

SPECIFICATION

DIGITAL TERRESTRIAL BROADCASTING WAVE RECEIVER

TECHNICAL FIELD

The present invention relates to a digital terrestrial broadcasting wave receiver.

BACKGROUND ART

In the conventional analog terrestrial broadcasting wave, each channel has one normal frequency assigned, and thus an analog terrestrial broadcasting wave receiver applies a one-channel-one-frequency mode therein. Accordingly, when a channel is selected, a frequency assigned thereto is also selected, and thus channel selection is securely done. With a frequency drift occurred, the terrestrial broadcasting wave receiver utilizes its automatic frequency tuning to carry out channel selection correctly, although it takes longer.

In the digital terrestrial broadcasting wave, on the other hand, three frequencies including a normal frequency, an upper-offset frequency, and a lower-offset frequency are possibilities to be singularly assigned to one channel. Such frequency assignment is varied depending on an area. Therefore, each digital broadcast station determines which frequency goes to which channel.

In a transition period of terrestrial broadcasting wave from analog to digital, an analog broadcast channel may be observed adjacent to a digital broadcast channel in some areas. If this is the case, radio waves on the digital broadcast channel and those on the adjacent analog broadcast channel may interfere with each other. To avoid such interference, when assigning a frequency to the digital broadcast channel out of three possible frequencies, the digital broadcast stations need to take the adjacent analog broadcast channel into consideration.

It is now assumed that a digital broadcast station has a 21ch assigned thereto (herein, a channel having a channel number N is referred to as "Nch", the same is applicable to the below). As exemplarily shown in FIG. 19, if neither of adjacent 20ch nor 22ch is the analog broadcast channel in an area where the broadcast station belongs, the broadcast station uses the normal frequency of the 21ch as the frequency for digital broadcast. Contrarily, as exemplarily shown in FIG. 20, if the upper-adjacent 22ch is the analog broadcast channel but the 21ch being the digital broadcast channel with the normal frequency assigned (i.e., if a frequency band denoted by a dotted line in FIG. 20 is used for digital broadcast) in the area where the broadcast station belongs, the radio waves on the digital broadcast channel and those on the analog broadcast channel 22ch may interfere with each other. In such case, the broadcast station uses the lower-offset frequency of the 21ch as the frequency for digital broadcast. Further, as

shown in FIG. 21, if the lower-adjacent 20ch is the analog broadcast channel but the 21ch being the digital broadcast channel with the normal frequency assigned (i.e., if a frequency band denoted by a dotted line in FIG. 21 is used for digital broadcast), the radio waves from the digital broadcast channel and those from the analog broadcast channel 20ch may interfere with each other. Therefore, the broadcast station uses the upper-offset frequency of the 21ch as the frequency for digital broadcast.

So far, no interference in radio waves has been observed for an analog broadcast channel adjacent to the terrestrial wave digital broadcast channel.

This is the reason why the conventional digital terrestrial broadcasting wave receiver has been structured to select only one frequency for one channel. Resultantly, the conventional digital terrestrial broadcasting wave receiver may leave some channel incapably unselected.

The terrestrial broadcasting wave receiver is generally provided with a function (preset function) of searching a broadcast frequency for every digital-broadcast-receivable channel, and storing a result obtained thereby. In the case that the digital terrestrial broadcasting wave receiver is provided with such preset function, in a transition period of terrestrial broadcasting wave from analog to digital, after preset, some new digital broadcast channel may be provided, some broadcast channel may be changed from analog to digital, or some digital broadcast

channel may be changed in frequency (e.g., changed from the normal frequency to the lower-offset frequency). In such case, the digital terrestrial broadcasting wave receiver cannot receive digital broadcast from such new channel or channels subjected to the above-described changes.

Therefore, an object of the present invention is to provide a digital terrestrial broadcasting wave receiver being freed from the above-described problems occurring in the transition period of terrestrial broadcasting wave from analog to digital while receiving digital broadcast assuredly on a channel on request. In detail, an object of the present invention is to provide a digital terrestrial broadcasting wave receiver receiving digital broadcast assuredly from a channel on request while taking three possible frequencies to be singularly assigned to one channel into consideration. Another object of the present invention is to provide a digital terrestrial broadcasting wave receiver which can receive digital broadcast from, after preset for channels, a digital broadcast channel newly provided, a broadcast channel changed from analog to digital, or a digital broadcast channel changed in frequency.

DISCLOSURE OF THE INVENTION

A first aspect of the present invention is directed to a digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by

an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital broadcast channel specified by a user, the receiver comprises:

channel selection means for outputting, when the user specifies a requested channel for reception through a user's operation in a predetermined manner, channel specifying information indicating the requested channel;

channel initial data storage means for previously storing three types of frequencies including a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to each of a plurality of predetermined digital broadcast channels;

a front end part for receiving a control signal which instructs a channel selection operation with any one of the three types of frequencies assigned to the requested channel, carrying out, based on the control signal, extraction and demodulation operations with respect to the digital terrestrial wave signals received by the antenna, and generating synchronization confirmation information indicating whether or not the selection operation is completed in a normal manner; and

control means for generating the control signal according to the channel specifying information, and controlling the front end part by supplying the generated control signal to the front end part, wherein

the control means

includes single channel selection search means for

generating the control signal according to the three types of frequencies assigned to one channel in the channel initial data storage means, and searching for a broadcast frequency in actual use for digital broadcast among the three types of frequencies assigned to the one channel, based on the synchronization confirmation information obtained by supplying the generated control signal to the front end part, and

determines the broadcast frequency of the requested channel by the single channel selection search means.

In the first aspect, channel selection is carried out with consideration for three possible frequencies being previously assigned to one channel for digital broadcast. In detail, the frequency in actual use for digital broadcast is searched for among the three types of frequencies assigned to the requested channel. Therefore, digital broadcast is assuredly received on the requested channel.

According to a second aspect of the present invention, in the first aspect,

the digital terrestrial broadcasting wave receiver further comprises rewritable nonvolatile storage means for storing a frequency in use for digital broadcast for any one of the predetermined digital broadcast channels in conjunction with each of the channels, wherein

the control means

further includes storage judgement means for judging

whether or not the broadcast frequency for digital broadcast on the requested channel is stored in the nonvolatile storage means,

when the storage judgement means judges that the broadcast frequency of the requested channel is stored in the nonvolatile storage means, supplies, to the front end part, the control signal instructing the channel selection operation with the stored broadcast frequency, and

when the storage judgement means does not judge that the broadcast frequency of the requested channel is stored in the nonvolatile storage means has the single channel selection search means search for the broadcast frequency of the requested channel, supplies, to the front end part, the control signal instructing the channel selection operation with the broadcast frequency of the requested channel and stores the broadcast frequency obtained by the search into the nonvolatile storage means in conjunction with the requested channel.

In the second aspect, with the search for the broadcast frequency of the requested channel, the frequency, among the three types of frequencies assigned to the channel, in actual use for digital broadcast, i.e., the broadcast frequency of the channel, is stored into the nonvolatile storage means. Therefore, when the channel is again specified by the user as the requested channel, the front end part can start channel selection operation with the already-stored frequency as the broadcast frequency of the requested channel. In this manner, a time taken from

specification of the requested channel to completion of channel selection can be shorter. Further, similarly to the first aspect, digital broadcast can be assuredly received on the requested channel with consideration for the three possible frequencies assigned to every channel.

According to a third aspect of the present invention, in the second aspect,

after generating the control signal instructing the channel selection operation with the frequency stored in the nonvolatile storage means as the broadcast frequency of the requested channel for output to the front end part, when the channel selection operation is not completed in a normal manner, the control means supplies the control signal instructing the channel selection operation with the broadcast frequency of the requested channel by having the single channel selection search means search for the broadcast frequency of the requested channel, and updates the broadcast frequency stored in the nonvolatile storage means in conjunction with the requested channel to the broadcast frequency obtained by the search.

In the third aspect, if the front end part cannot complete its channel selection operation in a normal manner after a channel selection operation carried out with the frequency stored as the broadcast frequency of the requested channel, the broadcast frequency of the requested channel is searched for by the single channel selection search means, the channel selection operation

is carried out with the searched broadcast frequency, and then the frequency stored as the broadcast frequency of the requested channel is updated to the searched broadcast frequency. In this manner, even if some digital broadcast channel is changed in frequency, digital broadcast can be received on the channel.

A fourth aspect of the present invention is directed to a digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital broadcast channel specified by a user, the receiver comprises:

channel selection means for outputting, when the user specifies a requested channel for reception through his/her operation in a predetermined manner, channel specifying information indicating the requested channel;

every channel scan means for receiving a predetermined preset instruction, and in response thereto, sequentially outputting, on a channel basis, channel specifying information which specifies each of a plurality of predetermined digital broadcast channels;

channel initial data storage means for previously storing three types of frequencies of a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to each of the predetermined digital broadcast channels;

rewritable nonvolatile storage means for storing a

frequency in use for digital broadcast on each of the predetermined digital broadcast channels in conjunction with the channels;

a front end part receiving a control signal which instructs a channel selection operation with any one of the three types of frequencies assigned to one channel, carrying out, based on the control signal, extraction and demodulation operations with respect to the digital terrestrial wave signals received by the antenna, and generating synchronization confirmation information indicating whether or not the channel selection operation is completed in a normal manner; and

control means for controlling the front end part by generating the control signal according to the channel specifying information outputted from the channel selection means or the every channel scan means and by supplying the generated control signal to the front end part, wherein

the control means,

includes every channel selection search means for generating, when the every channel scan means receives the preset instruction, the control signal according to the three types of frequencies, stored in the channel initial data storage means, being assigned to a specified channel specified by each of the channel specifying information sequentially outputted from the every channel scan means, searching for a broadcast frequency in actual use for digital broadcast among the three types of

frequencies assigned to the specified channel, based on the synchronization confirmation information obtained by supplying the generated control signal to the front end part, and storing the broadcast frequency obtained by the search into the nonvolatile storage means in conjunction with the specified channel, and

when the channel specifying information is outputted from the channel selection means, reads the broadcast frequency stored in the nonvolatile storage means in conjunction with the requested channel, and then generates the control signal instructing the channel selection operation with the read frequency for output to the front end part.

In the fourth aspect, with a preset instruction, the broadcast frequency is searched for every predetermined channel by the every channel selection search means with consideration for three possible frequencies to be singularly assigned to one channel for digital broadcast into consideration. Therefore, every predetermined channel can be assuredly searched for the broadcast frequency thereof. Further, once the preset is carried out, as long as the predetermined channels are the digital broadcast channels, the broadcast frequencies thereof are stored in the nonvolatile storage means. Therefore, in the case that the predetermined channels are the digital-broadcast-receivable channels, once the preset is carried out, digital broadcast can be received on the requested channel by first reading the

broadcast frequency of the requested channel from the nonvolatile storage means, and then starting the front end part for channel selection.

According to a fifth aspect of the present invention, in the fourth aspect,

the control means

further includes single channel selection search means for searching for, based on the synchronization confirmation information obtained by first generating the control signal according to the three types of frequencies assigned to one channel in the channel initial data storage means and then by supplying the generated control signal to the front end part, the broadcast frequency in actual use for digital broadcast among the three types of frequencies assigned to the one channel, and

storage judgement means for judging whether or not the broadcast frequency for digital broadcast on the requested channel is stored in the nonvolatile storage means, and

when the storage judgement means judges that the broadcast frequency of the requested channel is stored in the nonvolatile storage means, supplies the control signal instructing the channel selection operation with the stored broadcast frequency to the front end part, and

when the storage judgement means does not judge that the broadcast frequency of the requested channel is stored in the nonvolatile storage means, has the single channel selection

search means search the broadcast frequency of the requested channel, supplies the control signal instructing the channel selection operation with the broadcast frequency of the requested channel to the front end part, and stores the broadcast frequency obtained by the search into the nonvolatile storage means in conjunction with the requested channel.

In the fifth aspect, when the broadcast frequency of the requested channel is not stored, the broadcast frequency is searched for by the single channel selection search means. Therefore, even if some digital broadcast channel is newly provided after preset, digital broadcast can be received thereon. Further, the broadcast frequency obtained by the search is stored in the nonvolatile storage means. In this manner, when the channel is again specified as the requested channel, the broadcast frequency is read from the nonvolatile storage means, and thus channel selection can be immediately started.

According to a sixth aspect of the present invention, in the fourth aspect,

the control means

further includes single channel selection search means for generating the control signal according to the three types of frequencies assigned to one channel in the channel initial data storage means, and searching for a broadcast frequency in actual use for digital broadcast among the three types of frequencies assigned to the one channel, based on the

synchronization confirmation information obtained by and by supplying, the generated control signal to the front end part, and

after generating the control signal instructing the channel selection operation with the frequency stored in the nonvolatile storage means as the broadcast frequency of the requested channel for output to the front end part, when the channel selection operation is not completed in a normal manner, has the single channel selection search means search for the broadcast frequency of the requested channel, supplies the control signal instructing the channel selection operation with the broadcast frequency of the requested channel to the front end part, and updates the broadcast frequency stored in the nonvolatile storage means in conjunction with the requested channel to the broadcast frequency obtained by the search.

In the sixth aspect, if the front end part cannot complete its channel selection in a normal manner after a channel selection operation carried out with the frequency stored as the broadcast frequency of the requested channel, the broadcast frequency of the requested channel is searched for by the single channel selection search means. Therefore, even if some digital broadcast channel is changed in frequency after preset, digital broadcast can be received thereon. Further, the broadcast frequency of the channel stored in the nonvolatile storage means is updated to the broadcast frequency obtained by the search. In

this manner, when the channel is again specified as the requested channel, channel selection can be immediately started by reading the broadcast frequency from the nonvolatile storage means.

According to a seventh aspect of the present invention, in the fourth aspect,

the digital terrestrial broadcasting wave receiver further comprises every channel search instruction means for providing the preset instruction to the every channel scan means in response to a user's operation.

In the seventh aspect, in the case that some digital broadcast channel is newly provided or changed in arrangement, the every channel scan means is provided with a preset instruction through operation on the every channel search instruction means. With the every channel search means, the frequency of the newly-provided or arrangement-changed digital broadcast channel is stored into the nonvolatile storage means in conjunction with each channel. In this manner, even if some digital broadcast channel is newly provided or changed in arrangement, digital broadcast can be received thereon.

According to an eighth aspect of the present invention, in the fourth aspect,

the digital terrestrial broadcasting wave receiver further comprises timer means for outputting a signal providing the preset instruction to the every channel scan means at a predetermined time interval.

In the eighth aspect, the timer means outputs a signal providing the preset instruction to the every channel scan means at a predetermined time interval. Therefore, even if some digital broadcast channel is newly provided or changed in arrangement, digital broadcast can be received thereon at least after a predetermined period.

According to a ninth aspect of the present invention, in the fourth aspect,

the digital terrestrial broadcasting wave receiver further comprises reception means for receiving information transmitted through a predetermined transmission path, and when the received information indicates any digital broadcast channel being newly provided or changed in arrangement, providing the preset instruction to the every channel scan means .

In the ninth aspect, when the reception means receives information indicating that some digital broadcast channel is newly provided or changed in arrangement, the every channel scan means is provided with the preset instruction. Therefore, even if some digital broadcast channel is newly provided or changed in arrangement, digital broadcast can be received thereon.

According to a tenth aspect of the present invention, in the fourth aspect,

the digital terrestrial broadcasting wave receiver further comprises reception means for receiving information transmitted through a predetermined transmission path, and when the received

information includes identifying information of the digital broadcast channel in current use, outputting the identifying information, and

the control means

further includes single channel selection search means for generating the control signal according to the three types of frequencies assigned to one channel in the channel initial data storage means, and searching for a broadcast frequency in actual use for digital broadcast among the three types of frequencies assigned to the one channel based on the synchronization confirmation information obtained by and by supplying the generated control signal to the front end part , and

when the identification information is outputted from the reception means, determines the broadcast frequency of the channel identified by the identifying information by the single channel selection search means, and then stores the determined broadcast frequency into the nonvolatile storage means in conjunction with the channel identified by the identifying information.

In the tenth aspect, when the information received by the reception means includes specifying information about the digital broadcast channel in current use, the broadcast frequency of the channel is searched for by the single channel selection search means, and the result obtained thereby is stored. In this manner,

even if some digital broadcast channel is newly provided or changed in arrangement, after the above information including the identifying information about these channels is received, digital broadcast can be received thereon .

According to a eleventh aspect of the present invention, in the fourth aspect,

the digital terrestrial broadcasting wave receiver further comprises reception means for receiving information transmitted through a predetermined transmission path, and when the received information includes the identifying information and the broadcast frequency of the digital broadcast channel in current use, outputting the identifying information and the broadcast frequency, wherein

when the identifying information and the broadcast frequency are outputted from the reception means, the control means stores the broadcast frequency outputted from the reception means into the nonvolatile storage means in conjunction with the channel identified by the identifying information.

In the eleventh aspect, when the information received by the reception means includes the specifying information and the broadcast frequency of the digital broadcast channel in current use, the broadcast frequency is stored in conjunction with the channel. In this manner, even if some digital broadcast channel is newly provided or changed in arrangement, after the above information including the identifying information and the

broadcast frequency of the channel is received, digital broadcast can be received thereon .

According to a twelfth aspect of the present invention, in the first or fourth aspect,

the digital terrestrial wave signals are OFDM modulated signals, and

the front end part

includes OFDM demodulation means for demodulating the digital terrestrial wave signals, and

generates an OFDM synchronizing signal as the synchronization confirmation information when the OFDM demodulation means correctly demodulates the digital terrestrial wave signals.

According to a thirteenth aspect of the present invention, in the first or fourth aspect,

the digital terrestrial wave signals are OFDM modulated signals, and

the front end part includes

OFDM demodulation means for demodulating the digital terrestrial wave signals, and

voltage controlled oscillating means for generating a system clock for the OFDM demodulation means, and

the synchronization confirmation information is a signal indicating a control voltage to be supplied to the voltage controlled oscillating means.

According to a fourteenth aspect of the present invention,
in the first or fourth aspect,

the digital terrestrial wave signals are OFDM modulated signals,
and

the front end part includes

OFDM demodulation means for demodulating the digital
terrestrial wave signals, and

error correction means for correcting an error
included in a signal, if any, obtained by the demodulation carried
out by the OFDM demodulation means with respect to the digital
terrestrial wave signals, and

the synchronization confirmation information is BER
measurement information generated by the error correction means.

According to a fifteenth aspect of the present invention,
in the first aspect,

the single channel selection search means searches for the
normal frequency with a higher priority among the three types of
frequencies.

According to a sixteenth aspect of the present invention,
in the fourth aspect,

the every channel selection search means searches for the
normal frequency with a higher priority among the three types of
frequencies.

According to a seventeenth aspect of the present invention,
in the fifth or sixth aspect,

the every channel selection search means searches for the normal frequency with a higher priority among the three types of frequencies, and

the single channel selection search means searches the normal frequency with a higher priority among the three types of frequencies.

In the fifteenth, sixteenth, and seventeenth aspects, when the single channel selection means and the every channel selection means perform search, the normal frequency has a higher priority, for the search, among the three types of frequencies assigned to one channel. In detail, the front end part carries out the channel selection first with the normal frequency generally having a higher possibility for use than the upper-offset frequency or the lower-offset frequency. Therefore, according to the fifteenth, sixteenth, and seventeenth aspects, a time taken from specification of the requested channel to completion of channel selection or a time for preset can be averagely shorter.

According to an eighteenth aspect of the present invention, in the first, fifth, or sixth aspect,

the single channel selection search means includes

first synchronization confirmation means for judging, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a first frequency included in the three types of frequencies assigned to the one

channel, whether or not the channel selection operation with the first frequency is completed in a normal manner, and

second synchronization confirmation means for judging, when the channel selection operation with the first frequency is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a second frequency included in the three types of frequencies assigned to the one channel but not the first frequency, whether or not the channel selection operation with the second frequency is completed in a normal manner, wherein

when the channel selection operation with the first frequency is judged as being completed in a normal manner, the first frequency is determined as the broadcast frequency of the one channel, when the channel selection operation with the second frequency is judged as being completed in a normal manner, the second frequency is determined as the broadcast frequency of the one channel, and when neither of the channel selection operations with the first nor second frequencies is judged as being completed in a normal manner, a third frequency included in the three types of frequencies assigned to the one channel but not the first or the second frequency is determined as the broadcast frequency of the one channel.

According to a nineteenth aspect of the present invention, in the first, fifth, or sixth aspect,

the single channel selection search means includes:

first synchronization confirmation means for judging, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a first frequency which is any one of the three types of frequencies assigned to the one channel, whether or not the channel selection operation with the first frequency is completed in a normal manner;

second synchronization confirmation means for judging, when the channel selection operation with the first frequency is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a second frequency included in the three types of frequencies assigned to the one channel but not the first frequency, whether or not the channel selection operation with the second frequency is completed in a normal manner; and

third synchronization confirmation means for judging, when neither of the channel selection operations with the first nor second frequencies is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a third frequency included in the three types of frequencies assigned to the one channel but not the first or second frequency, whether or not the

channel selection operation with the third frequency is completed in a normal manner, wherein

when the channel selection operation with the first frequency is judged as being completed in a normal manner, the first frequency is determined as the broadcast frequency of the one channel, when the channel selection operation with the second frequency is judged as being completed in a normal manner, the second frequency is determined as the broadcast frequency of the one channel, and when the channel selection operation with the third frequency is judged as being completed in a normal manner, the third frequency is determined as the broadcast frequency of the one channel.

According to a twentieth aspect of the present invention, in the fourth, fifth, or sixth aspect,

the every channel selection search means includes:

first synchronization confirmation means for judging, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a first frequency which is any one of the three types of frequencies assigned to the specified channel, whether or not the channel selection operation with the first frequency is completed in a normal manner;

second synchronization confirmation means for judging, when the channel selection operation with the first frequency is

not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a second frequency included in the three types of frequencies assigned to the specified channel but not the first frequency, whether or not the channel selection operation with the second frequency is completed in a normal manner; and

third synchronization confirmation means for judging, when neither of the channel selection operations with the first nor second frequencies is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to the front end part, the control signal instructing a channel selection operation with a third frequency included in the three types of frequencies assigned to the specified channel but not the first or second frequency, whether or not the channel selection operation with the third frequency is completed in a normal manner, wherein

when the channel selection operation with the first frequency is judged as being completed in a normal manner, the first frequency is stored into the nonvolatile storage means as the broadcast frequency of the specified channel, when the channel selection operation with the second frequency is judged as being completed in a normal manner, the second frequency is stored into the nonvolatile storage means as the broadcast frequency of the

specified channel, and when the channel selection operation with the third frequency is judged as being completed in a normal manner, the third frequency is stored into the nonvolatile storage means as the broadcast frequency of the specified channel.

A twenty-first aspect of the present invention is directed to a reception channel selection method to be applied to a digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital broadcast channel specified by a user, the method comprises:

a channel initial data storing step of previously storing three types of frequencies including a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to every predetermined digital broadcast channel;

a channel specifying step of outputting, when the user specifies a requested channel for reception through a user's operation in a predetermined manner, channel specifying information indicating the requested channel;

a control signal generating step of generating, based on the three types of frequencies assigned to the requested channel in the channel initial data storing step, a control signal which instructs a channel selection operation with any one of the three types of frequencies assigned to the requested channel;

a synchronization confirmation information generating step

of carrying out, based on the generated control signal, extraction and demodulation operations with respect to the digital terrestrial wave signals received by the antenna, and generating synchronization confirmation information indicating whether or not the channel selection operation including the extraction and demodulation operations is completed in a normal manner; and

a search step of searching for, based on the synchronization confirmation information, a broadcast frequency in actual use for digital broadcast among the three types of frequencies assigned to the requested channel.

A twenty-second aspect of the present invention is directed to reception channel selection method to be applied to a digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital broadcast channel specified by a user, the method comprises:

a channel initial data storing step of previously storing three types of frequencies including a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to every predetermined digital broadcast channel;

an every channel scan step of receiving a predetermined preset instruction, and in response thereto, sequentially outputting, on a channel basis, channel specifying information which specifies each of a plurality of predetermined digital

broadcast channels;

a first control signal generating step of generating, on reception of the preset instruction, based on the previously stored three types of frequencies assigned to a specified channel specified by each of the channel specifying information sequentially outputted, a control signal instructing a channel selection operation with any one of the three types of frequencies;

a synchronization confirmation information generating step of carrying out, based on the control signal generated in the first control signal generating step, extraction and demodulation operations with respect to the digital terrestrial wave signals received by the antenna, and generating synchronization confirmation information indicating whether or not the channel selection operation including the extraction and demodulation operations are completed in a normal manner;

a search step of searching for, based on the synchronization confirmation information, a broadcast frequency in actual use for digital broadcast among the three types of frequencies assigned to the specified channel;

a storage step of storing the broadcast frequency obtained in the search step into predetermined nonvolatile storage means in conjunction with the specified channel;

a channel specifying step of outputting channel specifying information indicating a requested channel in response to the

user's requested channel for reception through the user's operation in a predetermined manner;

a reading step of reading the broadcast frequency stored in the nonvolatile storage means in conjunction with the requested channel when the channel specifying information is outputted in the channel specifying step;

a second control signal generating step of generating a control signal instructing a channel selection with the frequency read from the nonvolatile storage means; and

a channel selection operation step of carrying out extraction and demodulation operations with respect to the digital terrestrial wave signals received by the antenna based on the control signal generated in the second control signal generating step.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver according to a first embodiment of the present invention;

FIG. 2 is a block diagram showing a first exemplary structure of a front end part provided in the digital terrestrial broadcasting wave receiver of the first embodiment;

FIG. 3 is a block diagram showing a second exemplary structure of the front end part provided in the digital terrestrial broadcasting wave receiver of the first embodiment;

FIG. 4 is a block diagram showing a third exemplary structure of the front end part provided in the digital terrestrial broadcasting wave receiver according to the first embodiment;

FIG. 5 is a flowchart showing how the digital terrestrial broadcasting wave receiver of the first embodiment carries out channel selection;

FIG. 6 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver according to a second embodiment of the present invention;

FIG. 7 is a flowchart showing how the digital terrestrial broadcasting wave receiver of the second embodiment carries out channel selection;

FIG. 8 is a flowchart showing a procedure for a single channel selection search in the digital terrestrial broadcasting wave receiver of the second embodiment;

FIG. 9 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver according to a third embodiment of the present invention;

FIG. 10 is an exemplary flowchart showing how the digital terrestrial broadcasting wave receiver of the third embodiment carries out channel selection;

FIG. 11 is a flowchart showing a procedure for every channel selection search in the digital terrestrial broadcasting wave receiver of the third embodiment;

FIG. 12 is a block diagram showing the structure of a digital

terrestrial broadcasting wave receiver according to a fourth embodiment of the present invention;

FIG. 13 is a flowchart showing a procedure for a preset carried out in the digital terrestrial broadcasting wave receiver of the fourth embodiment;

FIG. 14 is a flowchart showing a first exemplary processing carried out to deal with an addition of a new digital broadcast channel or a change of channel arrangement in the digital terrestrial broadcasting wave receiver of the fourth embodiment;

FIG. 15 is a flowchart showing a second exemplary processing carried out to deal with an addition of a new digital broadcast channel or a change of channel arrangement in the digital terrestrial broadcasting wave receiver of the fourth embodiment;

FIG. 16 is a flowchart showing a third exemplary processing carried out to deal with an addition of a new digital broadcast channel or a change of channel arrangement in the digital terrestrial broadcasting wave receiver of the fourth embodiment;

FIG. 17 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver according to a fifth embodiment of the present invention;

FIG. 18 is a flowchart showing an exemplary processing carried out to deal with an addition of a new digital broadcast channel or a change of channel arrangement in the digital terrestrial broadcasting wave receiver of the fifth embodiment;

FIG. 19 is a diagram showing frequency assignment for

digital broadcast in the case that an adjacent channel is not an analog broadcast channel;

FIG. 20 is a diagram showing frequency assignment for digital broadcast in the case that an upper adjacent channel is the analog broadcast channel; and

FIG. 21 is a diagram showing frequency assignment for digital broadcast in the case that a lower adjacent channel is the analog broadcast channel.

BEST MODE FOR CARRYING OUT THE INVENTION

In order to describe the present invention to a greater detail, the description is made by referring to the accompanying drawings.

<1. First Embodiment>

<1.1 Structure of First Embodiment>

Depicted in FIG. 1 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver 100 according to a first embodiment of the present invention. The digital terrestrial broadcasting wave receiver 100 is provided with a terrestrial broadcasting wave antenna 11, a front end part 13, an MPEG decoding part 14, a control microcomputer 15, a channel selection part 16, and a channel initial data storage means 17. Thereamong, the control microcomputer 15 is the one which controls other constituents in the digital terrestrial broadcasting wave receiver 100, and operates in a later-described manner by carrying



out a predetermined program stored in internally-provided memory (this is applicable also to other embodiments). In other words, the control microcomputer 15 is a constituent mainly performing later-described channel selection, for example, and is operationally realized by software.

The terrestrial broadcasting wave antenna 11 receives an OFDM (Orthogonal Frequency Division Multiplex) modulated signal, which is a digital terrestrial wave signal transmitted from a broadcast station. The received OFDM signal is forwarded to the front end part 13. The channel selection part 16 responds to a user's operation, and outputs a signal specifying a user's requested channel (hereinafter, referred to as "channel specifying signal") Sch. The channel specifying signal Sch is provided to the control microcomputer 15. The channel initial data storage part 17 prestores data, as initial data, which indicates three types of frequencies including the normal frequency, the upper-offset frequency, and the lower-offset frequency for each of the channels selectable by the channel selection part 16. Based on the channel specifying signal Sch, the control microcomputer 15 reads, from the channel initial data storage part 17, at least one data (hereinafter, "requested channel frequency data") indicating the normal frequency, the upper-offset frequency, or the lower-offset frequency for the user's requested channel (referred also simply as "requested channel"). Thereafter, the control microcomputer 15 controls

the front end part 13 based both on the requested channel frequency data and a later-described signal provided by the front end part 13 for synchronization confirmation. Under the control of the control microcomputer 15, the front end part 13 subjects the OFDM modulated signal provided by the terrestrial broadcasting wave antenna 11 to digital demodulation so as to correct any error generated in a transmission path (hereinafter, such operation is referred to as "channel selection operation by the front end part 13", details of which are later described). In this manner, a transport stream signal on the user's requested channel is obtained, and then is forwarded to the MPEG decoding part 14. This transport stream signal is image data encoded under the MPEG scheme. The MPEG decoding part 14 generates decoded image data (data of MPEG image) from the transport stream signal for external output.

<1.2 Structure of Front End Part and Channel Selection Operation Thereby>

Depicted in FIG. 2 is a block diagram showing a first exemplary structure of the front end part 13. The front end part 13 in such structure is provided with an AGC circuit 31, a channel selection filter 32, a mixer 33, a PLL synchronization circuit 34, an IF+SAW filter 36, an AGC control part 37, an AD converter 38, an oscillator 35, a VCXO control part 311, an OFDM demodulation part 39, and an error correction part 310.

The front end part 13 in such structure is supplied with

control signals Sc1 and Sc2 on the basis of the requested channel frequency data from the control microcomputer 15. In response to the control signal Sc2, the PLL synchronization circuit 34 operates, and then channel selection is started. The OFDM modulated signal provided from the terrestrial broadcasting wave antenna 11 to the front end part 13 is controlled first by the AGC circuit 31 so as to be in a power level appropriate for a digital demodulation system in stages subsequent thereto. To be specific, the AGC control part 37 generates a control signal based on an output from the IF+SAW filter which is later-described, and based thereon, the AGC circuit 31 controls a gain thereof. In this manner, the OFDM modulated signal is controlled to be in a power level appropriate for the subsequent digital demodulation system. Thereafter, the OFDM signal is forwarded to the channel election filter 32.

The selection filter 32 functions, based on the control signal Sc1 from the control microcomputer 15, as a band-pass filter passing only a signal in a frequency band corresponding to the requested channel frequency data. Therefore, with the channel selection filter 32, a signal (hereinafter, referred to as "requested signal") having a frequency (hereinafter, referred to as "channel selection frequency") indicated by the requested channel frequency data is extracted from the above OFDM modulated signal. The extracted requested signal is mixed with an oscillation signal, which is generated by the PLL synchronization

circuit and is in the channel selection frequency, and then down-converted into a frequency band of an IF signal (intermediate frequency signal). The down-converted requested signal is wave-shaped by going through the IF+SAW filter 36, converted from analog to digital in the AD converter 38, and then outputted to the subsequent OFDM demodulation part 39.

The OFDM demodulation part 39 operates on a system clock Sck supplied from the oscillator 35. The oscillator 35 is a voltage controlled crystal oscillator (VCXO), and a control voltage Vc thereof is generated by the VCXO control part 311 based on a signal outputted from the OFDM demodulation part 39. When the requested channel is correctly selected, the VCXO control part 311 and the oscillator 35 generating the system clock Sck to be provided to the OFDM demodulation part 38 operate in a normal manner, and thus the OFDM demodulation part 39 can correctly carry out digital demodulation. Accordingly, an error generated in the transmission path, if any, can be corrected by the error correction part 310. The error-corrected signal is forwarded to the MPEG decoding part 14 as the transport stream signal on the requested channel.

When the front end part 13 operates in the above-described normal manner, the OFDM demodulation part 39 outputs an OFDM synchronizing signal Ssync. The OFDM synchronizing signal Ssync is forwarded to the control microcomputer 15 as information for synchronization confirmation. With the OFDM synchronizing

signal Ssync, the control microcomputer 15 judges that synchronization has been confirmed, i.e., the front end part 13 has normally completed its channel selection operation. If the requested channel is not correctly selected, the OFDM synchronizing signal Ssync is not forwarded to the control microcomputer 15. Consequently, the control microcomputer 15 judges that synchronization is not yet confirmed, i.e., the front end part 13 does not yet complete its channel selection operation.

Depicted in FIG. 3 is a block diagram showing a second exemplary structure of the front end part 13. The front end part 13 in such structure forwards a signal (hereinafter, referred to as "control voltage signal") Svc to the control microcomputer 15 as information for synchronization confirmation. The signal Svc indicates the control voltage Vc of the oscillator 35 which supplies the system clock Sck to the OFDM demodulation part 39. This is the difference from the first exemplary structure in which the OFDM synchronizing signal Ssync is forwarded to the control microcomputer 15 as information for synchronization confirmation. Other than that, the second exemplary structure is similar to the first, thus the same components share the same reference numerals, and are not described again.

In the front end part 13 in the second exemplary structure, when the requested channel is correctly selected on the basis of the control signals Sc1 and Sc2 (i.e., information corresponding to the requested channel frequency) provided by the control

microcomputer 15, the VCXO control part 311 which generates the system clock Sck to be provided to the OFDM demodulation part 38 operates in an appropriate range, and thus the control voltage Vc of the oscillator 35 does not vary. Therefore, in this exemplary structure, as described above, the control voltage signal Svc indicating the control voltage Vc is forwarded to the control microcomputer 15 as information for synchronization confirmation. Based on this control voltage signal Svc, the control microcomputer 15 checks whether or not the control voltage Vc varies (to be specific, regards as not varying if the variation of the control voltage Vc stays for a predetermined duration of time within a predetermined range). If the control voltage Vc is regarded as not varying, the control microcomputer 15 judges that synchronization has been confirmed, i.e., the front end part 13 has normally completed its channel selection operation. If the control voltage Vc is regarded as varying, on the other hand, the control microcomputer 15 judges that synchronization is not yet confirmed, i.e., the front end part 13 does not yet complete its channel selection operation.

Depicted in FIG. 4 is a block diagram showing a third exemplary structure of the front end part 13. The front end part 13 in this structure forwards, to the control microcomputer 15 as information for synchronization confirmation, a signal indicating BER (Bit Error Rate) measurement information DBER obtained by the error correction part 310. This is the difference

from the first exemplary structure in which the OFDM synchronizing signal Ssync is forwarded to the control microcomputer 15 as information for synchronization confirmation. Other than that, the third exemplary structure is similar to the first, thus the same components share the same reference numerals, and are not described again.

In the front end part 13 in the third exemplary structure, when the requested channel is correctly selected on the basis of the control signals Sc1 and Sc2 (i.e., information corresponding to the requested channel frequency) provided by the control microcomputer 15, a bit error rate (BER) measured by the error correction part 310 becomes "0". Therefore, in this exemplary structure, as described above, the signal indicating the BER measurement information DBER is forwarded to the control microcomputer 15 as information for synchronization confirmation. Based on the BER measurement information DBER, when $BER = 0$, the control microcomputer 15 judges that synchronization has been confirmed, i.e., the front end part 13 has normally completed its channel selection operation. When $BER \neq 0$, on the other hand, the control microcomputer 15 judges that synchronization is not yet confirmed, i.e., the front end part 13 does not yet complete its channel selection operation.

Herein, in the third exemplary structure, the value of BER is stored in a predetermined register provided in the error correction part 310. Further, as already described, the control

microcomputer 15 carrying out channel selection is operationally realized by software. Accordingly, in a respect that synchronization is confirmable by referring to the predetermined register, the third exemplary structure shows a better match for channel selection mainly realized by software.

<1.3 Channel Selection in First Embodiment>

Next, with reference to FIG. 5, it is described how the digital terrestrial broadcasting wave receiver of the first embodiment carries out channel selection. As described above, although synchronization confirmation is varied in means depending on the structure of the front end part 13, any exemplary structure from first to third in the foregoing may basically lead to the same manner for channel selection described below (the same is applicable to channel selection in other embodiments).

After the user operates the channel selection part 16 and specifies a channel (requested channel) for reception, the channel specifying signal Sch is provided, as information specifying the requested channel, from the channel selection part 16 to the control microcomputer 15 (step S100). With the channel specifying signal Sch, the control microcomputer 15 operates as follows: first reads a normal frequency Fn of the requested channel indicated by the channel specifying signal Sch from the channel initial data storage part 17 (step S102); secondly generates the control signals Sc1 and Sc2 on the basis of the normal frequency Fn, and then supplies the generated control signals Sc1

and Sc2 to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the normal frequency F_n (step S104); and lastly receives the information for synchronization confirmation (OFDM synchronizing signal Ssync, the control voltage signal Svc, or the signal indicating the BER measurement information DBER) from the front end part 13, and based thereon, judges whether or not synchronization has been confirmed in the above-described manner (step S106). If synchronization is confirmed through the judgement, the control microcomputer 15 ends its channel selection.

If synchronization is not judged as being confirmed in step S106, the control microcomputer 15 operates as follows: first reads an upper-offset frequency F_u of the above requested channel from the channel initial data storage part 17 (step S108); secondly generates the control signals Sc1 and Sc2 on the basis of the upper-offset frequency F_u , and then supplies the generated control signals Sc1 and Sc2 to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the upper-offset frequency F_u (step S110); and lastly receives the information for synchronization confirmation (OFDM synchronizing signal Ssync, the control voltage signal Svc, or the signal indicating the BER measurement information DBER) from the front end part 13, and based thereon, judges whether or not synchronization has been confirmed in the above-described manner (step S112). If synchronization is confirmed through the

judgement, the control microcomputer 15 ends its channel selection.

If synchronization is not judged as being confirmed in step S112, the control microcomputer 15 operates as follows: first reads a lower-offset frequency F_d of the above requested channel from the channel initial data storage part 17 (step S114); secondly generates the control signals $Sc1$ and $Sc2$ on the basis of the lower-offset frequency F_d , and then supplies the generated control signals $Sc1$ and $Sc2$ to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the lower-offset frequency F_d (step S116). If the requested channel is a digital broadcast channel, the control microcomputer 15 now ends its channel selection. As a result, the transport stream signal of the requested channel is outputted from the front end part 13, and then decoded by the MPEG decoding part 14.

Also in the case that synchronization is confirmed either in step S106 or S112, the transport stream signal of the requested channel is outputted from the front end part 13, and then decoded by the MPEG decoding part 14.

Herein, in the above-described procedure for channel selection in FIG. 5, with the requested channel specified, its channel selection is first carried out with the normal frequency of the requested channel. If synchronization is not confirmed thereby, then the upper-offset frequency of the requested channel is used for its channel selection. If synchronization is not yet

confirmed thereby, the lower-offset frequency of the requested channel is used for channel selection. In other words, in the above procedure for channel selection, priorities are set for searching the broadcast frequency of the requested channel in such order as normal frequency→upper-offset frequency→lower-offset frequency. In the present invention, however, the order is not restrictive and may be in order of normal frequency→lower-offset frequency→upper-offset frequency, or in some other orders for searching the broadcast frequency. In the case that the channel adjoining to the requested channel is not the analog broadcast channel, the requested channel is usually assigned the normal frequency for digital broadcast. Accordingly, the normal frequency generally has a higher possibility for use than the upper-offset frequency or the lower-offset frequency. Therefore, it is preferable to set the highest priority to the normal frequency among the three possible frequencies assigned to the requested channel. That is, for the search of the broadcast frequency for the requested channel, it is preferable to carry out channel selection firstly with the normal frequency. In this manner, a time taken for channel selection is averagely reduced.

<1.4 Effects of First Embodiment>

As described in the foregoing, according to the first embodiment, channel selection is carried out with consideration for three possible frequencies being previously assigned to one channel for digital broadcast (see FIG. 5), whereby digital

broadcast is assuredly received on the requested channel. In detail, even if the requested channel is not assigned, as the frequency for digital broadcast, the normal frequency but the upper-offset frequency or the lower-offset frequency, digital broadcast can be assuredly received thereon.

<2. Second Embodiment>

<2.1 Structure of Second Embodiment>

Depicted in FIG. 6 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver 2000 according to a second embodiment of the present invention. The digital terrestrial broadcasting wave receiver 200 is provided with a channel data nonvolatile storage part 18. In this respect, the digital terrestrial broadcasting wave receiver 200 differs from the digital terrestrial broadcasting wave receiver 100 of the first embodiment depicted in FIG. 1. The channel data nonvolatile storage part 18 is implemented by nonvolatile memory, and is used to store a frequency obtained by searching for the digital broadcast frequency for the requested channel. Constituents other than the channel data nonvolatile storage part 18 herein are the same as those in the first embodiment, thus are under the same reference numerals and not described again.

<2.2 Channel Selection in Second Embodiment>

By referring to FIGS. 7 and 8, it is described next below how the digital terrestrial broadcasting wave receiver of the second embodiment carries out channel selection.

After the user operates the channel selection part 16 and specifies a channel (requested channel) for reception, the channel specifying signal Sch is provided, as information for specifying the requested channel, from the channel selection part 16 to the control microcomputer 15 (step S200). With the channel specifying signal Sch, the control microcomputer 15 operates as follows.

First, the control microcomputer 15 checks whether or not the channel data nonvolatile storage part 18 stores a frequency (broadcast frequency) Fb for digital broadcast of the requested channel indicated by the channel specifying signal Sch (step S202). If the broadcast frequency of the requested channel is judged as being stored, the procedure goes to step S206. If the broadcast frequency Fb of the requested channel is not judged as being stored, the broadcast frequency of the requested channel is determined by carrying out a single channel selection search (details thereof are later described), the procedure of which is shown in FIG. 8 (step S204). Note that, the single channel selection search is carried out when the requested channel in the digital terrestrial broadcasting wave receiver has not yet been through the single channel selection search. As is described later, after the single channel selection search, the broadcast frequency of the requested channel, that is, the result obtained by the search is stored in the channel data nonvolatile storage part 18 as long as the requested channel is a digital broadcast channel.

In step S206, the control microcomputer 15 generates, as the broadcast frequency of the requested channel, the control signals Sc1 and Sc2 on the basis of the frequency Fb stored in the channel data nonvolatile storage part 18, and then outputs the generated control signals Sc1 and Sc2 to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the broadcast frequency Fb. Thereafter, the control microcomputer 15 receives the information for synchronization confirmation (OFDM synchronizing signal Ssync, the control voltage signal Svc, or the signal indicating the BER measurement information DBER) from the front end part 13, and based thereon, judges whether or not synchronization has been confirmed (step S208). If synchronization is confirmed through the judgement, the control microcomputer 15 ends its channel selection in a normal manner.

If synchronization is not judged as being confirmed in step S208, the procedure goes to step S210. This may be the case when the broadcast frequency of the requested channel which has been stored in the channel nonvolatile storage part 18 after the single channel selection search is changed, for example, from the normal frequency to the upper-offset frequency.

In step S210, the broadcast frequency of the requested channel is determined through the single channel selection search shown in FIG. 8 (step S210). Thereafter, the control microcomputer 15 generates the control signals Sc1 and Sc2 on the

basis of a broadcast frequency Fb2 stored in the channel data nonvolatile storage part 18 as the frequency obtained by the search, and outputs the generated control signals Sc1 and Sc2 to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the broadcast frequency Fb2 (step S212). Thereafter, the control microcomputer 15 ends its channel selection.

Referring to FIG. 8, it is described the procedure for the single channel selection search carried out in steps S204 and S212.

In the single channel selection search, the normal frequency Fn of the requested channel is read from the channel initial data storage part 17 (step S12). Then, the control signals Sc1 and Sc2 are generated on the basis of the normal frequency Fn, and then the generated control signals Sc1 and Sc2 are outputted to the front end part 13 so as to cause the front end part 13 to perform channel selection operation with the normal frequency Fn (step S14). Thereafter, the information for synchronization confirmation (OFDM synchronizing signal Ssync, the control voltage signal Svc, or the signal indicating the BER measurement information DBER) is received from the front end part 13, and based thereon, it is then determined whether or not synchronization has been confirmed (step S16). If synchronization is confirmed through the judgement, the synchronization-confirmed frequency, that is, the normal

frequency F_n , is stored into the channel data nonvolatile storage part 18 as the broadcast frequency of the requested channel (step S30), and the single channel selection search is ended.

If synchronization is not judged as being confirmed in step S16, the upper-offset frequency F_u of the requested channel is read from the channel initial data storage part 17 (step S18). Next, on the basis of the upper-offset frequency F_u , the control signals $Sc1$ and $Sc2$ are generated and outputted to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the upper-offset frequency F_u (step S20). Thereafter, the information for synchronization confirmation (OFDM synchronizing signal S_{sync} , the control voltage signal S_{vc} , or the signal indicating the BER measurement information $DBER$) is received from the front end part 13, and based thereon, it is then judged whether or not synchronization has been confirmed (step S22). If synchronization is confirmed through the judgement, the synchronization-confirmed frequency, that is, the upper-offset frequency F_u , is stored into the channel data nonvolatile storage part 18 as the broadcast frequency of the requested channel (step S30), and the single channel selection search is ended.

If synchronization is not judged as being confirmed in step S22, the lower-offset frequency F_d of the requested channel is read from the channel initial data storage part 17 (step S24). Next, the control signals $Sc1$ and $Sc2$ are generated on the basis

of the lower-offset frequency F_d , and then the generated control signals $Sc1$ and $Sc2$ are outputted to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the lower-offset frequency F_d (step S26). Thereafter, information for synchronization confirmation is received from the front end part 13, and based thereon, it is then judged whether or not synchronization has been confirmed (step S28). If synchronization is confirmed through the judgement, the synchronization-confirmed frequency, that is, the lower-offset frequency F_d , is stored in the channel data nonvolatile storage part 18 as the broadcast frequency of the requested channel (step S30), and the single channel selection search is ended. If synchronization is not confirmed through the judgement, on the other hand, it means that the user's requested channel is not a digital broadcast channel. If this is the case, the single channel selection search is ended without the lower-offset frequency being stored into the channel data nonvolatile storage part 18.

After the single channel selections search carried out in the above-described manner, the broadcast frequency of the requested channel is stored in the channel data nonvolatile storage part 18 as long as the requested channel is a digital broadcast channel.

<2.3 Effects of Second Embodiment>

According to the above-described second embodiment, with

the broadcast frequency of the requested channel searched (single channel selection search), among three possible frequencies assigned to the channel, a frequency in actual use for digital broadcast, i.e., the broadcast frequency of the channel, is stored in the channel data nonvolatile storage part 18 (step S30 in FIG. 8). Therefore, when the channel is again specified by the user as the requested channel, the control microcomputer 15 has the front end part 13 start channel selection operation with the already-stored frequency as the broadcast frequency of the requested channel (steps S202 and S206 in FIG. 7). In this manner, a time taken from specification of the requested channel to completion of channel selection can be shorter than the first embodiment. Further, similarly to the first embodiment, digital broadcast can be assuredly received on the requested channel while taking the three possible frequencies assigned to every channel into consideration.

Further, according to the second embodiment, if synchronization is not confirmed by channel selection carried out with the frequency stored as the broadcast frequency of the requested channel, the single channel selection search is carried out to newly search for the broadcast frequency of the requested channel (step S210 in FIG. 7, and FIG. 8). Thus, channel selection is carried out with the broadcast frequency determined thereby (step S212 in FIG. 7). As is known from this, even if a digital broadcast channel is changed in frequency (e.g., from the normal

frequency to the upper-offset frequency) and thus the broadcast frequency stored in the channel data nonvolatile storage part 18 is not the broadcast frequency in actual use any more, the broadcast frequency in storage is updated so that digital broadcast can be received on the channel.

<3. Third Embodiment>

<3.1 Structure of Third Embodiment>

Depicted in FIG. 9 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver 300 according to a third embodiment of the present invention. The digital terrestrial broadcasting wave receiver 300 is provided with an every channel search part 21. In this respect, the digital terrestrial broadcasting wave receiver 300 differs the digital terrestrial broadcasting wave receiver 200 of the second embodiment shown in FIG. 6. Constituents other than the every channel search part 21 are the same as those in the second embodiment, thus are under the same reference numerals and not described again.

In the third embodiment, the digital terrestrial broadcasting wave receiver typically carries out an operation (referred to as "preset") of searching for the broadcast frequency for every digital-broadcast-receivable channel as of the placement thereof. When the preset is carried out, the every channel search part 21 sequentially supplies, on a channel basis, information about every possible digital broadcast channel to the

channel selection part 16. Whenever receiving the information about channel from the every channel search part 21, the channel selection part 15 outputs the channel specifying signal Sch specifying the channel. The channel specifying signal Sch is provided to the control microcomputer 15. In this manner, when preset is carried out, one channel specifying signal Sch for every possible digital broadcast channel is provided, on a channel basis, to the control microcomputer 15. Based on the channel specifying signal Sch, the control microcomputer 15 carries out preset in a later-described manner.

<3.2 Preset Operation and Effects Thereof in Third Embodiment>

Hereinafter, by referring to FIG. 11, it is described how the digital terrestrial broadcasting wave receiver of the third embodiment carries out preset.

In the third embodiment, preset is carried out through an every channel selection search, the procedure of which is shown in FIG. 11. The every channel selection search is started by pushing a specific button (not shown). In the description below, the available digital broadcast channels are presumably 1ch to 61ch.

In the every channel selection search, the channel selection part 16 first specifies, according to information provided by the every channel search part, any one channel being not yet through with channel selection among the 1ch to 61ch, that is, any one not-yet-searched channel, and then outputs the channel



specifying signal Sch specifying the channel (step S50). Note that, at the point in time immediately after the every channel selection search is started, every channel from 1ch to 61ch is not yet searched. Thus, assuming that the search is sequentially made from a channel smallest in number, the channel specifying signal Sch outputted first is the one specifying the 1ch. Hereinafter, the channel specified by the channel specifying signal Sch outputted in step S50 is referred to as "specified channel".

The channel specifying signal Sch outputted in step S50 is forwarded to the control microcomputer 15, and based thereon, the control microcomputer 15 operates as follows.

First, the control microcomputer 15 reads the normal frequency F_n of the specified channel from the channel initial data storage part 17 (step S52). Thereafter, the control microcomputer 15 generates the control signals Sc1 and Sc2 on the basis of the normal frequency F_n , and then outputs the generated control signals Sc1 and Sc2 to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the normal frequency F_n (step S54). Thereafter, the control microcomputer 15 receives the information for synchronization confirmation (OFDM synchronizing signal Ssync, the control voltage signal Svc, or the signal indicating the BER measurement information DBER) from the front end part 13, and based thereon, judges whether or not synchronization has been confirmed (step

S56). If synchronization is confirmed through the judgement, the synchronization-confirmed frequency, that is, the normal frequency F_n is stored into the channel data nonvolatile storage part 18 as the broadcast frequency of the specified channel (step S70), and then the procedure goes to step S72.

If synchronization is not judged as being confirmed in step S56, the control microcomputer 15 reads the upper-offset frequency F_u of the specified channel from the channel initial data storage part 17 (step S58). Next, the control microcomputer 15 generates the control signals $Sc1$ and $Sc2$ on the basis of the upper-offset frequency F_u , and then outputs the generated control signals $Sc1$ and $Sc2$ to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the upper-offset frequency F_u (step S60). Thereafter, the control microcomputer 15 receives the information for synchronization confirmation from the front end part 13, and based thereon, judges whether or not synchronization has been confirmed (step S62). If synchronization is confirmed through the judgement, the synchronization-confirmed frequency, that is, the upper-offset frequency F_u is stored into the channel data nonvolatile storage part 18 as the broadcast frequency of the specified channel (step S70), and then the procedure goes to step S72.

If synchronization is not judged as being confirmed in step S62, the control microcomputer 15 reads the lower-offset

frequency F_d of the specified channel from the channel initial data storage part 17 (step S64). Next, the control microcomputer 15 generates the control signals $Sc1$ and $Sc2$ on the basis of the lower-offset frequency F_d , and then outputs the generated control signals $Sc1$ and $Sc2$ to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the lower-offset frequency F_d (step S66). Thereafter, the control microcomputer 15 receives the information for synchronization confirmation from the front end part 13, and based thereon, judges whether or not synchronization has been confirmed (step S68). If synchronization is confirmed through the judgement, the synchronization-confirmed frequency, that is, the lower-offset frequency F_d is stored into the channel data nonvolatile storage part 18 as the broadcast frequency of the specified channel (step S70), and then the procedure goes to step S72. If synchronization is not confirmed through the judgement, on the other hand, it means that the specified channel is not a digital broadcast channel. If this is the case, the procedure goes to step S72 without the lower-offset frequency being stored into the channel data nonvolatile storage part 18.

In step S72, it is judged whether or not every channel from 1ch to 61ch has been searched. Herein, an expression of "channel is searched" means that the frequency for digital broadcast (broadcast frequency) of the channel is searched through the above-described processing (steps S50 to S70). If the judgement

in step S72 tells that some channel is not yet searched, the procedure returns to step S50. From then and onwards, the procedure from S50 to S70 is repeated until every channel is thoroughly searched, and with every channel searched, the every channel selection search is ended.

According to the above-described preset operation, the every channel selection search is carried out while taking three possible frequencies to be singularly assigned to one channel into consideration. Therefore, every channel from 1ch to 61ch is assuredly searched for the broadcast frequency thereof. Further, once the preset is carried out, as long as the channel specified by the above every channel selection search is the digital broadcast channel, the broadcast frequency thereof is stored in the channel data nonvolatile storage part 18.

<3.3 Channel Selection and Effects Thereof in Third Embodiment>

Next, it is described how channel selection is carried out for the user's requested channel. Herein, it is assumed that preset is carried out by the above-described every channel selection with a user's request.

FIG. 10 is a flowchart showing an exemplary procedure for channel selection (hereinafter, referred to as "first exemplary channel selection") in the third embodiment. In the first exemplary channel selection, after the user operates the channel selection part 16 and specifies a channel for reception (requested channel), the channel specifying signal Sch is provided, as

information for specifying the requested channel, from the channel selection part 16 to the control microcomputer 15 (step S300). With the channel specifying signal Sch, the control microcomputer 15 reads the frequency (broadcast frequency) Fb for digital broadcast of the requested channel indicated by the channel specifying signal Sch from the channel data nonvolatile storage part 18 (step S302). Next, the control microcomputer 15 generates the control signals Sc1 and Sc2 on the basis of the read broadcast frequency Fb, and then outputs the generated control signals Sc1 and Sc2 to the front end part 13 so as to cause the front end part 13 to carry out channel selection operation with the broadcast frequency Fb (step S304). If the user's requested channel is a digital broadcast channel, the front end part 13 outputs the transport stream signal of the requested channel by the channel selection operation. The transport stream signal is then decoded by the MPEG decoding part 14, and image data obtained by decoding is externally outputted from the digital terrestrial broadcasting wave receiver.

In the first exemplary channel selection, if some digital broadcast channel is newly provided or changed in frequency (e.g., from the normal frequency to the lower-offset frequency) after preset, digital broadcast cannot be correctly received on such channel. If this is the case, channel selection operation similar to that in the second embodiment, i.e., channel selection according to the procedure shown in FIG. 7 (hereinafter, referred

to as "second exemplary channel selection"), may be carried out. According to the second exemplary channel selection, when the broadcast frequency of the requested channel is not stored, the broadcast frequency of the requested channel is searched through the single channel selection search (step S202 in FIG. 7, and FIG. 8). Therefore, even if some digital broadcast channel is newly provided after preset, digital broadcast can be received thereon. Further, according to the second exemplary channel selection, if synchronization is not confirmed through channel selection carried out with the frequency stored as the broadcast frequency of the requested channel, the broadcast frequency of the requested channel is searched through the single channel selection search (step S210 in FIG. 7, and FIG. 8). In this manner, even if some digital broadcast frequency is changed in frequency after preset, the digital broadcast can be received thereon.

<4. Fourth Embodiment>

<4.1 Structure of Fourth Embodiment>

Depicted in FIG. 12 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver 400 according to a fourth embodiment of the present invention. The digital terrestrial broadcasting wave receiver 400 is provided with a communications control part 52 as means for receiving channel arrangement information. The communications control part 52 is implemented by a modem, for example, and is used to connect the digital terrestrial broadcasting wave receiver to a

communications network such as a telephone line or a wide-area network (WAN). In this respect, the digital terrestrial broadcasting wave receiver 400 differs the digital terrestrial broadcasting wave receiver 300 of the third embodiment. Further, the digital terrestrial broadcasting wave receiver 400 is provided with an every channel search button 54 and a circuit accompanying thereto. The every channel search button 54 is used to start preset operation in response to the user's instruction. Other constituents are similar to those in the third embodiment, and are under the same reference numerals and not described again.

<4.2 Operation and Effects of Fourth Embodiment>

In the digital terrestrial broadcasting wave receiver 400 of the fourth embodiment, as shown in FIG. 13, with the every channel search button 54 pushed (ON) by the user, for example (step S400), a signal indicating the start of the preset operation is provided from the every channel search part 21 to the control microcomputer 15. Thereafter, according to the procedure shown in FIG. 11, the every channel selection search is carried out (step S402).

Therefore, according to the fourth embodiment, in the case that some broadcast channel is newly provided or changed in arrangement, the every channel search button is pushed (ON). As a result, the frequency of the digital broadcast channel newly provided or changed in arrangement is stored in relation to the channel in the channel data nonvolatile storage part 18. In this

manner, even if some digital broadcast channel is newly provided or changed in arrangement, digital broadcast can be received thereon. Note that, an expression of "channel is changed in arrangement" means that a broadcast channel is changed from analog to digital or a digital broadcast channel is changed in frequency (e.g., from the normal frequency to the upper-offset frequency).

Further, the digital terrestrial broadcasting wave receiver of the fourth embodiment is structured on the premise that, in the case that some digital broadcast channel is newly provided or changed in arrangement, the channel arrangement information is transmitted thereto from the broadcast station via a telephone line or WAN. To be more specific, with the channel arrangement information transmitted from the broadcast station via a communications network 51, the digital terrestrial broadcasting wave receiver 400 receives the information by the communications control part 52. Thereafter, depending on the contents of the received channel arrangement information, the digital terrestrial broadcasting wave receiver 400 goes through any one of the processing next below.

1. In the case that the channel arrangement information notifies only the addition or change in arrangement relevant to some digital broadcast channel,

on reception of the channel arrangement information (step S410), the communications control part 52 forwards the received channel arrangement information to the every channel search part

21. In response thereto, the every channel search part 21 sends an instruction for starting the preset operation to the control microcomputer 15. In this manner, the every channel selection search is carried out according to the procedure shown in FIG. 11 (step S412).

2. In the case that the channel arrangement information includes any number of the digital broadcast channel newly provided or changed in arrangement,

on reception of the channel arrangement information including the number N indicating any newly provided channel number or any number of the digital broadcast channel changed in arrangement, the communications control part 52 sends, to the control microcomputer 15, an instruction for channel selection search together with the channel number N. In this manner, the single channel selection search is carried out according to the procedure shown in FIG. 8 (step S424). Then, with the single channel selection search, the broadcast frequency for the channel having the number N is determined, and then is stored into the channel data nonvolatile storage part 18.

3. In the case that the channel arrangement information includes information indicating the broadcast frequency of the digital broadcast channel newly provided or changed in arrangement,

on reception of the channel arrangement information including information indicating the broadcast frequency F_b of

the digital broadcast channel newly provided or changed in arrangement, the communications control part 52 sends, to the control microcomputer 15, an instruction for single channel selection search together with the information indicating the broadcast frequency F_b . In reception thereto, the control microcomputer 15 stores the broadcast frequency F_b into the channel data nonvolatile storage part 18 as the frequency for the digital broadcast channel (step S434).

In the fourth embodiment, with each operation of (1) to (3), a frequency of a digital broadcast channel newly provided or changed in arrangement is newly-stored or updated, respectively, among the broadcast frequencies stored for every channel in the channel data nonvolatile storage part 18. Accordingly, even if some digital broadcast channel is newly provided or changed in arrangement, digital broadcast can be received thereon.

Note that, in the digital terrestrial broadcasting wave receiver of the fourth embodiment, channel selection with a user's request is similar to the third embodiment. Therefore it is not described again (see FIG. 7, FIG. 8, and FIG. 10).

<4.3 Exemplary Modification of Fourth Embodiment>

In the fourth embodiment in the foregoing, the channel arrangement information is assumed to be transmitted from broadcast stations only when a digital broadcast channel is newly provided or changed in arrangement. Herein, in the case that the channel arrangement information is regularly transmitted, the

operation similar thereto may lead to similar effects (see FIGS. 14 to 16). Further, the channel arrangement information may include information for identifying channels not only newly provided or changed in arrangement but also the digital broadcast channels at the time of transmission thereof, and the broadcast frequency for the channels may be also included. In this case, similarly to the fourth embodiment, the broadcast frequencies of the digital broadcast channel are newly stored or updated in the channel data nonvolatile storage part 18 according to the channel arrangement information.

Further, in the fourth embodiment, the channel arrangement information is transmitted from the broadcast stations to the digital terrestrial broadcasting wave receiver via the communications network such as a telephone line. However, it is not restrictive and the channel arrangement information may be transmitted over airwaves.

<5. Fifth Embodiment>

<5.1 Structure of Fifth Embodiment>

Depicted in FIG. 17 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver 500 according to a fifth embodiment of the present invention. The digital terrestrial broadcasting wave receiver 500 is provided with a timer 62 outputting a signal for starting the every channel selection search (preset operation) at a predetermined time interval. In this respect, the digital terrestrial broadcasting

wave receiver 500 differs from the digital terrestrial broadcasting wave receiver 300 of the third embodiment in FIG. 9. Further, the digital terrestrial broadcasting wave receiver 500 is provided with the every channel search button 54 and the circuit accompanying thereto. The every channel search button 54 is used to start the preset operation. Other constituents are the same as those in the third embodiment, thus the same constituents are under the same reference numerals and not described again.

<5.2 Operation and Effects of Fifth Embodiment>

Also in the digital terrestrial broadcasting wave receiver 500 of the fifth embodiment, similarly to the digital terrestrial broadcasting wave receiver 400 of the fourth embodiment shown in FIG. 12, as shown in FIG. 13, with the every channel search button 54 pushed (ON) by the user, for example (step S400), a signal indicating start of the preset operation is provided from the every channel search part 21 to the control microcomputer 15, and then the every channel selection search is carried out according to the procedure shown in FIG. 11 (step S402).

Therefore, according to the fifth embodiment, similarly to the fourth embodiment, even if some digital broadcast channel is newly provided or changed in arrangement, digital broadcast can be received thereon only by pushing (ON) the every channel search button.

Further, in the fifth embodiment, to deal with the case that

some digital broadcast channel is newly provided or changed in arrangement, the timer 62 is provided. The timer 62 outputs an every channel search starting signal Ss at a predetermined time interval (e.g., every day or every week) (step S500). The every channel search starting signal Ss is forwarded to the every channel search part 21. In response to the every channel search starting signal Ss, the every channel search part 21 sends the instruction for starting the preset operation to the control microcomputer 15. Thereby, the every channel selection search is carried out according to the procedure shown in FIG. 11 (step S502). As a result, the broadcast frequency of the digital broadcast channel newly provided or changed in arrangement is updated or newly stored among the broadcast frequencies stored for every channel in the channel data nonvolatile storage part 18. In this manner, even if some digital broadcast channel is newly provided or changed in arrangement, digital broadcast can be received thereon.

Note that, also in the digital terrestrial broadcasting wave receiver of the fifth embodiment, channel selection with a user's request is similar to the third embodiment. Therefore, it is not described again (see FIG. 7, FIG. 8, and FIG. 10).

INDUSTRIAL APPLICABILITY

The present invention is applied to digital terrestrial broadcasting wave receivers, and more specifically suitably

applied to a digital terrestrial broadcasting wave receiver used in an area where digital terrestrial broadcasting wave and analog terrestrial broadcasting wave are both observed.

WHAT IS CLAIMED IS:

1. A digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital broadcast channel specified by a user, the receiver comprises:

channel selection means for outputting, when the user specifies a requested channel for reception through a user's operation in a predetermined manner, channel specifying information indicating the requested channel;

channel initial data storage means for previously storing three types of frequencies of a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to each of a plurality of predetermined digital broadcast channels;

a front end part for receiving a control signal which instructs a channel selection operation with any one of said three types of frequencies assigned to said requested channel, carrying out, based on the control signal, extraction and demodulation operations with respect to the digital terrestrial wave signals received by said antenna, and generating synchronization confirmation information indicating whether or not the channel selection operation is completed in a normal manner; and

control means for generating said control signal according to said channel specifying information, and controlling said



front end part by supplying said generated control signal to said front end part, wherein

said control means

includes single channel selection search means for generating said control signal according to said three types of frequencies assigned to one channel in said channel initial data storage means, and searching for a broadcast frequency in actual use for digital broadcast among said three types of frequencies assigned to the one channel, based on said synchronization confirmation information obtained by supplying said generated control signal to said front end part, and

determines the broadcast frequency of said requested channel by said single channel selection search means.

2. The digital terrestrial broadcasting wave receiver as claimed in claim 1, further comprising rewritable nonvolatile storage means for storing a frequency in use for digital broadcast for any one of said predetermined digital broadcast channels in conjunction with each of said channels, wherein

said control means

further includes storage judgement means for judging whether or not the broadcast frequency for digital broadcast on said requested channel is stored in said nonvolatile storage means,

when said storage judgement means judges that said broadcast frequency of said requested channel is stored in said



nonvolatile storage means, supplies, to said front end part, said control signal instructing the channel selection operation with said stored broadcast frequency, and

when said storage judgement means does not judge that said broadcast frequency of said requested channel is stored in said nonvolatile storage means has said single channel selection search means search for the broadcast frequency of said requested channel, supplies, to said front end part, said control signal instructing the channel selection operation with the broadcast frequency of said requested channel and stores the broadcast frequency obtained by the search into said nonvolatile storage means in conjunction with said requested channel.

3. The digital terrestrial broadcasting wave receiver as claimed in claim 2, wherein, after generating said control signal instructing the channel selection operation with the frequency stored in said nonvolatile storage means as the broadcast frequency of said requested channel for output to said front end part, when the channel selection operation is not completed in a normal manner, said control means supplies said control signal instructing the channel selection operation with the broadcast frequency of said requested channel by having said single channel selection search means search for the broadcast frequency of said requested channel, and updates said broadcast frequency stored in said nonvolatile storage means in conjunction with said requested channel to the broadcast frequency obtained by the



search.

4. A digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital broadcast channel specified by a user, the receiver comprises:

channel selection means for outputting, when the user specifies a requested channel for reception through his/her operation in a predetermined manner, channel specifying information indicating the requested channel;

every channel scan means for receiving a predetermined preset instruction, and in response thereto, sequentially outputting, on a channel basis, channel specifying information which specifies each of a plurality of predetermined digital broadcast channels;

channel initial data storage means for previously storing three types of frequencies of a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to each of said predetermined digital broadcast channels;

rewritable nonvolatile storage means for storing a frequency in use for digital broadcast on each of said predetermined digital broadcast channels in conjunction with said channels;

a front end part receiving a control signal which instructs a channel selection operation with any one of said three types



of frequencies assigned to one channel, carrying out, based on the control signal, extraction and demodulation operations with respect to the digital terrestrial wave signals received by said antenna, and generating synchronization confirmation information indicating whether or not the channel selection operation is completed in a normal manner; and

control means for controlling said front end part by generating said control signal according to said channel specifying information outputted from said channel selection means or said every channel scan means and by supplying said generated control signal to said front end part, wherein

said control means,

includes every channel selection search means for generating, when said every channel scan means receives said preset instruction, said control signal according to said three types of frequencies, stored in said channel initial data storage means, being assigned to a specified channel specified by each of the channel specifying information sequentially outputted from said every channel scan means, searching for a broadcast frequency in actual use for digital broadcast among said three types of frequencies assigned to said specified channel, based on said synchronization confirmation information obtained by supplying said generated control signal to said front end part, and storing the broadcast frequency obtained by the search into said nonvolatile storage means in conjunction with said specified



channel, and

when said channel specifying information is outputted from said channel selection means, reads the broadcast frequency stored in said nonvolatile storage means in conjunction with said requested channel, and then generates said control signal instructing the channel selection operation with the read frequency for output to said front end part.

5. The digital terrestrial broadcasting wave receiver as claimed in claim 4, wherein said control means

further includes single channel selection search means for searching for, based on said synchronization confirmation information obtained by first generating said control signal according to said three types of frequencies assigned to one channel in said channel initial data storage means and then by supplying said generated control signal to said front end part, the broadcast frequency in actual use for digital broadcast among said three types of frequencies assigned to the one channel, and

storage judgement means for judging whether or not the broadcast frequency for digital broadcast on said requested channel is stored in said nonvolatile storage means, and

when said storage judgement means judges that the broadcast frequency of said requested channel is stored in said nonvolatile storage means, supplies said control signal instructing the channel selection operation with said stored broadcast frequency to said front end part, and



when said storage judgement means does not judge that the broadcast frequency of said requested channel is stored in said nonvolatile storage means, has said single channel selection search means search the broadcast frequency of said requested channel, supplies said control signal instructing the channel selection operation with the broadcast frequency of said requested channel to said front end part, and stores the broadcast frequency obtained by the search into said nonvolatile storage means in conjunction with said requested channel.

6. The digital terrestrial broadcasting wave receiver as claimed in claim 4, wherein said control means

further includes single channel selection search means for generating said control signal according to said three types of frequencies assigned to one channel in said channel initial data storage means, and searching for a broadcast frequency in actual use for digital broadcast among said three types of frequencies assigned to the one channel, based on said synchronization confirmation information obtained by and by supplying, said generated control signal to said front end part, and

after generating said control signal instructing the channel selection operation with the frequency stored in said nonvolatile storage means as the broadcast frequency of said requested channel for output to said front end part, when the channel selection operation is not completed in a normal manner, has said single channel selection search means search for the



broadcast frequency of said requested channel, supplies said control signal instructing the channel selection operation with the broadcast frequency of said requested channel to said front end part, and updates said broadcast frequency stored in said nonvolatile storage means in conjunction with said requested channel to the broadcast frequency obtained by the search.

7. The digital terrestrial broadcasting wave receiver as claimed in claim 4, further comprising every channel search instruction means for providing said preset instruction to said every channel scan means in response to a user's operation.

8. The digital terrestrial broadcasting wave receiver as claimed in claim 4, further comprising timer means for outputting a signal providing said preset instruction to said every channel scan means at a predetermined time interval.

9. The digital terrestrial broadcasting wave receiver as claimed in claim 4, further comprising reception means for receiving information transmitted through a predetermined transmission path, and when the received information indicates any digital broadcast channel being newly provided or changed in arrangement, providing said preset instruction to said every channel scan means .

10. The digital terrestrial broadcasting wave receiver as claimed in claim 4, further comprising reception means for receiving information transmitted through a predetermined transmission path, and when the received information includes



identifying information of the digital broadcast channel in current use, outputting the identifying information, and

said control means

further includes single channel selection search means for generating said control signal according to said three types of frequencies assigned to one channel in said channel initial data storage means, and searching for a broadcast frequency in actual use for digital broadcast among said three types of frequencies assigned to the one channel based on said synchronization confirmation information obtained by and by supplying said generated control signal to said front end part , and

when said identification information is outputted from said reception means, determines the broadcast frequency of the channel identified by said identifying information by said single channel selection search means, and then stores the determined broadcast frequency into said nonvolatile storage means in conjunction with the channel identified by said identifying information.

11. The digital terrestrial broadcasting wave receiver as claimed in claim 4, further comprising reception means for receiving information transmitted through a predetermined transmission path, and when the received information includes the identifying information and the broadcast frequency of the digital broadcast channel in current use, outputting the



identifying information and the broadcast frequency, wherein

when said identifying information and said broadcast frequency are outputted from said reception means, said control means stores said broadcast frequency outputted from said reception means into said nonvolatile storage means in conjunction with the channel identified by said identifying information.

12. The digital terrestrial broadcasting wave receiver as claimed in claim 1 or 4, wherein said digital terrestrial wave signals are OFDM modulated signals, and

said front end part

includes OFDM demodulation means for demodulating said digital terrestrial wave signals, and

generates an OFDM synchronizing signal as said synchronization confirmation information when said OFDM demodulation means correctly demodulates said digital terrestrial wave signals.

13. The digital terrestrial broadcasting wave receiver as claimed in claim 1 or 4, wherein said digital terrestrial wave signals are OFDM modulated signals, and

said front end part includes

OFDM demodulation means for demodulating said digital terrestrial wave signals, and

voltage controlled oscillating means for generating a system clock for said OFDM demodulation means, and



said synchronization confirmation information is a signal indicating a control voltage to be supplied to said voltage controlled oscillating means.

14. The digital terrestrial broadcasting wave receiver as claimed in claim 1 or 4, wherein said digital terrestrial wave signals are OFDM modulated signals, and

said front end part includes

OFDM demodulation means for demodulating said digital terrestrial wave signals, and

error correction means for correcting an error included in a signal, if any, obtained by the demodulation carried out by said OFDM demodulation means with respect to said digital terrestrial wave signals, and

said synchronization confirmation information is BER measurement information generated by said error correction means.

15. The digital terrestrial broadcasting wave receiver as claimed in claim 1, wherein said single channel selection search means searches for the normal frequency with a higher priority among said three types of frequencies.

16. The digital terrestrial broadcasting wave receiver as claimed in claim 4, wherein said every channel selection search means searches for the normal frequency with a higher priority among said three types of frequencies.

17. The digital terrestrial broadcasting wave receiver as claimed in claim 5 or 6, wherein said every channel selection



search means searches for the normal frequency with a higher priority among said three types of frequencies, and

said single channel selection search means searches for the normal frequency with a higher priority among said three types of frequencies.

18. The digital terrestrial broadcasting wave receiver as claimed in any one of claims 1, 5 and 6, wherein said single channel selection search means includes

first synchronization confirmation means for judging, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a first frequency included in said three types of frequencies assigned to said one channel, whether or not the channel selection operation with the first frequency is completed in a normal manner, and

second synchronization confirmation means for judging whether or not the channel selection operation with the second frequency is completed in a normal manner, when the channel selection operation with said first frequency is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a second frequency included in said three types of frequencies assigned to said one channel but not said first frequency, wherein



when the channel selection operation with said first frequency is judged as being completed in a normal manner, said first frequency is determined as the broadcast frequency of said one channel, when the channel selection operation with said second frequency is judged as being completed in a normal manner, said second frequency is determined as the broadcast frequency of said one channel, and when neither of the channel selection operations with said first nor second frequencies is judged as being completed in a normal manner, a third frequency included in said three types of frequencies assigned to said one channel but not said first or said second frequency is determined as the broadcast frequency of said one channel.

19. The digital terrestrial broadcasting wave receiver as claimed in any one of claims 1, 5 and 6, wherein said single channel selection search means includes:

first synchronization confirmation means for judging whether or not the channel selection operation with the first frequency is completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a first frequency which is any one of said three types of frequencies assigned to said one channel;

second synchronization confirmation means for judging whether or not the channel selection operation with the second frequency is completed in a normal manner, when the channel



selection operation with said first frequency is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a second frequency included in said three types of frequencies assigned to said one channel but not said first frequency; and

third synchronization confirmation means for judging whether or not the channel selection operation with the third frequency is completed in a normal manner, when neither of the channel selection operations with said first nor second frequencies is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a third frequency included in said three types of frequencies assigned to said one channel but not said first or second frequency, wherein

when the channel selection operation with said first frequency is judged as being completed in a normal manner, said first frequency is determined as the broadcast frequency of said one channel, when the channel selection operation with said second frequency is judged as being completed in a normal manner, said second frequency is determined as the broadcast frequency of said one channel, and when the channel selection operation with said third frequency is judged as being completed in a normal manner,



said third frequency is determined as the broadcast frequency of said one channel.

20. The digital terrestrial broadcasting wave receiver as claimed in any one of claims 4, 5 and 6, wherein said every channel selection search means includes:

first synchronization confirmation means for judging whether or not the channel selection operation with the first frequency is completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a first frequency which is any one of said three types of frequencies assigned to said specified channel;

second synchronization confirmation means for judging whether or not the channel selection operation with the second frequency is completed in a normal manner, when the channel selection operation with said first frequency is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a second frequency included in said three types of frequencies assigned to said specified channel but not said first frequency; and

third synchronization confirmation means for judging whether or not the channel selection operation with the third



frequency is completed in a normal manner, when neither of the channel selection operations with said first nor second frequencies is not judged as being completed in a normal manner, based on the synchronization confirmation information obtained by supplying, to said front end part, the control signal instructing a channel selection operation with a third frequency included in said three types of frequencies assigned to said specified channel but not said first or second frequency, wherein

when the channel selection operation with said first frequency is judged as being completed in a normal manner, said first frequency is stored into said nonvolatile storage means as the broadcast frequency of said specified channel, when the channel selection operation with said second frequency is judged as being completed in a normal manner, said second frequency is stored into said nonvolatile storage means as the broadcast frequency of said specified channel, and when the channel selection operation with said third frequency is judged as being completed in a normal manner, said third frequency is stored into said nonvolatile storage means as the broadcast frequency of said specified channel.

21. A reception channel selection method to be applied to a digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital



broadcast channel specified by a user, the method comprises:

a channel initial data storing step of previously storing three types of frequencies including a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to every predetermined digital broadcast channel;

a channel specifying step of outputting, when the user specifies a requested channel for reception through a user's operation in a predetermined manner, channel specifying information indicating the requested channel;

a control signal generating step of generating, based on said three types of frequencies assigned to said requested channel in said channel initial data storing step, a control signal which instructs a channel selection operation with any one of said three types of frequencies assigned to said requested channel;

a synchronization confirmation information generating step of carrying out, based on said generated control signal, extraction and demodulation operations with respect to the digital terrestrial wave signals received by said antenna, and generating synchronization confirmation information indicating whether or not said channel selection operation including the selection and demodulation operations is completed in a normal manner; and

a search step of searching for, based on said synchronization confirmation information, a broadcast frequency in actual use for digital broadcast among said three types of



frequencies assigned to said requested channel.

22. A reception channel selection method to be applied to a digital terrestrial broadcasting wave receiver of a type receiving digital-modulated digital terrestrial wave signals by an antenna, and extracting thereamong, for demodulation, one digital terrestrial wave signal corresponding to a digital broadcast channel specified by a user, the method comprises:

a channel initial data storing step of previously storing three types of frequencies including a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to every predetermined digital broadcast channel;

an every channel scan step of receiving a predetermined preset instruction, and in response thereto, sequentially outputting, on a channel basis, channel specifying information which specifies each of a plurality of predetermined digital broadcast channels;

a first control signal generating step of generating, on reception of said preset instruction, based on said previously stored three types of frequencies assigned to a specified channel specified by each of said channel specifying information sequentially outputted, a control signal instructing a channel selection operation with any one of said three types of frequencies;

a synchronization confirmation information generating step of carrying out, based on said control signal generated in said



first control signal generating step, extraction and demodulation operations with respect to the digital terrestrial wave signals received by said antenna, and generating synchronization confirmation information indicating whether or not said channel selection operation including the extraction and demodulation operations are completed in a normal manner;

a search step of searching for, based on said synchronization confirmation information, a broadcast frequency in actual use for digital broadcast among said three types of frequencies assigned to said specified channel;

a storage step of storing the broadcast frequency obtained in said search step into predetermined nonvolatile storage means in conjunction with said specified channel;

a channel specifying step of outputting channel specifying information indicating a requested channel in response to the user's requested channel for reception through the user's operation in a predetermined manner;

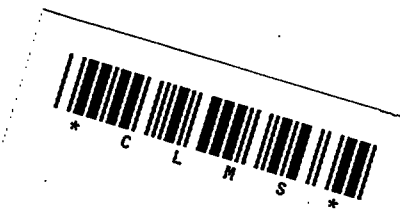
a reading step of reading the broadcast frequency stored in said nonvolatile storage means in conjunction with said requested channel when said channel specifying information is outputted in said channel specifying step;

a second control signal generating step of generating a control signal instructing a channel selection with said frequency read from said nonvolatile storage means; and

a channel selection operation step of carrying out



extraction and demodulation operations with respect to the digital terrestrial wave signals received by said antenna based on said control signal generated in said second control signal generating step.



ABSTRACT OF THE DISCLOSURE

An object of the present invention is to provide a digital terrestrial broadcasting wave receiver of a type being freed from problems occurring in a transition period of terrestrial broadcasting wave from analog to digital while receiving digital broadcast assuredly from a channel on request. To attain this object, in a digital terrestrial broadcasting wave receiver (100), a channel initial data storage part (17) previously stores three types of frequencies of a normal frequency, an upper-offset frequency, and a lower-offset frequency assigned to each digital broadcast channel. With a requested channel specified by a user, a front end part (13) operates according to the three frequencies assigned thereto. And then based on an OFDM synchronizing signal provided by an OFDM demodulation part (39) in the front end part (13), a frequency in actual use for digital broadcast is determined among the above three frequencies.

FIG. 1

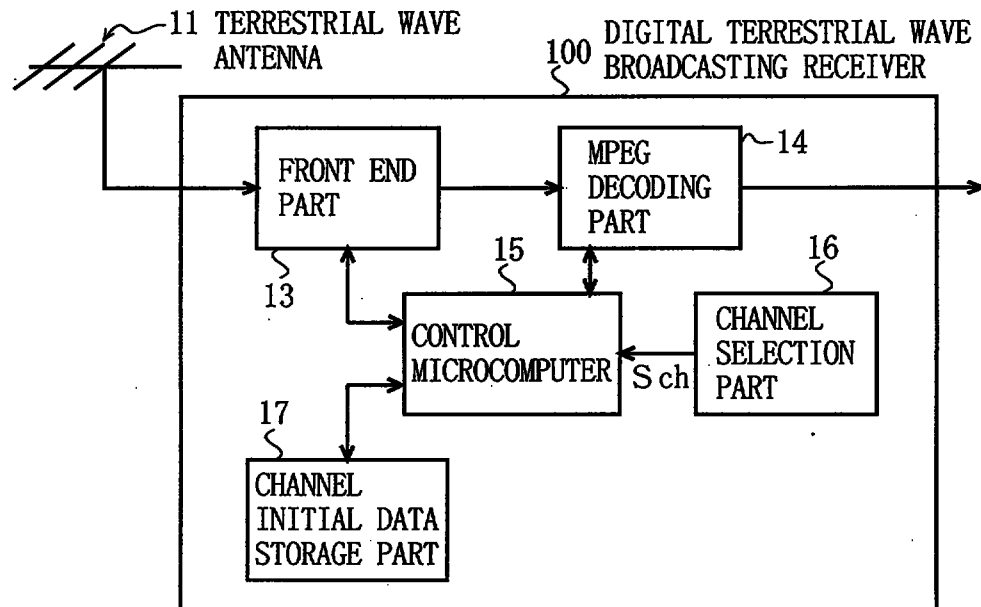


FIG. 2

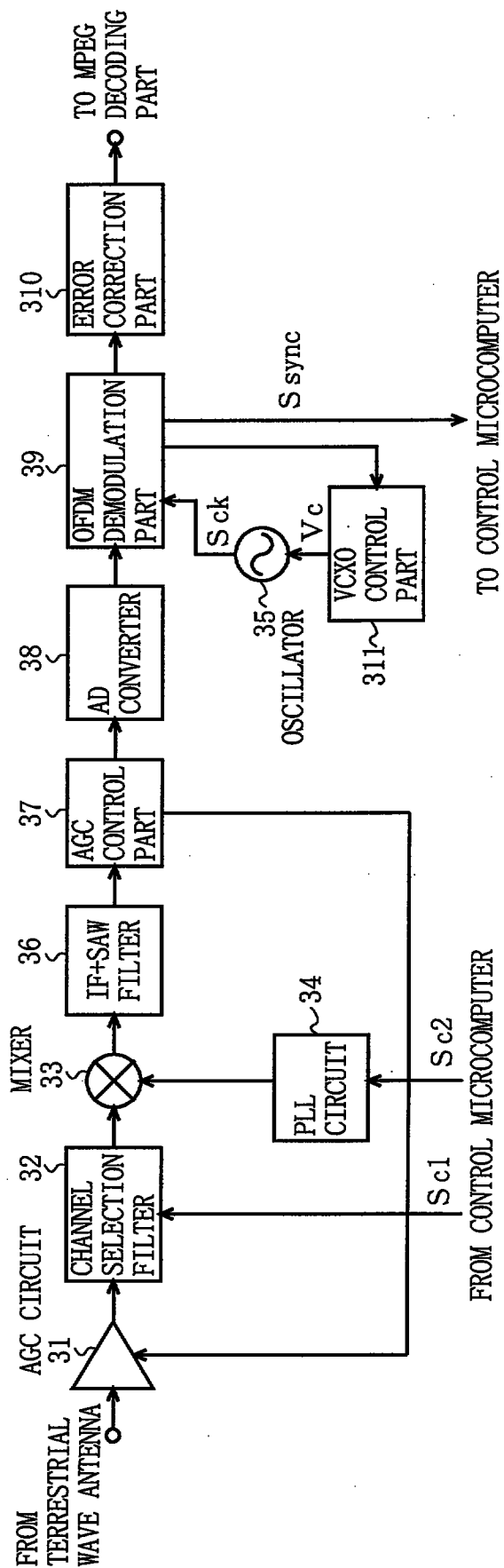


FIG. 3

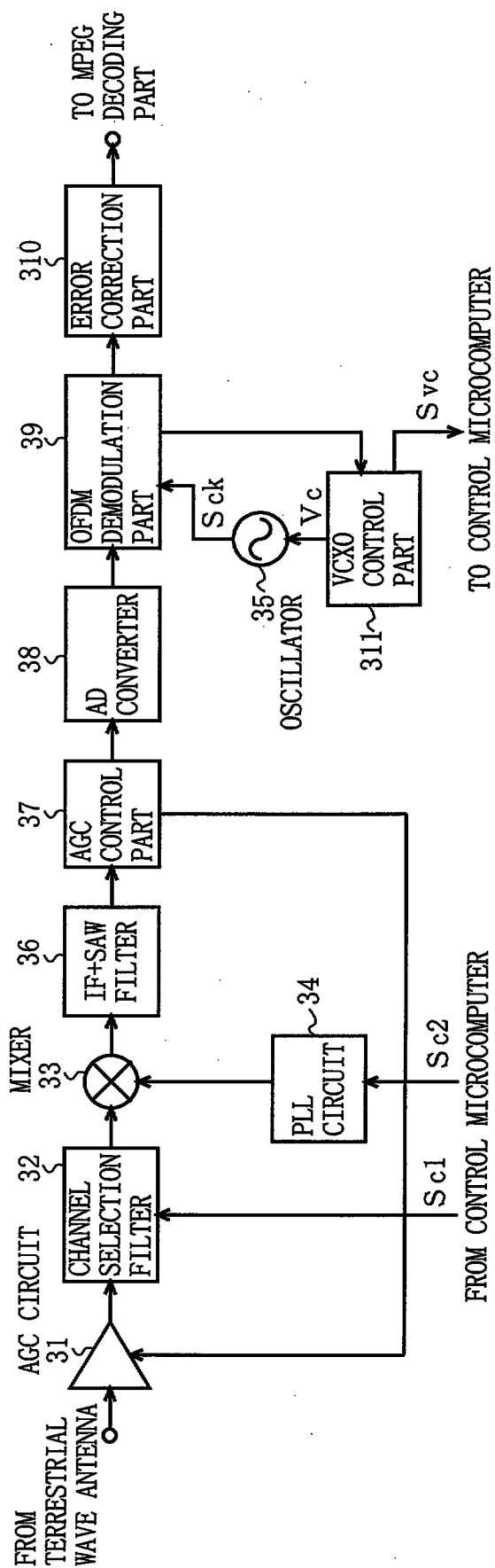


FIG. 4

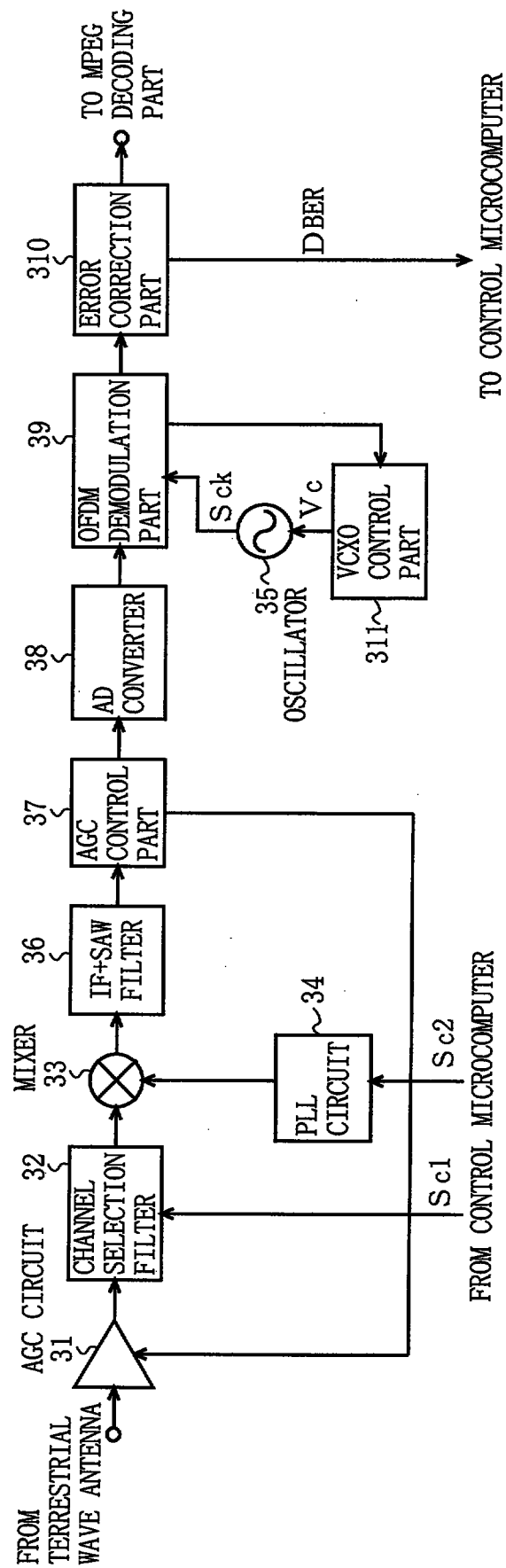


FIG. 5

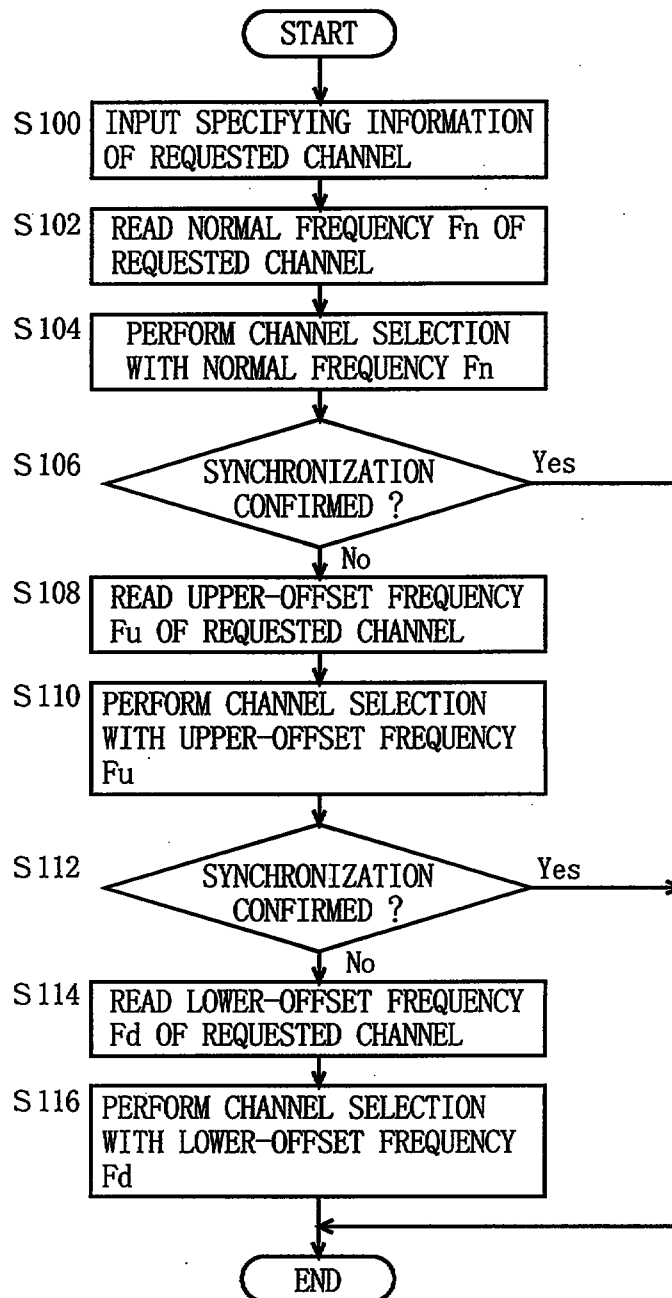


FIG. 6

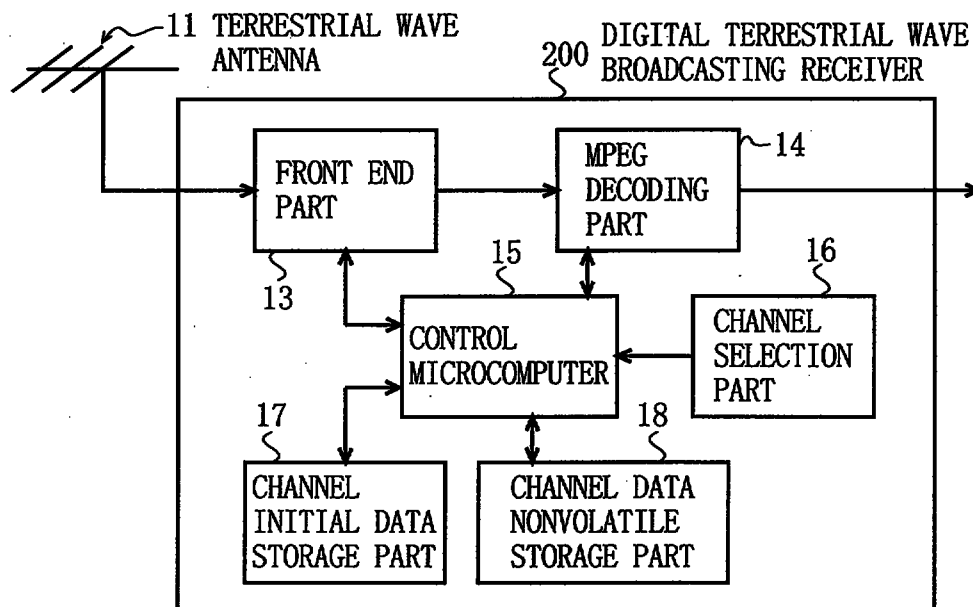


FIG. 7

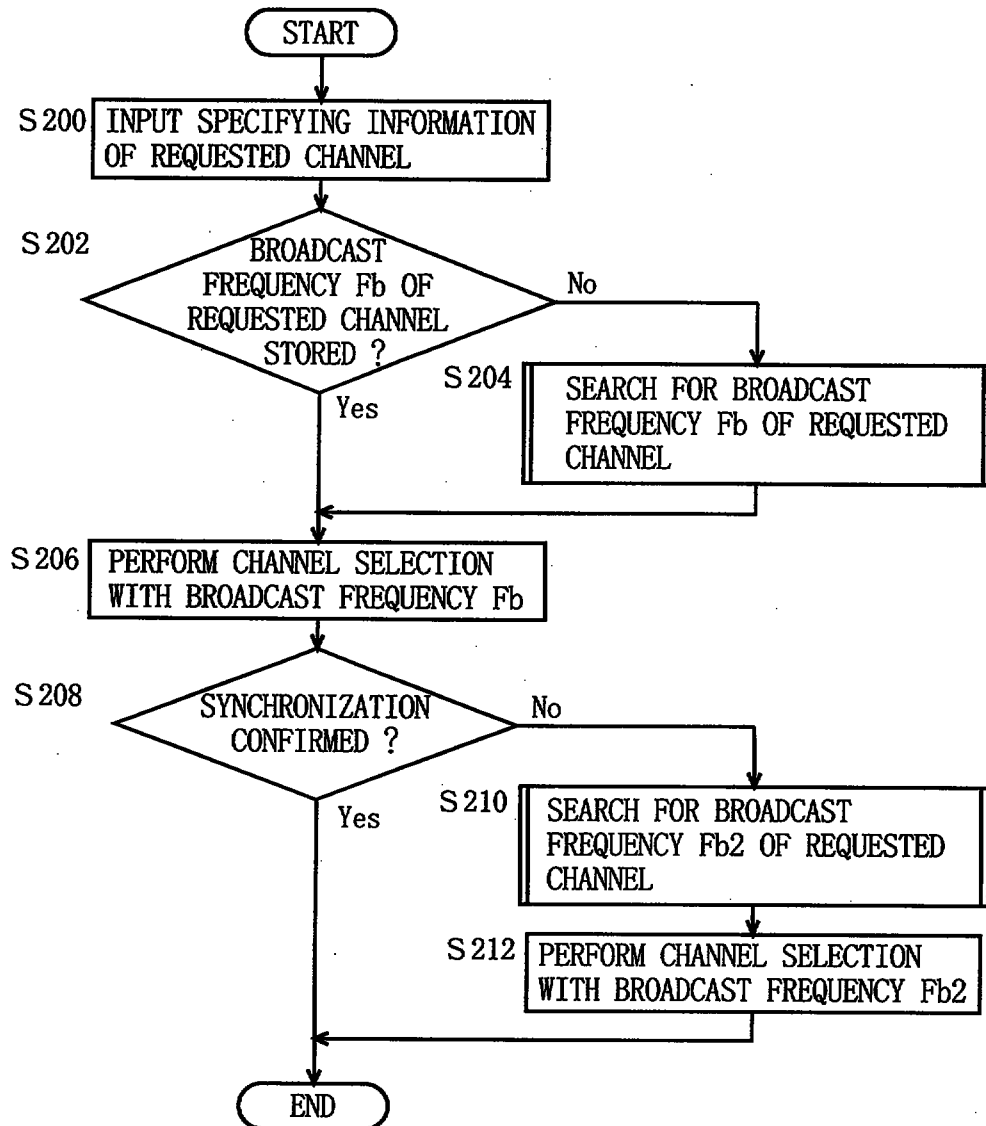


FIG. 8

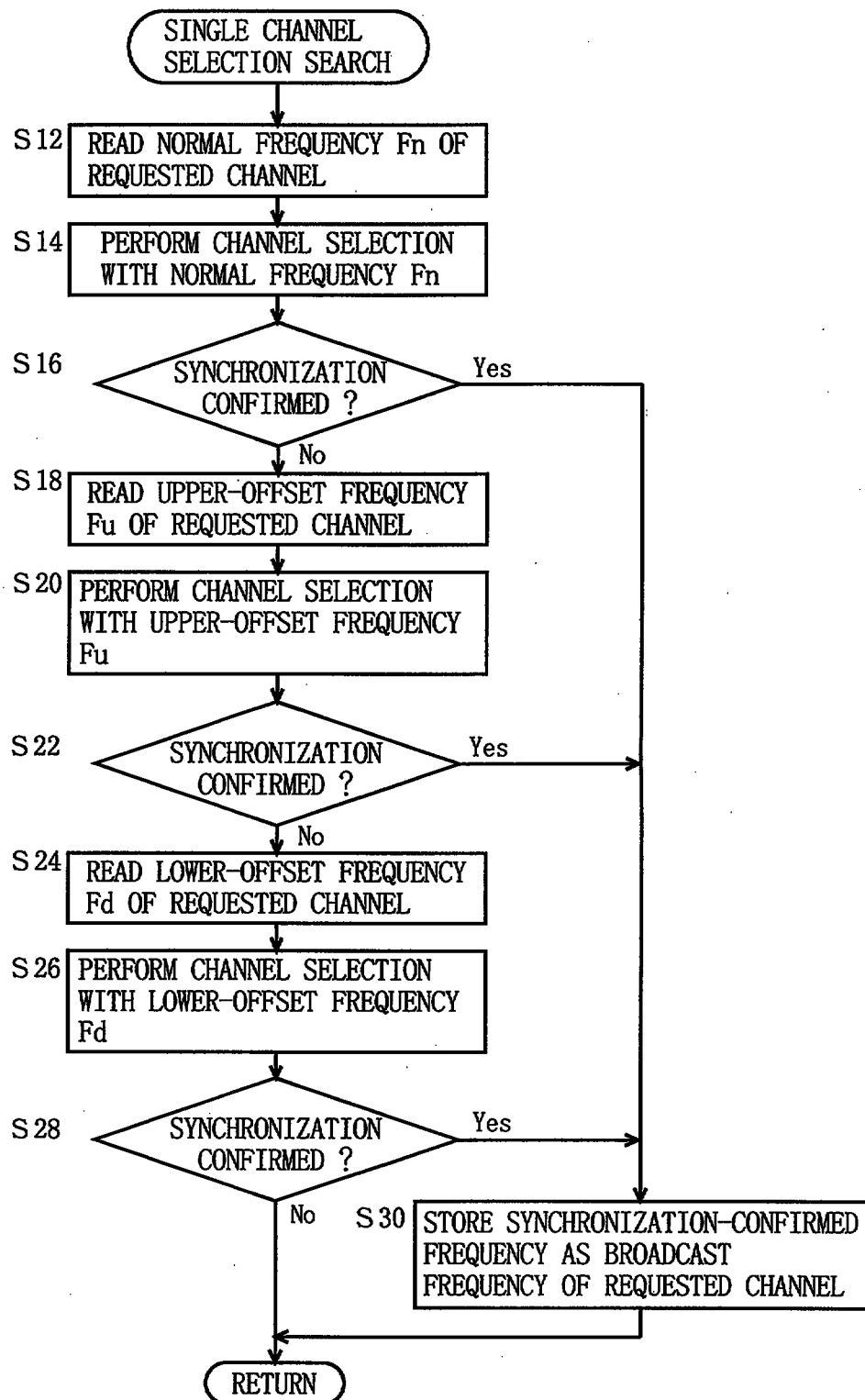


FIG. 9

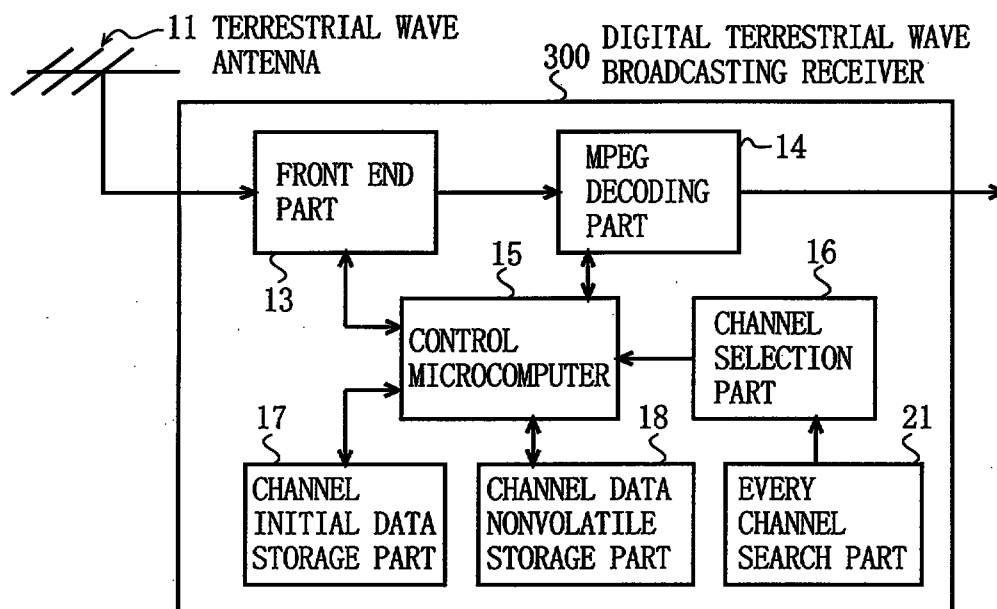


FIG. 10

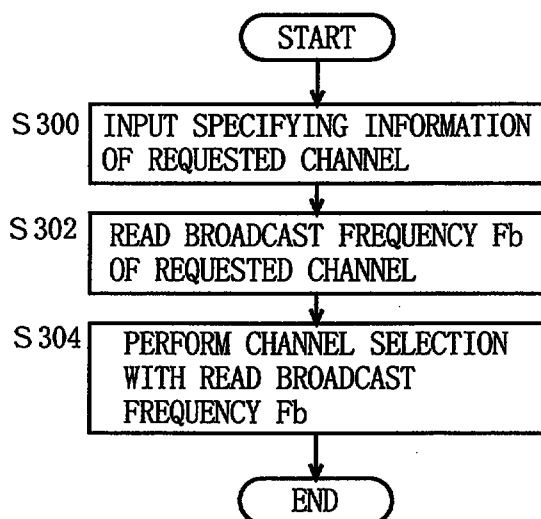


FIG. 11

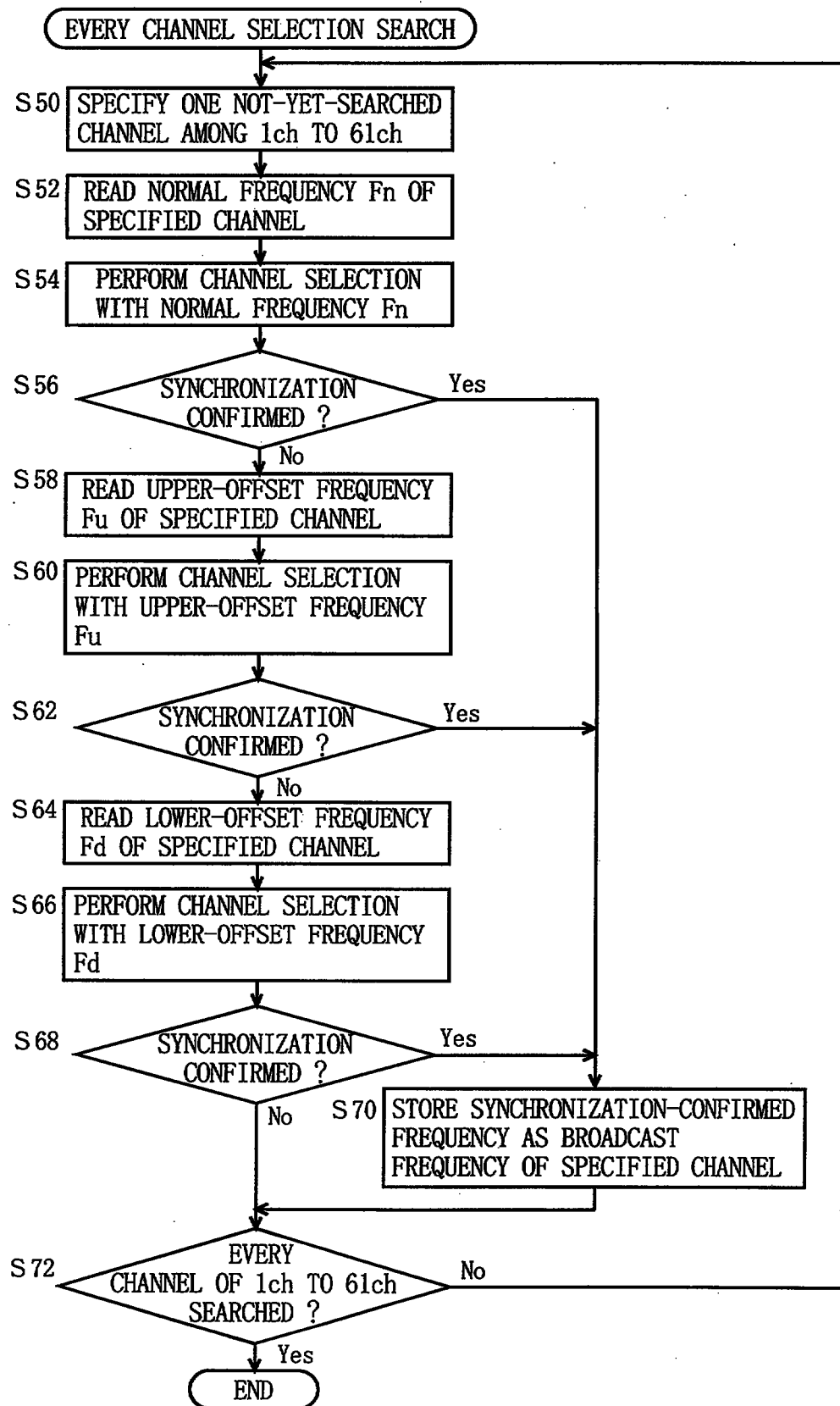


FIG. 12

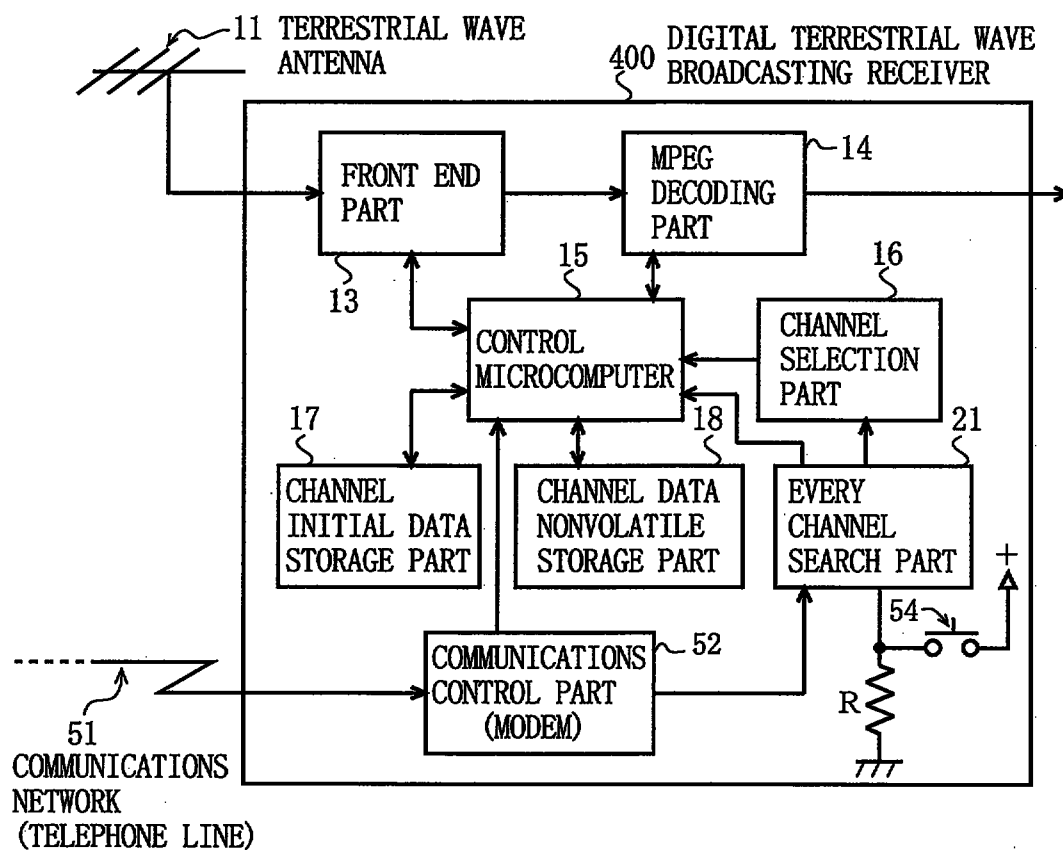


FIG. 13

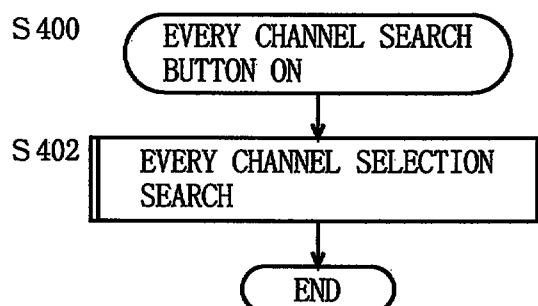


FIG. 14

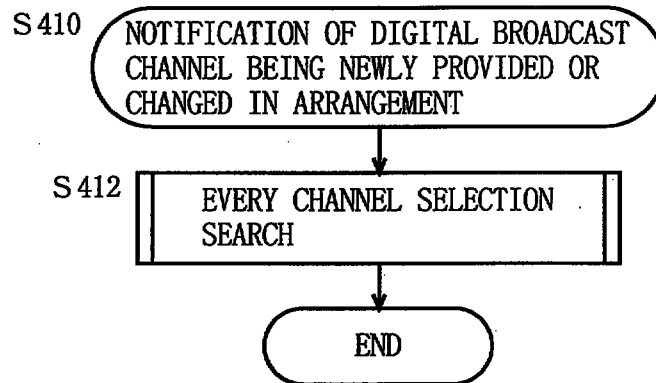


FIG. 15

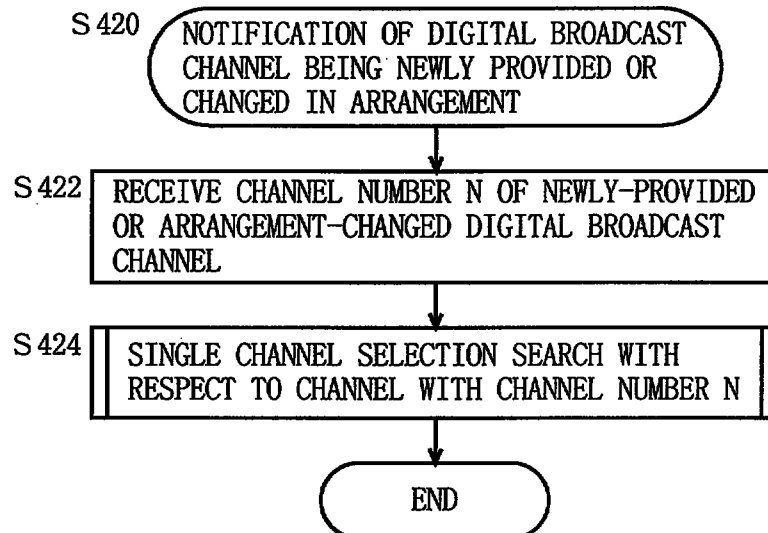


FIG. 16

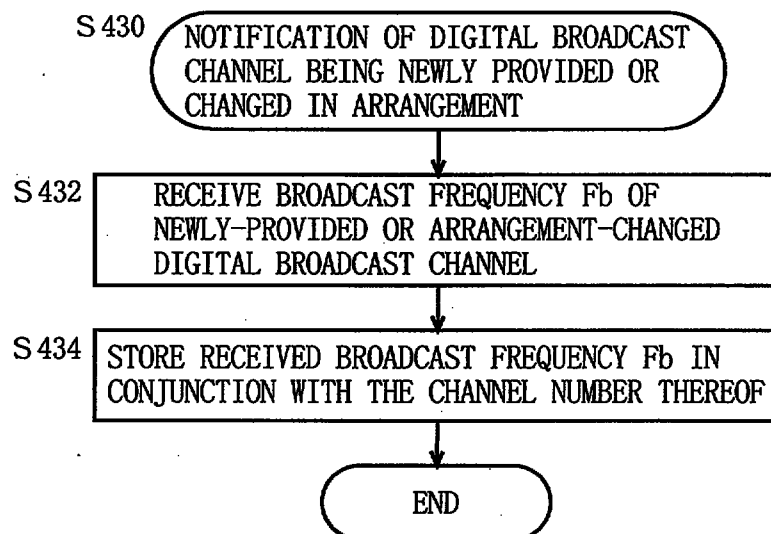


FIG. 17

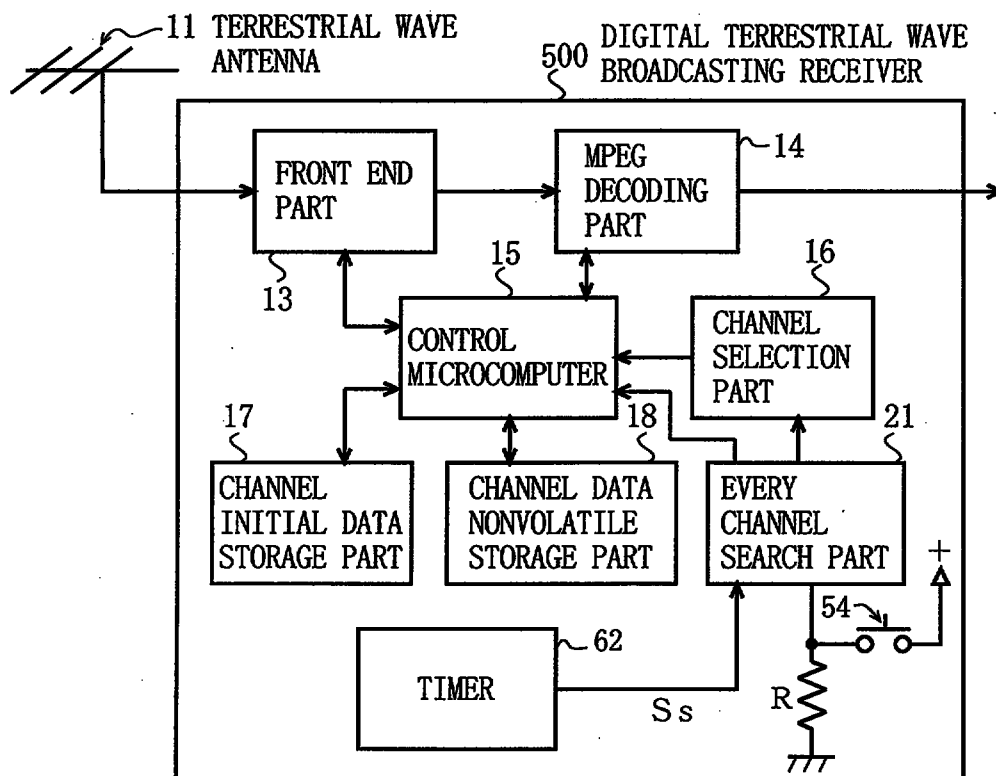


FIG. 18

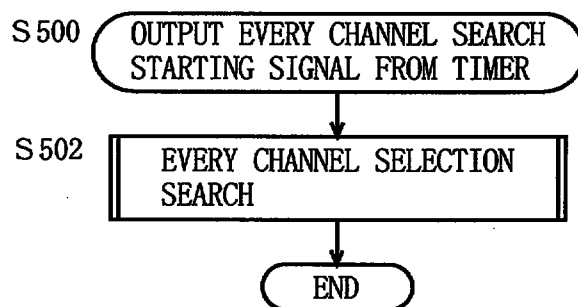


FIG. 19

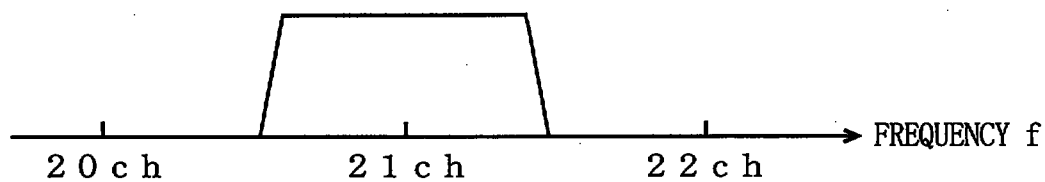


FIG. 20

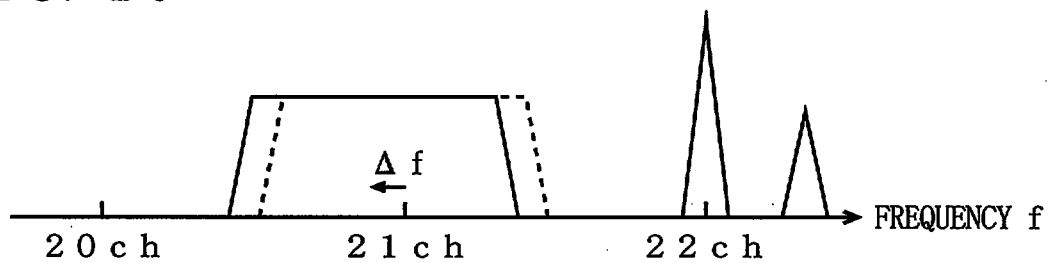
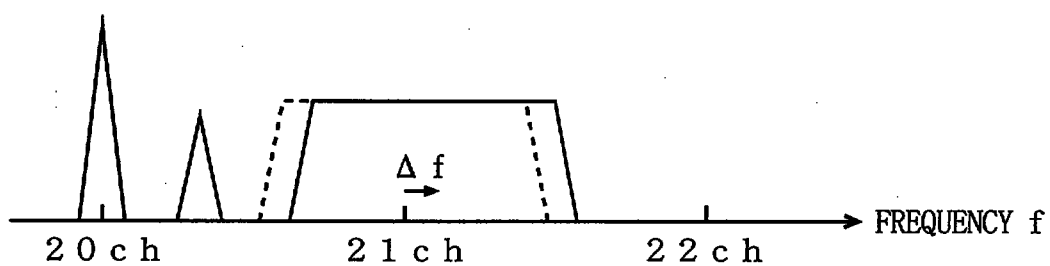
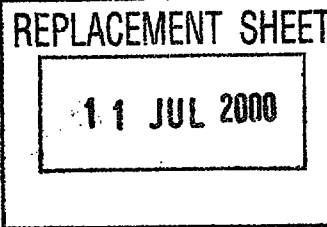


FIG. 21





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digital broadcast in the case that an adjacent channel is not an analog broadcast channel;

FIG. 20 is a diagram showing frequency assignment for digital broadcast in the case that an upper adjacent channel is the analog broadcast channel; and

FIG. 21 is a diagram showing frequency assignment for digital broadcast in the case that a lower adjacent channel is the analog broadcast channel.

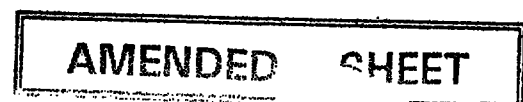
BEST MODE FOR CARRYING OUT THE INVENTION

In order to describe the present invention to a greater detail, the description is made by referring to the accompanying drawings.

<1. First Embodiment>

<1.1 Structure of First Embodiment>

Depicted in FIG. 1 is a block diagram showing the structure of a digital terrestrial broadcasting wave receiver 100 according to a first embodiment of the present invention. The digital terrestrial broadcasting wave receiver 100 is provided with a terrestrial broadcasting wave antenna 11, a front end part 13, an MPEG decoding part 14, a control microcomputer 15, a channel selection part 16, and a channel initial data storage ~~means~~ ^{part} 17. Thereamong, the control microcomputer 15 is the one which controls other constituents in the digital terrestrial broadcasting wave receiver 100, and operates in a later-described manner by carrying



circuit and is in the channel selection frequency, and then down-converted into a frequency band of an IF signal (intermediate frequency signal). The down-converted requested signal is wave-shaped by going through the IF+SAW filter 36, converted from analog to digital in the AD converter 38, and then outputted to the subsequent OFDM demodulation part 39.

The OFDM demodulation part 39 operates on a system clock Sck supplied from the oscillator 35. The oscillator 35 is a voltage controlled crystal oscillator (VCXO), and a control voltage Vc thereof is generated by the VCXO control part 311 based on a signal outputted from the OFDM demodulation part 39. When the requested channel is correctly selected, the VCXO control part 311 and the oscillator 35 generating the system clock Sck to be provided to the OFDM demodulation part ~~38~~³⁹ operate in a normal manner, and thus the OFDM demodulation part 39 can correctly carry out digital demodulation. Accordingly, an error generated in the transmission path, if any, can be corrected by the error correction part 310. The error-corrected signal is forwarded to the MPEG decoding part 14 as the transport stream signal on the requested channel.

When the front end part 13 operates in the above-described normal manner, the OFDM demodulation part 39 outputs an OFDM synchronizing signal Ssync. The OFDM synchronizing signal Ssync is forwarded to the control microcomputer 15 as information for synchronization confirmation. With the OFDM synchronizing

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channel selection part 16. Whenever receiving the information about channel from the every channel search part 21, the channel selection part ~~15~~¹⁶ outputs the channel specifying signal Sch specifying the channel. The channel specifying signal Sch is provided to the control microcomputer 15. In this manner, when preset is carried out, one channel specifying signal Sch for every possible digital broadcast channel is provided, on a channel basis, to the control microcomputer 15. Based on the channel specifying signal Sch, the control microcomputer 15 carries out preset in a later-described manner.

<3.2 Preset Operation and Effects Thereof in Third Embodiment>

Hereinafter, by referring to FIG. 11, it is described how the digital terrestrial broadcasting wave receiver of the third embodiment carries out preset.

In the third embodiment, preset is carried out through an every channel selection search, the procedure of which is shown in FIG. 11. The every channel selection search is started by pushing a specific button (not shown). In the description below, the available digital broadcast channels are presumably 1ch to 61ch.

In the every channel selection search, the channel selection part 16 first specifies, according to information provided by the every channel search part, any one channel being not yet through with channel selection among the 1ch to 61ch, that is, any one not-yet-searched channel, and then outputs the channel