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(71) Applicant:
**KABUSHIKI KAISHA KENWOOD
Shibuya-ku Tokyo (JP)**

(72) Inventor: **Asami, Masaru
Hamura-shi, Tokyo (JP)**

(74) Representative:
**Patentanwälte
Leinweber & Zimmermann
Rosental 7
80331 München (DE)**

(54) **Broadcast receiver for receiving digital audio broadcast comprising supplementary data**

(57) In DAB, X-PAD of an audio frame may have information associated with the audio frame as a dynamic label. In the case of a music program, the information may be the name of the program, the artist name, a shop name and telephone number of its CD and the like. This dynamic label is used effectively. In response to a user storage request, a dynamic label is stored. This stored dynamic label is later displayed again on a display unit 32.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a broadcast receiver for receiving radio waves transmitted from broadcasting stations such as digital audio broadcasting (DAB) stations.

2. Description of the Related Art

DAB has drawn attention as one of radio broadcasting systems which can suppress sound quality deterioration to be caused by interference by an increased number of FM broadcasting stations or can alleviate a difficulty of a good reception state at mobile units. DAB has been developed by EUREKA and has European Telecommunications Standard. This standard adopts, as a modulation scheme, $\pi/4$ DQPSK-OFDM (Differential Quadrature Phase Shift Keying - Orthogonal Frequency Division Multiplex) which is characterized in that influence by fading and multipath is less, and adopts high efficiency MPEG layer II as voice coding. Six programs of stereo and data broadcasting can be realized in a transmission bandwidth of 1.5 MHz.

A transmission frame of DAB includes an audio frame which contains audio data and its PAD (Program Associated Data).

There are a plurality of application types of PAD. One type includes a dynamic label whose character information can be displayed on a display unit while the program is reproduced from speakers.

The dynamic label of a program, for example, a music program, may be the name of the program, a shop name and telephone number of its CD (compact disk) and the like. If a broadcast receiver is a car radio, this information such as the music program name cannot be displayed and discarded wastefully.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a broadcast receiver for receiving radio waves of audio data and its associated character information in which the character information can be used effectively.

According to the present invention, a broadcast receiver (10) for receiving a radio wave containing information on audio data and associated character data, comprises:

- (a) display information storage means (40) for storing the character data displayed on a display unit (32) upon request from a user; and
- (b) re-display means (44) for displaying the character data stored in said display information storage means (40) upon request from the user.

The character data associated with the audio data is displayed on the display unit (32), and if a user requests, it is stored in the display information storage means (40). The re-display means (44) displays the character data stored in the display information storage means (40) in response to a call request from a user. The user can write the re-displayed character data on a memo or the like. The display unit (32) for displaying the character data while broadcast audio data is reproduced from speakers, head phones or the like, may be different from a display unit for displaying the character data by the re-display means (44).

In the broadcast receiver (10) of this invention, the character data together with the audio data may be contained in the audio frame.

For example, in DAB, the dynamic label as the character data is included in the audio frame.

In the broadcast receiver (10) of this invention, the display information storage means (40) may be data storage means (42) for storing the character data together with the audio data, and the re-display means (44) may be data reproduction means (46) for displaying the character data while reproducing the audio data in accordance with the stored contents of said data storage means (42).

In displaying the character data upon request by a user, the data re-production means (46) reproduces also the audio data stored together with the character data (normally, only the audio data for a predetermined time because of a memory capacity limit). Accordingly, the user can know reliably the audio data corresponding to the displayed character data.

In the broadcast receiver (10) of this invention, the display information storage means (40) may be data storage means (42) for storing the character data together with a storage time, and the re-display means (44) may be data reproduction means (46) for displaying the storage time together with the character data in accordance with the stored contents of said data storage means (42).

In displaying the character data upon request by a user, the data re-production means (46) notifies the storage time when the character data was stored, by using a display unit or by using voices. Accordingly, the user can reliably know the audio data such as a musical program corresponding to the displayed character data.

In the broadcast receiver (10) of the invention, the broadcast radio wave may be in conformity with DAB, and the character data may be a dynamic label with a variable character length.

In the broadcast receiver (10) of the invention, the dynamic label may contain the name of a music program, the name of an artist, or sales shop information.

In the broadcast receiver (10) of the invention, the broadcast receiver may be mounted on a vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a flow chart illustrating a routine of storing a dynamic label.

Fig. 2 is a flow chart illustrating a routine of calling a dynamic label.

Fig. 3 is a block diagram showing the structure of a vehicle-mounted DAB radio system.

Fig. 4 is a diagram showing the structure of a DAB transmission frame.

Fig. 5 is a diagram showing an example of a DAB service structure.

Fig. 6 is a diagram showing the structure of the final portion of a DAB audio frame.

Fig. 7 is a diagram showing the structure of an F-PAD field.

Fig. 8 is a diagram illustrating transmission of an X-PAD data group by X-PADs of three consecutive audio frames.

Fig. 9 is a diagram illustrating transmission of three types of X-PAD data by a single audio frame.

Fig. 10 is a diagram showing an X-PAD data group for a single dynamic label segment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the invention will be described with reference to the accompanying drawings.

Fig. 3 shows the system structure of a vehicle-mounted DAB radio 10. The DAB radio 10 has a main body 12 and a separated unit mounted with a DAB control microcomputer 26 and the like. The main body 12 has a DAB system microcomputer 14 with a memory 16, designates one ensemble from a plurality of multiplexed radio broadcasting waves (ensembles) and sends this designation information to an RF block 18. An ensemble is a radio broadcasting wave modulated by DQPSK-OFDM. One ensemble has a bandwidth of about 1.5 MHz and contains usually six broadcasting programs. Each broadcasting program constitutes a sub-channel of a main channel which constitutes one ensemble. The RF block 18 detects an RF (radio frequency) radio wave of the ensemble designated by the DAB system microcomputer 14, and sends it to a demodulating block 20. The demodulating block 20 demodulates the RF signal sent from the RF block 18, and a channel decoding block 22 decodes the signal demodulated by the demodulating block 20. In this manner, all digital signals of one ensemble designated by the DAB system microcomputer 14 and sent to the RF block 18 are obtained by the channel decoding block 22. Of the 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 whereas data contained in FIG (Fast Information Group) to be described later is sent from the channel decoding block

22 to the DAB system microcomputer 14. Of the audio data sent from the channel decoding block 22, an audio frame of the sub-channel designated by the DAB system microcomputer 14 is decoded by the audio decoding block 24. The decoded audio data is reproduced from right and left speakers (not shown), and X-PAD to be described later is sent to the DAB system microcomputer 14. The DAB control microcomputer 26 with the memory 28 transfers data to and from the DAB system microcomputer 14 of the main body 12. An instruction from a user is input from a key 30 to the DAB control microcomputer 26 which outputs predetermined data to a display unit 32 to display it and inform the user of it.

Communications protocols of various elements of DAB will be described with reference to Figs. 4 to 10, the details of which are to be referred to European Telecommunications Standard published by European Telecommunications Standards Institute.

Fig. 4 shows the structure of a transmission frame of DAB.

The transmission frame includes, from the head thereof, a synchronization channel, a fast information channel and a main service channel. FIC is constituted of a plurality of fast information blocks, and MSC is constituted of a plurality of common interleaved frames. DAB has the specifications, mode 1 to mode 3. The duration of the transmission frame and the numbers of FIBs and CIFs per transmission frame are different for each mode. For example, the mode 1 has one transmission frame duration of 96 ms, 12 FIBs and 4 CIFs in one transmission frame.

Fig. 5 shows an example of the service structure of DAB. An ensemble having an ensemble label "DAB ENSEMBLE ONE" contains a plurality of services such as those having service labels "ALPHA 1 RADIO", "BETA RADIO", "ALPHA 2 RADIO" and the like. A user listens to a selected service from the DAB receiver 10. The "ALPHA 1 RADIO" service has one set of main service components and two sets of subsidiary service components. The main service components are "Audio" components, and the subsidiary service components are "TMC (Traffic Message Channel)" components and "SI (Service Information)" components. The audio components and SI components are transmitted by different sub-channels (SubCh) of MSC (Main Service Channel). TMC is transmitted by an FIDC (Fast Information Data Channel) of FIC (First Information Channel).

The "BETA RADIO" service has two sets of service components, audio components and secondary audio components both of which are carried on sub-channels of MSC.

The "ALPHA 2 RADIO" service has the same TMC and SI as the "ALPHA 1 RADIO" service, and the same audio service as the "ALPHA 1 RADIO" may be used upon selection by a switch.

Fig. 6 shows the structure of the final portion of the DAB audio frame. Disposed next to the audio data in the final portion of the DAB audio frame are an X-PAD

(extended PAD) field, an SCF-CRC (Scale Factor Cyclic Redundancy Check) field, and an F-PAD (fixed PAD) field with a fixed byte length of 2 bytes. The start and end bytes in F-PAD are called a byte L-1 and a byte L.

Fig. 7 shows the structure of the F-PAD field. A CI (Contents Indicator) flag is assigned to the bit b1 of the byte L (8 bits of each byte are represented by b7, b6, ..., b0 from its MSB). If this flag is "1", it means that the audio frame contains X-PAD. In the case of a dynamic label segment which is one kind of X-PAD, the bits b7 and b6 of the byte L-1 representing an F-PAD type are "00". In this case, the bits b5 and b4 of the byte L-1 as an X-PAD indicator (X-PAD Ind) indicate the length of X-PAD.

There are two methods of transmitting X-PAD as illustrated in Figs. 8 and 9.

Fig. 8 illustrates transmission of an X-PAD data group by three consecutive audio frames. Since X-PAD of the first (n-1) audio frame contains CI, the CI flag of F-PAD is "1". The last (n+1) X-PAD is padded if necessary in order to adjust the number of bits to a preset value.

Fig. 9 illustrates transmission of three types of X-PAD data by a single audio frame. The number of CIs is the number of types of X-PAD data added by 1. The last (in this example, the fourth) CI in the logical order is an end mark of CI. In Fig. 9, X-PADs are shown in the logical order. In actual, they are transmitted in the order opposite to the logical order. There are two types of X-PAD, one being a fixed byte type of 4 bytes and the other being a variable byte type of 5 bytes or more. CI of a variable byte type contains application type information as well as length information of X-PAD. The application type number of a dynamic label segment is defined by "2" for the first X-PAD, and by "3" for the second and following X-PADs. From the application type information, presence/absence of the dynamic label segment, i.e., reception of the dynamic label can be detected.

Fig. 10 shows the structure of the X-PAD data group for a single dynamic label segment. The dynamic label is constituted of 8 segments at a maximum, and the character field of each segment is constituted of 16 bytes at a maximum. Characters of the dynamic label are defined with ASCII codes so that the number of characters of the dynamic label is 128 at a maximum.

Fig. 1 is a flow chart illustrating a routine of storing a dynamic label. At Step S10 it is checked whether a dynamic label is detected. If detected, the flow advances to Step S12, whereas if not, the routine is terminated. Whether the dynamic label is detected or not is determined in accordance with the application type number "2" indicating the CI dynamic label. The dynamic label is displayed on the display unit 32 to notify a user of program associated character information such as the name of a program, e.g., a music program, the artist name, a shop name and telephone number of its CD and the like, while reproducing the program from speakers of the DAB receiver or head

phones. At Step S12 it is checked whether there is a request for storing the dynamic label. If there is a request, the flow advances to Step S14, whereas if not, the routine is terminated. If the user wants to see later the dynamic label displayed on the display unit 32, the predetermined key 30 of the DAB receiver 10 is actuated. The judgement at Step S12 can be determined in accordance with this user actuation. At Step S14 the dynamic label is stored in predetermined memories. The audio data of the audio frame 6, i.e., sounds being reproduced from the speakers, corresponding to the dynamic label stored at Step S14 are stored in one of the memories for a predetermined time period. At Step S18 the current time is stored in the data memory.

The storage routine of Fig. 1 is repetitively executed upon request from a user as the dynamic label changes from one to another. Therefore, a plurality of sets (hereinafter called "storage sets") each constituted of a dynamic label, corresponding audio data and time are stored. The memory for storing the storage set has a capacity limit. Therefore, for example, if the data memory becomes full, the old storage sets in the memory are replaced by new storage sets.

Display information storage means 40 is used for storing a dynamic label upon request by a user, and corresponds to Step S14. Data storage means 42 is used for storing the dynamic label as well as corresponding audio data and/or time, and corresponds to Steps S14, S16, and S18.

Fig. 2 is a flow chart illustrating a routine of calling a dynamic label. A user can call later a dynamic label or the like stored in the storage routine shown in Fig. 1 and display it on the display unit 32. At Step S20 it is checked whether there is any stored dynamic label and the like. If affirmative, the flow advances to Step S22, whereas if negated, the routine is terminated. At Step S22 it is checked whether there is a call request from a user. If affirmative, the flow advances to Step S24, whereas if not, the routine is terminated. If a user wishes to again display the dynamic label, the predetermined key 30 of the DAB receiver 10 is activated. This activation allows the judgement at Step S22. At Step S24, the stored dynamic label is displayed on the display unit 32. If there is a plurality of storage sets, they are displayed in a preset order, for example, starting from the newest one among those still not displayed in the present call routine. At Steps S26 and S28, the audio data and time corresponding to the dynamic label displayed at Step S24 are read from the memory to reproduce the audio data from the speakers and display the time on the display unit 32 together with the dynamic label. The user listens to sounds reproduced from the speakers and looks at the storage time on the display unit 32 so that the user can confirm more reliably the dynamic label displayed on the display unit 32 and the corresponding program. At Step S30 it is checked whether there is any other stored dynamic label. If there is any other stored dynamic label, the flow returns to

Step S22, whereas if not, the routine is terminated.

Re-display means 44 is used for displaying later a dynamic label upon request by a user, and corresponds to Step S24. Data re-production means 46 is used for re-producing later the dynamic label as well as corresponding audio data and/or time, and corresponds to Steps S24, S26, and S28. 5

Claims

1. A broadcast receiver (10) for receiving a radio wave containing information on audio data and associated character data, comprising: 10
 - (a) display information storage means (40) for storing the character data displayed on a display unit (32) upon request from a user; and 15
 - (b) re-display means (44) for displaying the character data stored in said display information storage means (40) upon request from the user. 20
2. A broadcast receiver according to claim 1, wherein the character data together with the audio data is contained in the audio frame. 25
3. A broadcast receiver according to claim 1 or 2, wherein said display information storage means (40) is data storage means (42) for storing the character data together with the audio data, and said re-display means (44) is data reproduction means (46) for displaying the character data while reproducing the audio data in accordance with the stored contents of said data storage means (42). 30 35
4. A broadcast receiver according to any preceding claim, wherein said display information storage means (40) is data storage means (42) for storing the character data together with a storage time, and said re-display means (44) is data reproduction means (46) for displaying the storage time together with the character data in accordance with the stored contents of said data storage means (42). 40 45
5. A broadcast receiver according to any preceding claim, wherein the broadcast radio wave is in conformity with DAB, and the character data is a dynamic label with a variable character length. 50
6. A broadcast receiver according to claim 5, wherein the dynamic label contains the name of a music program, the name of an artist, or sales shop information. 55
7. A broadcast receiver according to any one of claims 1 to 6, wherein the broadcast receiver is mounted on a vehicle.

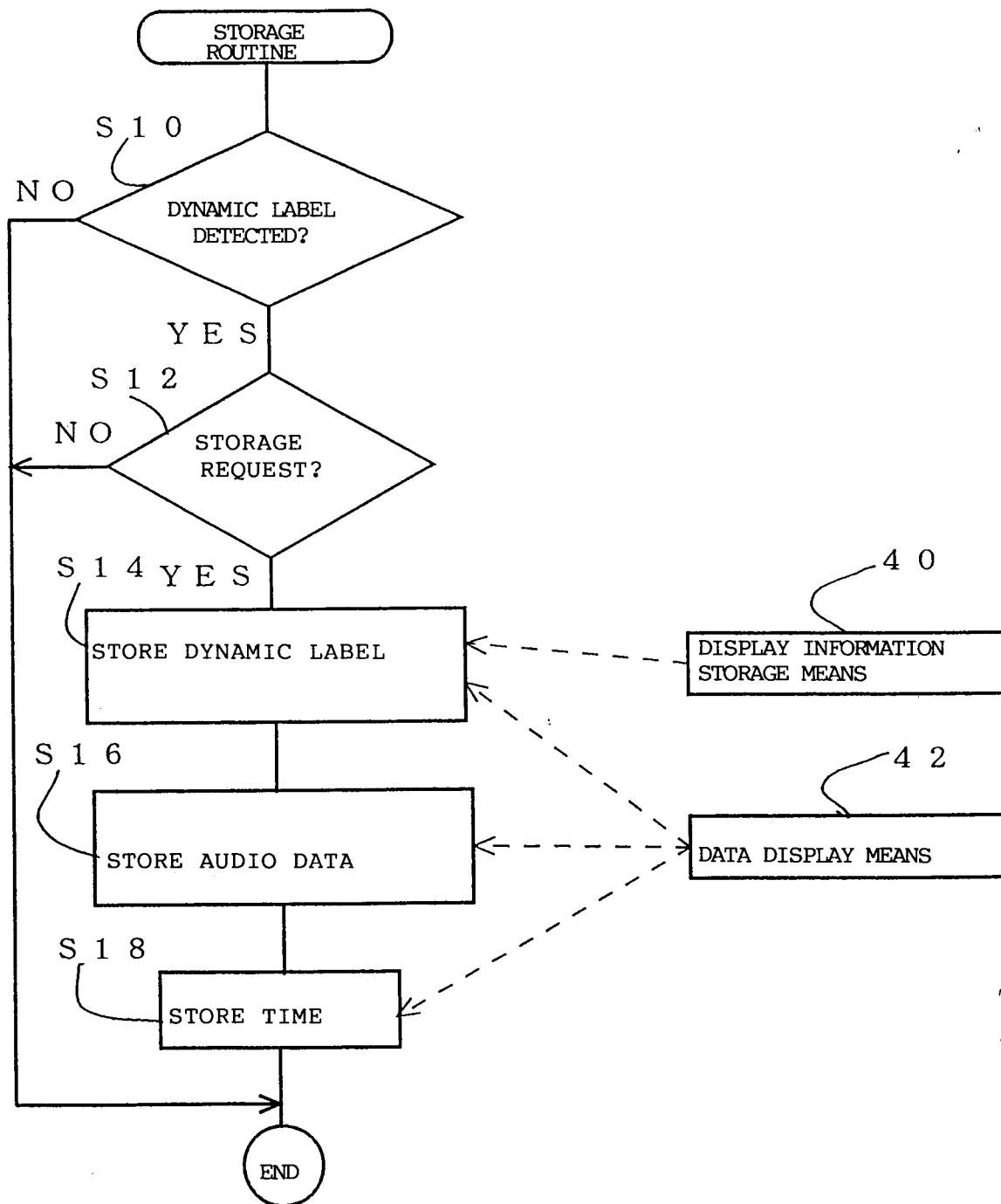


Fig. 1

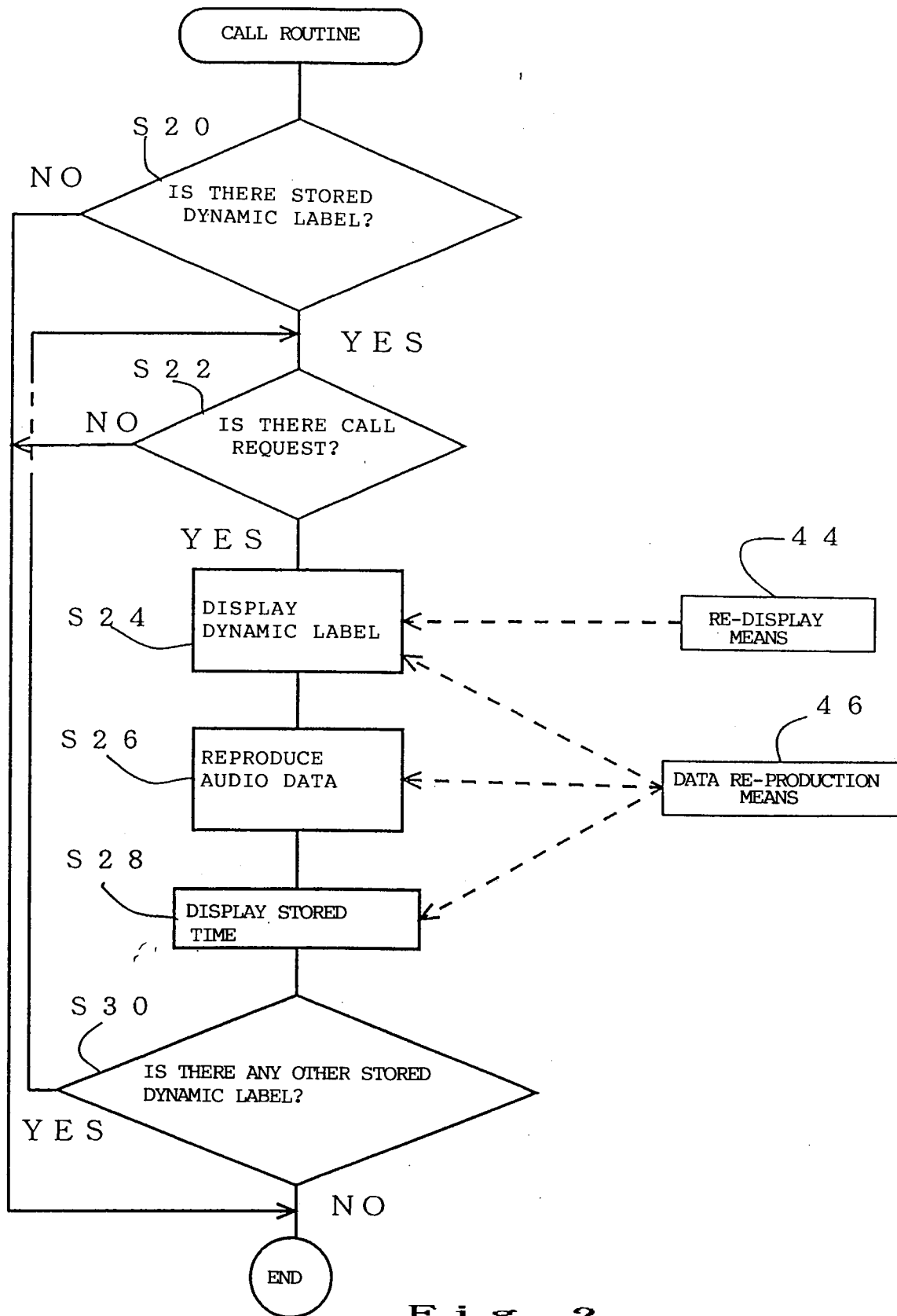


Fig. 2

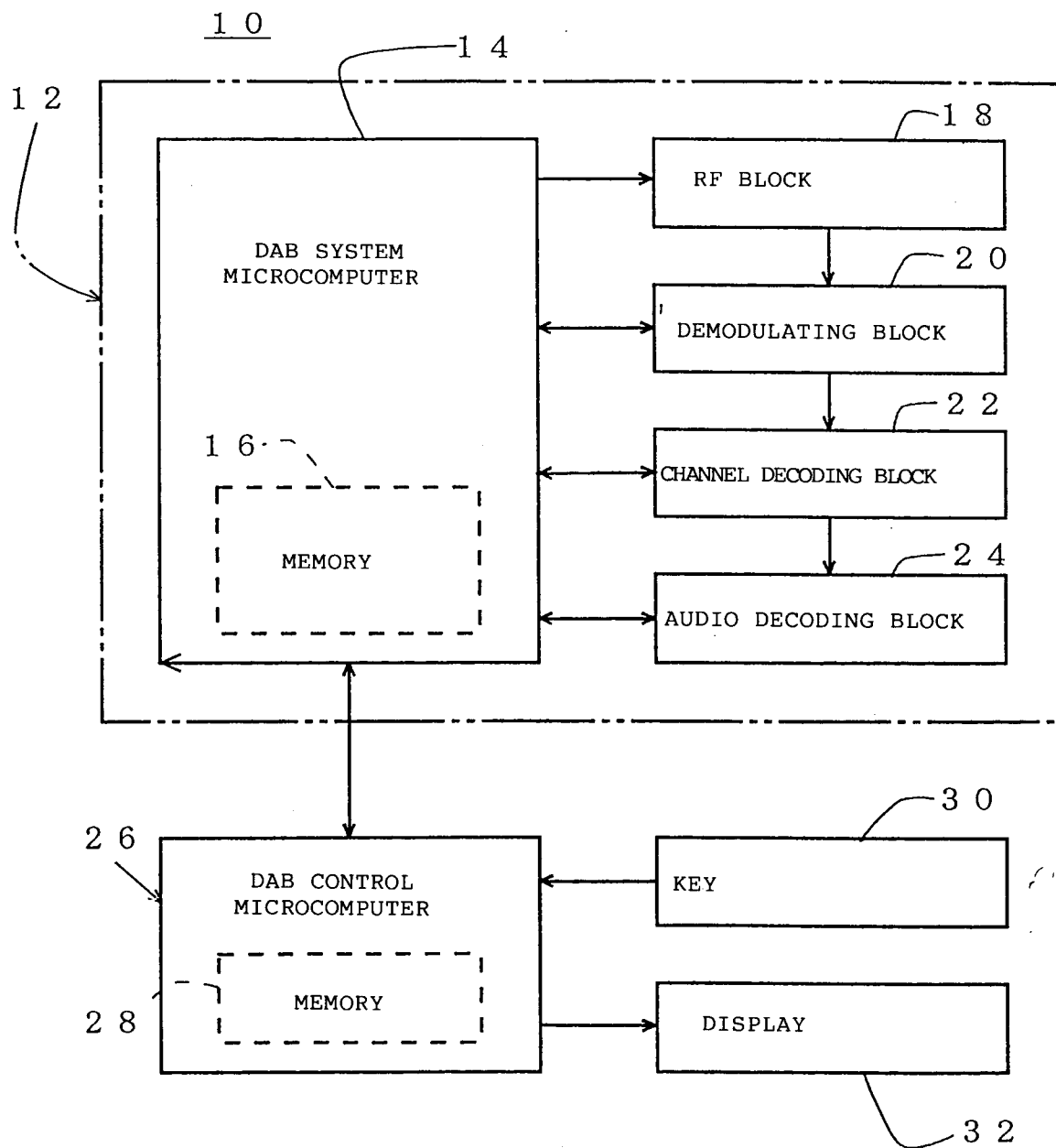
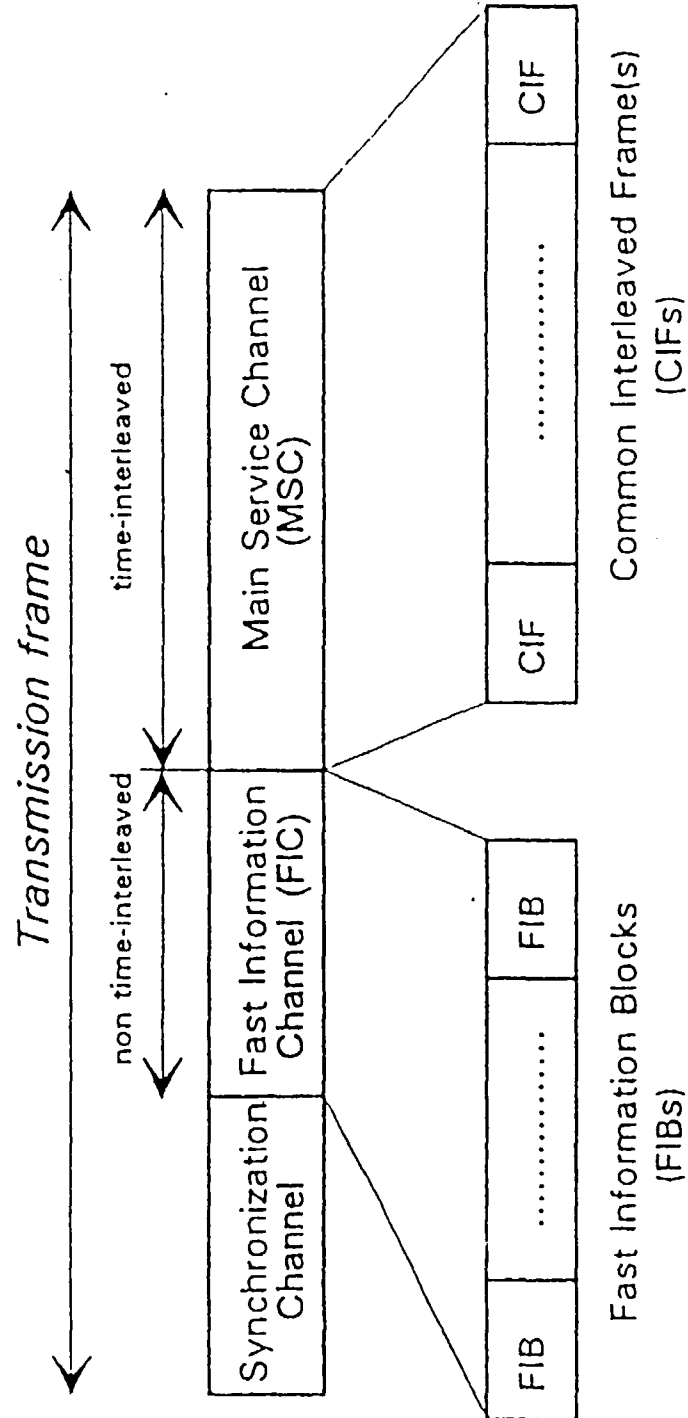


Fig. 3



F i g . 4

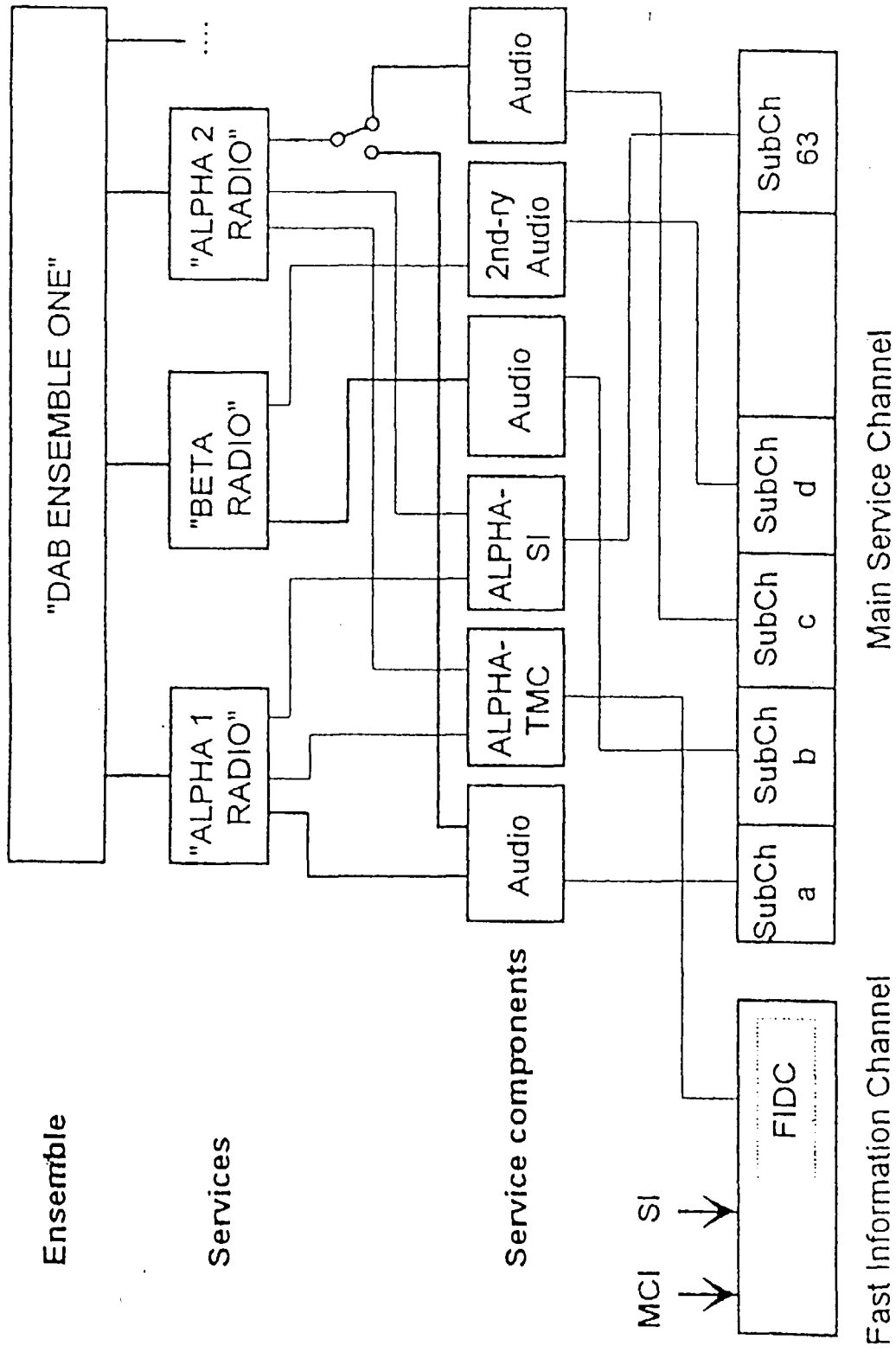
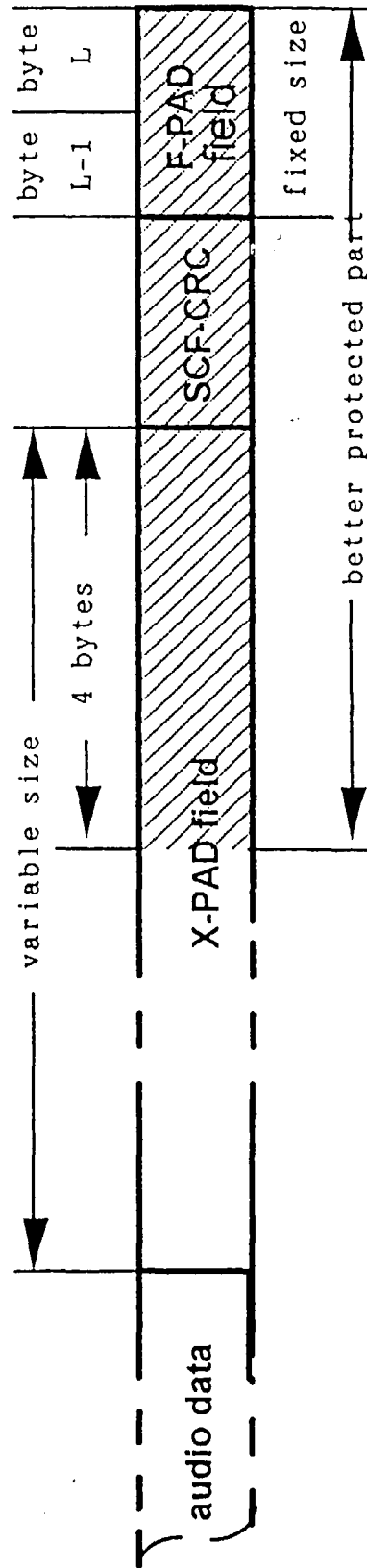
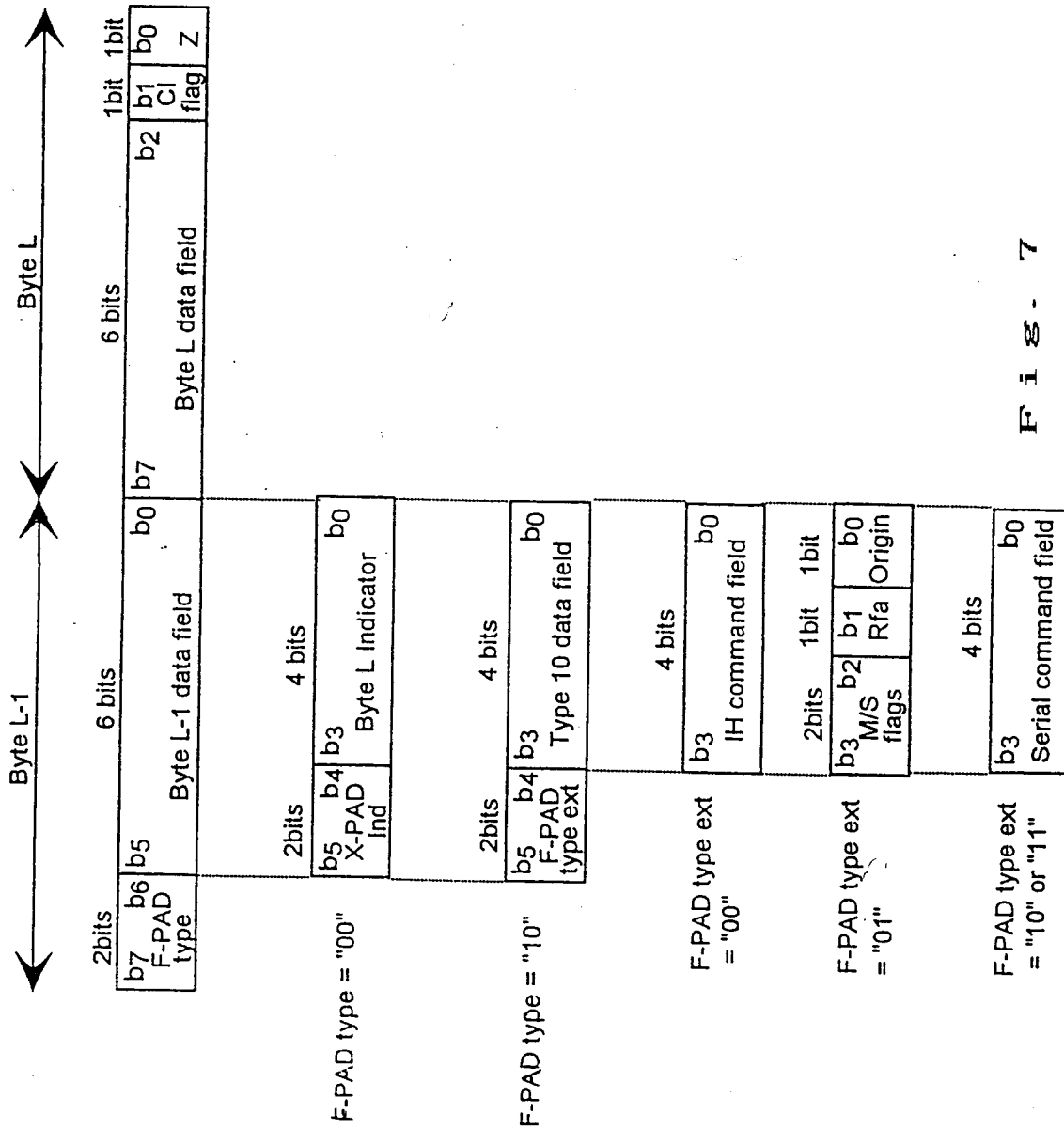


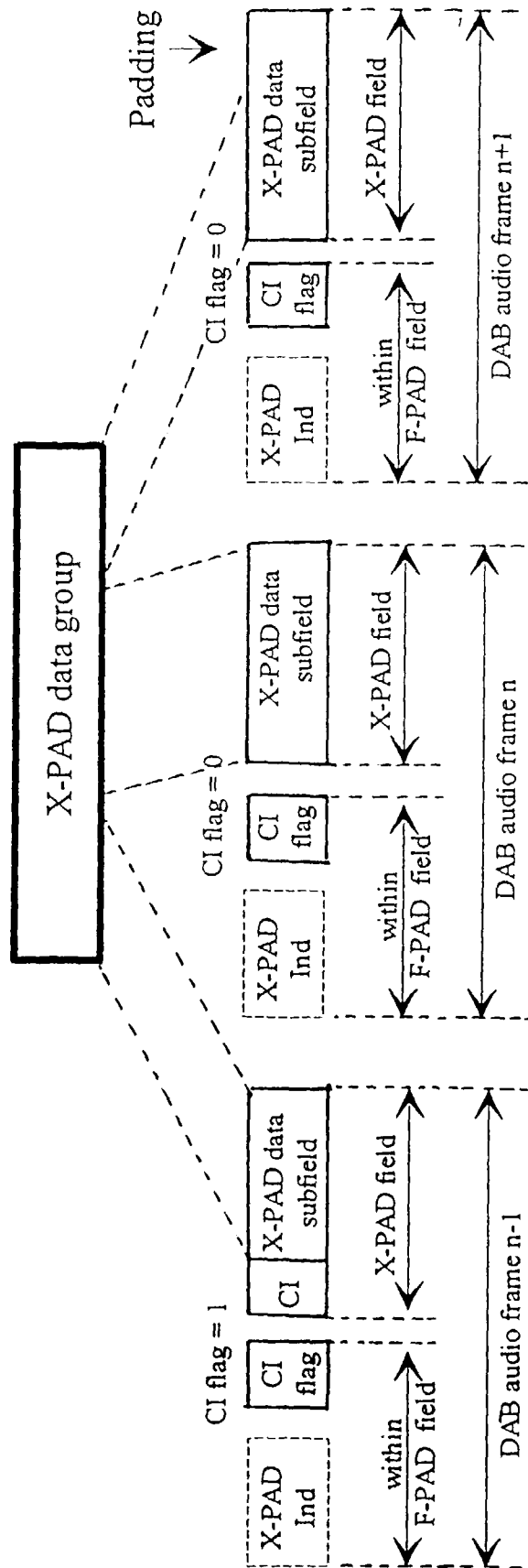
Fig - 5



F i g - 6



F i g - 7



F i g . 8

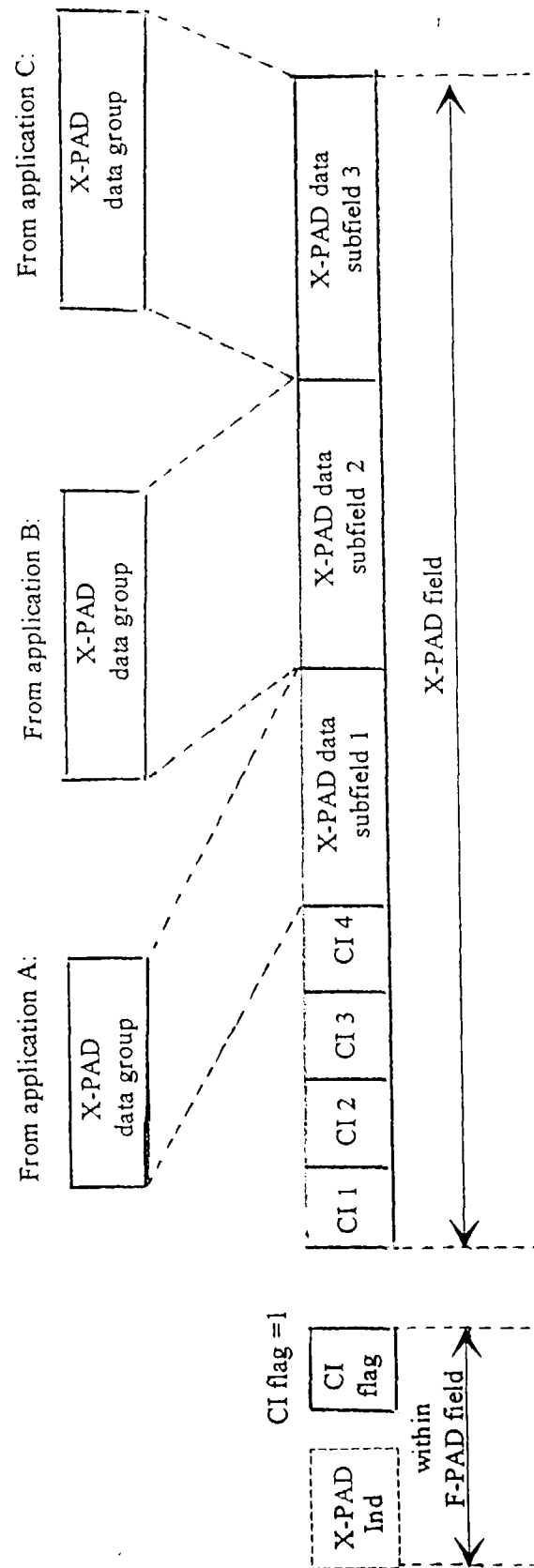


Fig. 9

