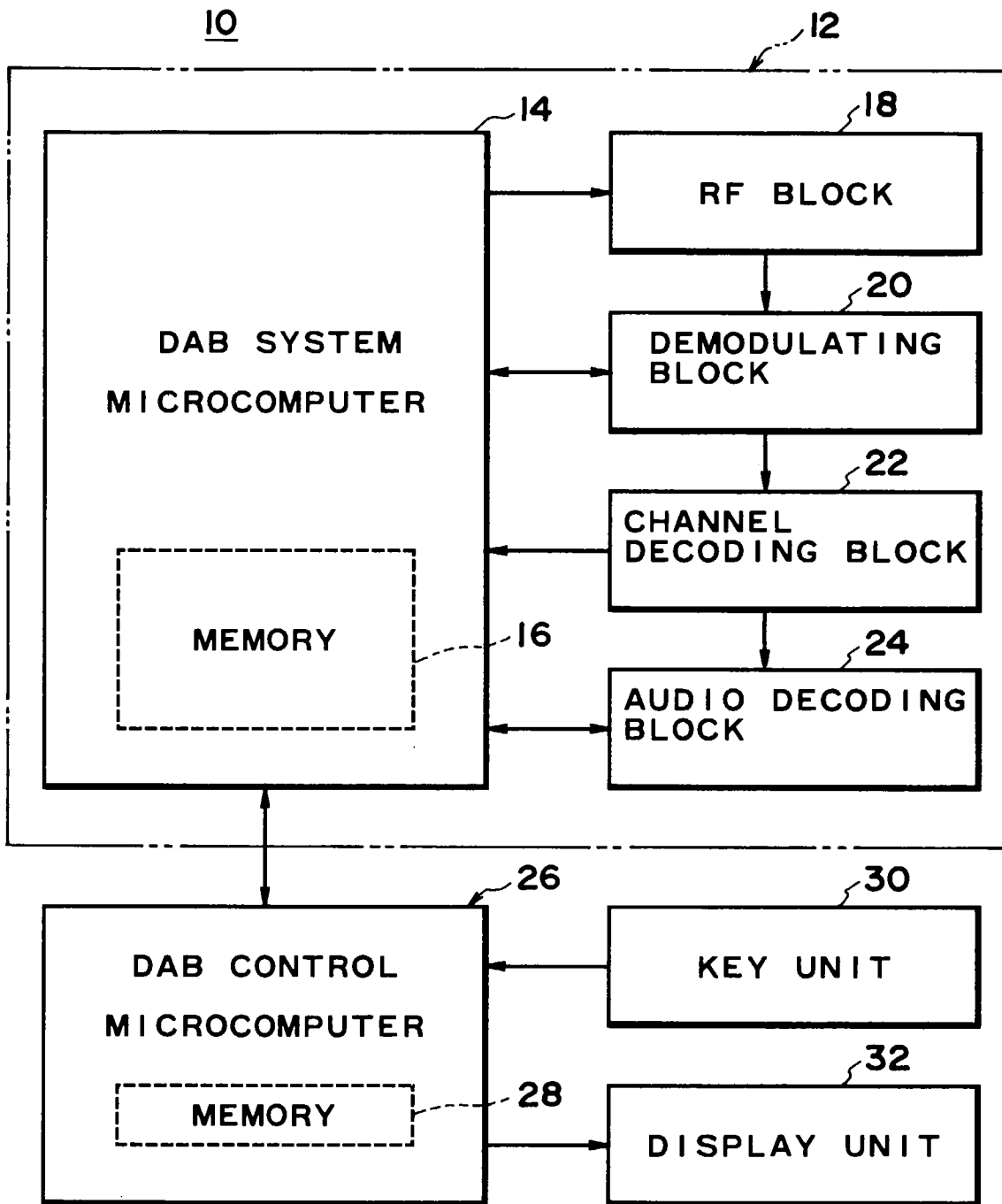
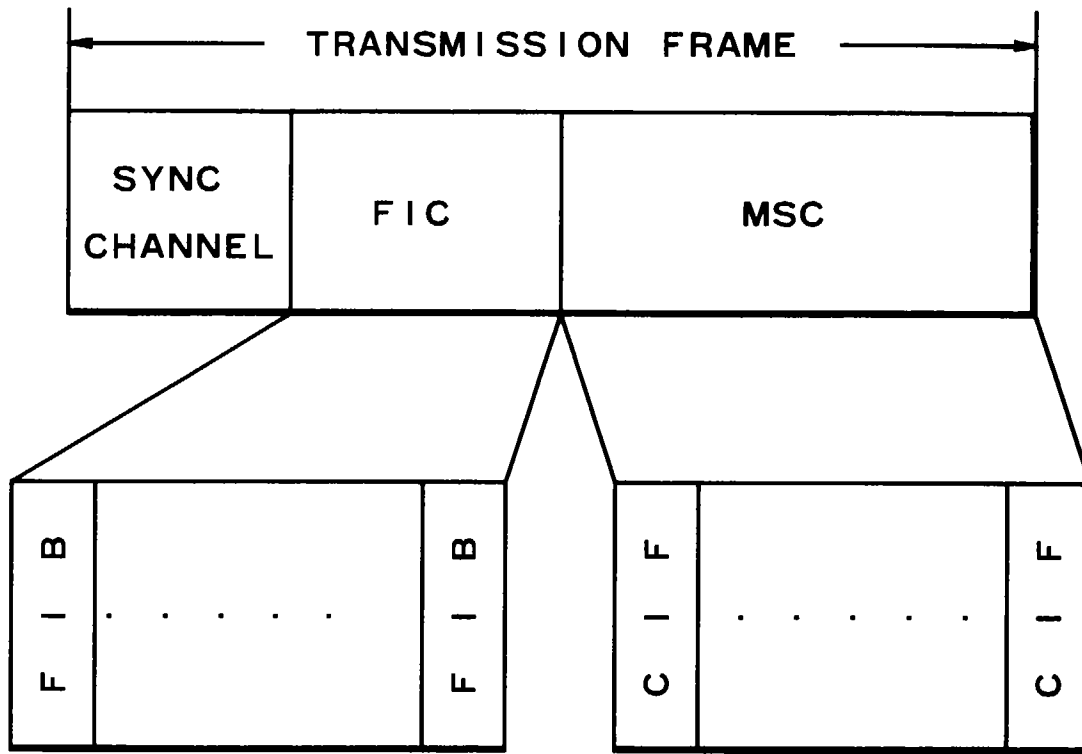
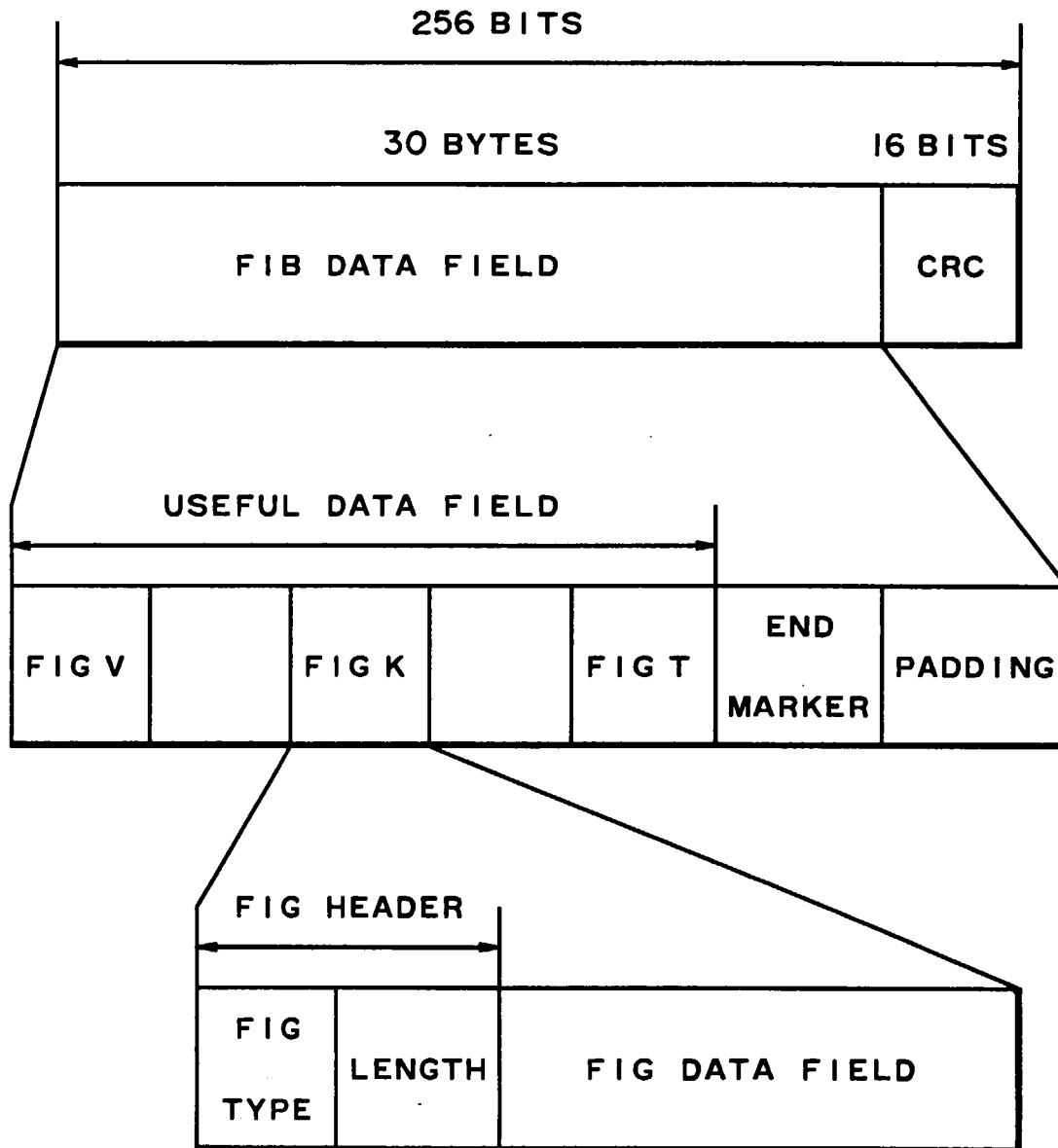


FIG. 5



**FIG. 6**



**FIG. 7**

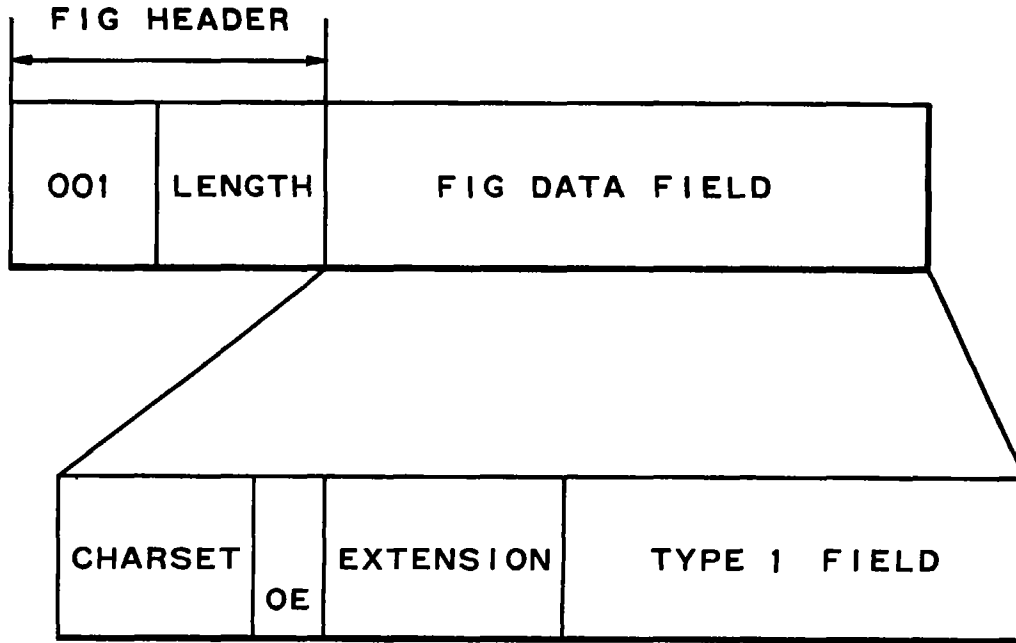


FIG. 8

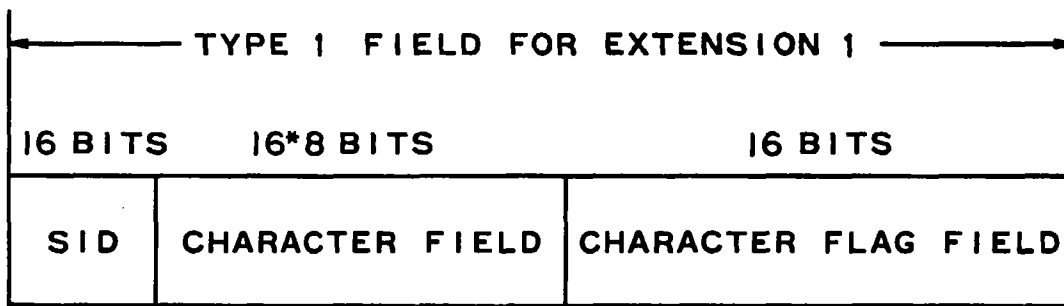


FIG. 9