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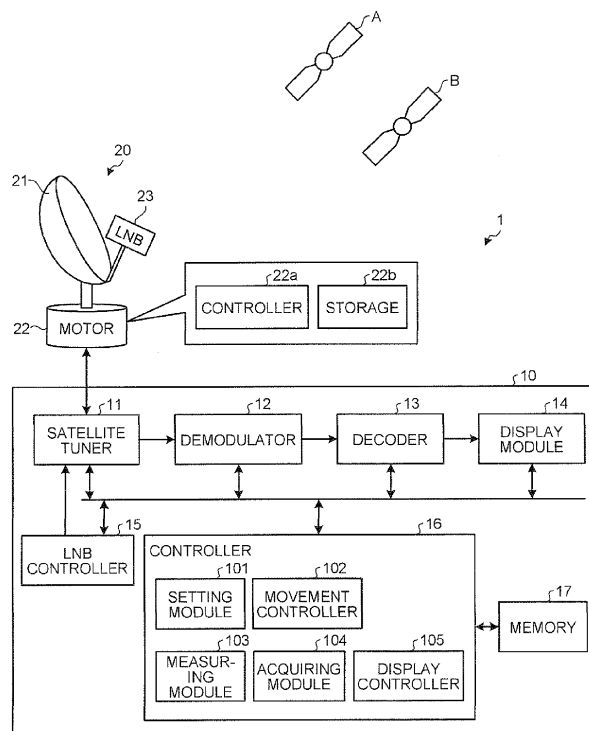
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(54) **Antenna controlling apparatus and method for controlling antenna**

(57) According to one embodiment, an antenna control apparatus (16) includes a movement controller (102), a measuring module (103), and an acquiring module (104). The movement controller (102) controls a moving module (22) that moves an antenna (21) to a receiving position in response to a change of a target satellite from which the satellite broadcasting is received to move the antenna (21) from a reference position to the receiving

position. The measuring module (103) measures a moving time required to move the antenna (21) from the reference position to the receiving position for each satellite. The acquiring module (104) acquires, when the target satellite changes from one to another, a timeout period required to move the antenna (21) from a receiving position of the one satellite to that of the other satellite based on moving times measured for the satellites.

FIG.1



Description

FIELD

[0001] Embodiments described herein relate generally to an antenna control apparatus and a method for controlling an antenna.

BACKGROUND

[0002] Generally, to receive satellite broadcasting from a plurality of satellites with one satellite antenna and a low noise block converter (LNB), the satellite antenna is moved by a rotationally driven motor. This is defined in the Digital Satellite Equipment Control (DiSEqC) standard.

[0003] The DiSEqC standard comes mainly in four versions of DiSEqC 1.0, 1.1, 1.2, and 2.0. In the DiSEqC 1.2, bi-directional communication cannot be performed between a receiver side for receiving satellite broadcasting and a motor. More specifically, in the DiSEqC 1.2, although the receiver side can control the motor, the receiver side cannot acquire information on the motor such as the present positional information of a satellite antenna from the motor.

[0004] Accordingly, after outputting a command to the motor to move the satellite antenna, the receiver side cannot determine whether the satellite antenna is moved by the rotationally driven motor to a position at which it can receive satellite broadcasting from a satellite. The receiver side cannot also determine how long a timeout period the satellite antenna requires to move to the position. Therefore, when satellite broadcasting of a channel selected by a user cannot be received, unless waiting for the longest timeout period required to move the satellite antenna, the receiver side cannot determine whether this is due to lack of signal or because the satellite antenna is being moved. That is, the receiver side cannot specify the reason why the satellite broadcasting cannot be received.

[0005] It is therefore an object to provide an antenna control apparatus and a method for controlling an antenna capable of reducing the timeout period required for selecting a channel.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0006] A general architecture that implements the various features of the invention will now be described with reference to the drawings. The drawings and the associated descriptions are provided to illustrate embodiments of the invention and not to limit the scope of the invention.

[0007]

FIG. 1 is an exemplary block diagram of a receiving system of satellite broadcasting according to a first

embodiment;

FIG. 2 is an exemplary schematic diagram of channels that can be selected in the receiving system of satellite broadcasting according to the first embodiment;

FIG. 3 is an exemplary flowchart of a measurement process of the moving time and the moving direction during the set-up of a receiving device in the first embodiment;

FIG. 4 is an exemplary flowchart of the measurement process of the moving time and the moving direction during the set-up of the receiving device in the first embodiment;

FIG. 5 is an exemplary flowchart of a moving process of an antenna main body when a channel is selected while satellite broadcasting is being viewed, and a satellite from which satellite broadcast radio waves are received is changed from a satellite B to a satellite A in the first embodiment;

FIG. 6 is an exemplary schematic diagram illustrating the movement of the antenna main body when a channel is selected while satellite broadcasting is being viewed, and a satellite from which satellite broadcast radio waves are received is changed from the satellite B to the satellite A in the first embodiment;

FIG. 7 is an exemplary schematic diagram of a message displayed on a display module while an antenna is being moved in the first embodiment;

FIG. 8 is an exemplary schematic diagram of a message displayed on the display module after a timeout period has passed in the first embodiment;

FIG. 9 is an exemplary schematic diagram of a message displayed on the display module after a timeout period has passed in the first embodiment;

FIG. 10 is an exemplary schematic diagram of a message displayed on the display module while an antenna is being moved in the first embodiment;

FIG. 11 is an exemplary flowchart of a measurement process of the moving time and the moving direction during the set-up of the receiving device according to a second embodiment; and

FIG. 12 is an exemplary flowchart of a moving process of an antenna main body when a channel is selected while satellite broadcasting is being viewed, and a satellite from which satellite broadcast radio waves are received is changed from a satellite B to a satellite A in the second embodiment.

DETAILED DESCRIPTION

[0008] Various embodiments will be described hereinafter with reference to the accompanying drawings.

[0009] FIG. 1 is a block diagram of a receiving system of satellite broadcasting according to a first embodiment. As illustrated in FIG. 1, a receiving system 1 of satellite broadcasting of the first embodiment comprises a receiving device 10, a satellite antenna 20, and the like.

[0010] The satellite antenna 20 receives satellite broadcasting from a plurality of satellites A and B. In the first embodiment, the satellite antenna 20 comprises an antenna main body 21, a motor 22, a low noise block converter (LNB) 23, and the like.

[0011] The antenna main body 21 receives satellite broadcast radio waves from the satellites A and B; satellites from which satellite broadcasting is received.

[0012] The LNB 23 serves as a converting device that, after amplifying the satellite broadcast radio waves received from the satellites A and B to a level that can be handled by the receiving device 10 (satellite tuner 11), converts the frequency of the amplified radio waves. The LNB 23 also serves as a switching device that, depending on the voltage of 13 V or 18 V applied by the receiving device 10 (LNB controller 15) (hereinafter, "LNB voltage"), switches the polarization (polarization method) of the satellite broadcast radio waves received by the antenna main body 21 from the satellites A and B.

[0013] In the first embodiment, when the LNB voltage of 13 V is applied by the receiving device 10, the LNB 23 switches the polarization of the satellite broadcast radio waves received by the antenna main body 21 from the satellites A and B to a vertically polarized wave. When the LNB voltage of 18 V is applied by the receiving device 10, the LNB 23 switches the polarization of the satellite broadcast radio waves received by the antenna main body 21 from the satellites A and B to a horizontally polarized wave.

[0014] Based on a command output from the receiving device 10, the motor 22 is rotationally driven and moves the antenna main body 21 to a position capable of receiving satellite broadcast radio waves (hereinafter, "receiving position") from the satellites A and B. The motor 22 is rotationally driven by the LNB voltage applied to the LNB 23. In the first embodiment, the motor 22 is rotationally driven by two types of LNB voltages of 13 V and 18 V, and depending on the increase in the LNB voltage applied to the LNB 23, the speed of moving the antenna main body 21 is increased. Specifically, in the motor 22, the speed of moving the antenna main body 21 when the LNB voltage of 18 V is applied to the LNB 23 (when the polarization of the satellite broadcast radio waves received from the satellites A and B is horizontally polarized wave) is faster than the speed of moving the antenna main body 21 when the LNB voltage of 13 V is applied to the LNB 23 (when the polarization of the satellite broadcast radio waves received from the satellites A and B is vertically polarized wave).

[0015] In the first embodiment, the motor 22 comprises a storage 22b and a controller 22a. The storage 22b stores therein receiving positions of satellites and a reference position of the antenna main body 21 set in advance. The controller 22a reads the receiving position or the reference position from the storage 22b based on a command output from the receiving device 10. The controller 22a rotationally drives the motor 22 and moves the antenna main body 21 to the read receiving position or

the reference position.

[0016] The receiving device 10 converts a signal converted from the satellite broadcast radio waves by the LNB 23 of the satellite antenna 20 to a video signal and an audio signal, and displays video on a display module 14 and outputs audio based on the video signal and the audio signal.

[0017] The receiving device 10 comprises the satellite tuner 11, a demodulator 12, a decoder 13, the display module 14, the LNB controller 15, a controller 16, a memory 17, and the like.

[0018] The satellite tuner 11 extracts a signal converted from the satellite broadcast radio waves of a channel selected by the controller 16 from the signals converted by the LNB 23.

[0019] The demodulator 12 demodulates the signal of the channel extracted by the satellite tuner 11. The demodulator 12, for example, comprises a phase shift keying (PSK) demodulator, an amplitude phase shift keying (APSK) demodulator, and the like. The demodulator 12 demodulates a moving picture experts group-transport stream (MPEG-TS) signal from the signal extracted by the satellite tuner 11.

[0020] The decoder 13 performs TS decoding on the MPEG-TS signal supplied from the demodulator 12. In the TS decoding performed by the decoder 13, digital broadcasting signals (digital video signal and digital audio signal) of a program broadcasted by a broadcasting station are extracted from the signals extracted by the satellite tuner 11. The decoder 13 outputs the digital video signal and the digital audio signal obtained by the TS decoding to the display module 14.

[0021] The display module 14 displays video based on the video signal among the digital broadcasting signals supplied from the decoder 13 under the control by the controller 16. The display module 14 performs various image processes on the video or the like. For example, the display module 14 comprises an on-screen display (OSD) combining function. By using this function, for example, when character information is supplied from the controller 16, the display module 14 converts the character information to display data, and displays the data. The display module 14 also comprises a speaker (which is not illustrated) for outputting audio based on an audio signal.

[0022] Based on the polarization set by the controller 16, the LNB controller 15 applies the LNB voltage to the LNB 23 of the satellite antenna 20. Specifically, when the controller 16 sets the vertically polarized wave, the LNB controller 15 applies the LNB voltage of 13 V to the LNB 23 of the satellite antenna 20, and when the controller 16 sets the horizontally polarized wave, the LNB controller 15 applies the LNB voltage of 18 V to the LNB 23 of the satellite antenna 20.

[0023] The controller 16 is the main portion of the receiving device 10, and intensively controls the modules. In the first embodiment, the LNB controller 15 and the controller 16 serve as an antenna control apparatus that

rotationally drives the motor 22 based on the change of a satellite from which the satellite antenna 20 receives satellite broadcasting between the satellites A and B, and that moves the satellite antenna 20 to the receiving position.

[0024] The controller 16 is a microprocessor comprising a central processing unit (CPU) and the like, and controls the modules so that the operation content from an operation module, which is not illustrated, is reflected. In this case, the controller 16 uses the memory 17. The memory 17 mainly comprises a read only memory (ROM) in which a control program executed by the CPU is stored, a random access memory (RAM) for providing a working area for the CPU, and a nonvolatile memory in which various types of setting information, control information, and the like are stored. The controller 16 is realized by causing the CPU to execute the control program stored in the memory 17.

[0025] The controller 16 comprises a setting module 101, a movement controller 102, a measuring module 103, an acquiring module 104, a display controller 105, and the like.

[0026] The setting module 101 sets the polarization of the satellite broadcast radio waves received from the satellites A and B, and the satellite broadcast band received from the satellites A and B during the set-up of the receiving device 10 and while a channel is selected. In the first embodiment, the setting module 101 sets a horizontally polarized wave or a vertically polarized wave as the polarization of the satellite broadcast radio waves received from the satellites A and B. When a satellite from which the antenna main body 21 receives satellite broadcasting is changed while a channel is selected and the antenna main body 21 is to be moved to the receiving position, the setting module 101 sets the polarization by which the LNB voltage applied to the LNB 23 by the LNB controller 15 becomes highest (horizontally polarized wave) among the polarizations (horizontally polarized wave and vertically polarized wave) of the satellite broadcast radio waves received from the satellites A and B. The setting module 101 also sets a Low band or a High band as the satellite broadcast band received from the satellites A and B. The Low band herein is from 9.6 to 10.6 gigahertz, and the High band herein is from 10.6 to 11.6 gigahertz. In the first embodiment, the setting module 101 sets the polarization and the band based on a selection made by a user through the operation module, which is not illustrated.

[0027] The setting module 101 selects a channel based on the set polarization and band. FIG. 2 is a schematic diagram of channels that can be selected in the receiving system of satellite broadcasting according to the first embodiment. As illustrated in FIG. 2, if the satellite antenna 20 has been moved to a receiving position capable of receiving satellite broadcasting from the satellite A, the setting module 101 can select channels 1 and 2. If the satellite antenna 20 has been moved to a receiving position capable of receiving satellite broad-

casting from the satellite B, the setting module 101 can select channels 3 and 4.

[0028] When a channel is selected while satellite broadcasting is being viewed, the setting module 101 tunes the frequency of a signal extracted by the satellite tuner 11 to the frequency of the satellite broadcast radio waves of the selected channel. If the demodulator 12 is not locked even if the time required for tuning (hereinafter, "tuning time") is equal to or longer than the maximum tuning time set in advance (hereinafter, "maximum tuning time"), or if the demodulator 12 is locked within the maximum tuning time, the setting module 101 finishes the tuning. While tuning, the setting module 101 calculates the time by adding a predetermined time to the tuning time stored in the memory 17 as a new tuning time every time the predetermined time has passed, and stores the new tuning time in the memory 17. The setting module 101 also resets the tuning time stored in the memory 17 before starting tuning.

[0029] The movement controller 102 controls the motor 22. The movement controller 102 controls the rotational drive of the motor 22 and moves the antenna main body 21 from the reference position to the receiving position while a channel is selected and during the set-up of the receiving device 10.

[0030] In the first embodiment, during the set-up of the receiving device 10, the movement controller 102 rotationally drives the motor 22 at every predetermined period of time by a Continuous mode, and moves the antenna main body 21 eastward or westward until the antenna main body 21 is moved to the receiving position. The Continuous mode herein is a mode for roughly moving the antenna main body 21 to the receiving position by continuously and rotationally driving the motor 22.

[0031] The movement controller 102 stops the rotational drive of the motor 22 when the demodulator 12 is locked, when the level of the signal supplied to the demodulator 12 reaches the maximum, or when a carrier-to-noise (C/N) ratio of the signal supplied to the demodulator 12 becomes good, by determining that the antenna main body 21 has been moved to the receiving position. The movement controller 102 determines whether the demodulator 12 is locked based on whether the demodulator 12 has received a signal from the satellite tuner 11 and is in a state capable of demodulating the received signal.

[0032] When the antenna main body 21 has been moved to the receiving position and the rotational drive of the motor 22 is stopped, the movement controller 102 rotationally drives the motor 22 by a Step mode, and finely adjusts the position of the antenna main body 21 by moving the antenna main body 21 eastward or westward. The Step mode herein is a mode for finely moving the antenna main body 21 by rotationally driving the motor 22 in units of steps set in advance. When the C/N ratio of the signal supplied to the demodulator 12 becomes good, the movement controller 102 stores the present position as the receiving position of the antenna main

body 21 in the storage 22b of the motor 22.

[0033] During the set-up of the receiving device 10, the measuring module 103 measures the moving time required for moving the antenna main body 21 from the reference position to the receiving position for each satellite. In the first embodiment, the measuring module 103 resets the total time indicating the total predetermined time during which the motor 22 is rotationally driven by the Continuous mode, and the total step indicating the total number of steps of the motor 22 being rotationally driven by the Step mode before the movement of the antenna main body 21 is started. The total time and the total step are stored in the memory 17.

[0034] While the motor 22 is rotationally driven by the Continuous mode, the measuring module 103 adds or subtracts a predetermined time to and from the total time every time the predetermined time has passed, and stores the calculated total time in the memory 17. For example, when the motor 22 is rotationally driven by the Continuous mode and a predetermined time has passed since the antenna main body 21 moved eastward, the measuring module 103 adds the predetermined time to the total time. When the motor 22 is rotationally driven by the Continuous mode and a predetermined time has passed since the antenna main body 21 moved westward, the measuring module 103 subtracts the predetermined time from the total time.

[0035] While the motor 22 is rotationally driven by the Step mode, the measuring module 103 adds or subtracts the number of steps of the motor 22 being rotationally driven to and from the total step, and stores the calculated total step in the memory 17. For example, when the motor 22 is rotationally driven by the Step mode and the antenna main body 21 has been moved eastward, the measuring module 103 adds the number of steps to the total step. When the motor 22 is rotationally driven by the Step mode and the antenna main body 21 has been moved westward, the measuring module 103 subtracts the number of steps from the total step.

[0036] If the polarization set by the setting module 101 during the set-up of the receiving device 10 is the vertically polarized wave, or if the total step calculated by the controller 16 is greater than the reference step, the measuring module 103 recalculates the total time. Specifically, the measuring module 103 rotationally drives the motor 22 through the movement controller 102, and moves the antenna main body 21 to the reference position. The measuring module 103 also resets the polarization (horizontally polarized wave) and band, and reselects a channel through the setting module 101. The measuring module 103 then resets the total time. The measuring module 103 rotationally drives the motor 22 through the movement controller 102, moves the antenna main body 21 from the reference position to the receiving position, and calculates the time during which the antenna main body 21 is moved from the reference position to the receiving position as the total time. In other words, the measuring module 103 can calculate the total time during which the

highest voltage is supplied among the voltages applied to the LNB 23 by the LNB controller 15.

[0037] When the total time is calculated by the process described above, the measuring module 103 measures an absolute value of the calculated total time as the moving time required for moving the antenna main body 21 from the reference position to the receiving position. Because the measuring module 103 recalculates the total time when the polarization set by the setting module 101 during the set-up is the vertically polarized wave, it is possible to measure the moving time during which the highest LNB voltage is supplied among the LNB voltages applied to the LNB 23 by the LNB controller 15.

[0038] During the set-up of the receiving device 10, the measuring module 103 measures the moving direction in which the antenna main body 21 has been moved from the reference position to the receiving position for each satellite. In the first embodiment, the measuring module 103 measures the moving direction depending on whether the calculated total time is greater than "0". Specifically, if the calculated total time is greater than "0", the measuring module 103 determines that the antenna main body 21 has been moved eastward. If the calculated total time is smaller than "0", the measuring module 103 determines that the antenna main body 21 has been moved westward.

[0039] The measuring module 103 then stores the measured moving time and the moving direction in the memory 17.

[0040] When a channel is selected by a user while satellite broadcasting is being viewed, and a satellite from which the antenna main body 21 receives satellite broadcast radio waves is changed between the satellites A and B, the acquiring module 104 acquires the moving time and the moving direction measured for a satellite before being changed, and the moving time and the moving direction measured for a satellite after being changed (other satellite) from the memory 17. The acquiring module 104 then acquires the time (hereinafter, "timeout period") required for moving the antenna main body 21 from the receiving position capable of receiving satellite broadcasting from the satellite before being changed to the receiving position capable of receiving satellite broadcasting from the satellite after being changed based on the moving time and the moving direction measured for the satellite before being changed and the moving time and the moving direction measured for the satellite after being changed.

[0041] The display controller 105, depending on the timeout period, displays a message related to the movement of the antenna main body 21 or the reception status of a signal on the display module 14, such as "moving", "currently moved by ?%", "reception disabled", "received signal level is low", and the like.

[0042] While the setting module 101 is tuning, the display controller 105 determines whether the demodulator 12 is locked. If the tuning is finished in a state where the demodulator 12 is not locked even if the tuning time is

equal to or longer than the maximum tuning time, the display controller 105 determines that satellite broadcasting cannot be received from the satellites A and B, and finishes the receiving process of satellite broadcasting. If the demodulator 12 is locked within the maximum tuning time, the display controller 105 supplies a signal demodulated by the demodulator 12 to the decoder 13, and outputs a digital video signal and a digital audio signal on which TS decoding is performed by the decoder 13 to the display module 14.

[0043] The measurement process of the moving time and the moving direction during the set-up of the receiving device 10 is described below with reference to FIGS. 3 and 4. FIGS. 3 and 4 are flowcharts of measurement processes of the moving time and the moving direction during the set-up of the receiving device.

[0044] The movement controller 102 rotationally drives the motor 22 by outputting a command to the controller 22a of the motor 22, and moves the antenna main body 21 to the reference position (S301). The setting module 101 then sets the polarization of the satellite broadcast radio waves received from the satellite A and the satellite broadcast band received from the satellite A (S302). The setting module 101 also selects a channel based on the set polarization and band (S303). The measuring module 103 resets the total time and the total step stored in the memory 17 to "0" (S304).

[0045] The movement controller 102 rotationally drives the motor 22 by the Continuous mode, and moves the antenna main body 21 eastward or westward (S305). While the antenna main body 21 is being moved, the movement controller 102 determines whether the demodulator 12 is locked, whether the level of the signal supplied to the demodulator 12 has reached the maximum, or whether the C/N ratio of the signal supplied to the demodulator 12 is good (S306).

[0046] While moving the antenna main body 21 for a predetermined period of time, if the demodulator 12 is not locked, if the level of the signal supplied to the demodulator 12 does not reach the maximum, and if the C/N ratio of the signal supplied to the demodulator 12 is not good (No at S306), the movement controller 102 temporarily stops the rotational drive of the motor 22 (S307). The measuring module 103 then determines whether the antenna main body 21 has been moved in the moving direction of either east or west (S308). If the antenna main body 21 has been moved in the moving direction of east (EAST at S308), the measuring module 103 calculates the time by adding the predetermined time to the total time stored in the memory 17 as a new total time, and stores the new total time in the memory 17 (S309). If the antenna main body 21 has been moved in the moving direction of west (WEST at S308), the measuring module 103 calculates the time by subtracting the predetermined time from the total time stored in the memory 17 as a new total time, and stores the new total time in the memory 17 (S310).

[0047] While the antenna main body 21 is being moved

for the predetermined period of time, if the demodulator 12 is locked, if the level of the signal supplied to the demodulator 12 reaches the maximum, or if the C/N ratio of the signal supplied to the demodulator 12 becomes good (Yes at S306), the movement controller 102 determines that the antenna main body 21 has been moved to the receiving position, and stops the rotational drive of the motor 22 (S311).

[0048] The movement controller 102 then finely adjusts the position of the antenna main body 21 by rotationally driving the motor 22 by the Step mode in units of steps set in advance, and moving the antenna main body 21 eastward or westward (S312). The measuring module 103 then determines whether the moving direction in which the antenna main body 21 has been moved is east or west (S313). If the moving direction in which the antenna main body 21 has been moved is east (EAST at S313), the measuring module 103 calculates a value by adding the number of steps of the motor 22 being rotationally driven to the total step stored in the memory 17 as a new total step, and stores the new total step in the memory 17 (S314). If the moving direction in which the antenna main body 21 has been moved is west (WEST at S313), the measuring module 103 calculates a value by subtracting the number of steps of the motor 22 being rotationally driven from the total step stored in the memory 17 as a new total step, and stores the new total step in the memory 17 (S315). The movement controller 102 repeats the movement of the antenna main body 21 by rotationally driving the motor 22 (S312 to S315) until the C/N ratio of the signal supplied to the demodulator 12 becomes good (No at S316).

[0049] If the C/N ratio of the signal supplied to the demodulator 12 becomes good (Yes at S316), the movement controller 102 stores the present position of the antenna main body 21 as the receiving position in the storage 22b of the motor 22 (S317).

[0050] When the receiving position of the antenna main body 21 is stored in the storage 22b of the motor 22, the measuring module 103 determines whether the total time stored in the memory 17 is greater than "0" (S401). If the total time stored in the memory 17 is greater than "0" (Yes at S401), the measuring module 103 determines that "east" is the moving direction of the antenna main body 21 (S402). If the total time stored in the memory 17 is smaller than "0" (No at S401), the measuring module 103 determines that "west" is the moving direction of the antenna main body 21 (S403).

[0051] When the moving direction is determined, the measuring module 103 determines whether the set polarization is the vertically polarized wave (S404). If the set polarization is the horizontally polarized wave (No at S404), the measuring module 103 determines whether the total step stored in the memory 17 is greater than the reference step set in advance (S405).

[0052] If the set polarization is the vertically polarized wave (Yes at S404), and if the total step is greater than the reference step (Yes at S405), the measuring module

103 recalculates the total time.

[0053] Specifically, the movement controller 102 outputs a command to the controller 22a of the motor 22, rotationally drives the motor 22, and moves the antenna main body 21 to the reference position (S406). The measuring module 103 then waits for as much as the time obtained by adding the time (α) corresponding to the total step stored in the memory 17 to the total time stored in the memory 17 (total time+ α) (S407). The setting module 101 then sets the polarization (horizontally polarized wave) and band of the satellite broadcast radio waves received from the satellite A (S408), and selects a channel based on the set polarization (horizontally polarized wave) and band (S409). The measuring module 103 then resets the total time stored in the memory 17 to "0" (S410).

[0054] The movement controller 102 then outputs a command to the controller 22a of the motor 22, rotationally drives the motor 22, and moves the antenna main body 21 to the receiving position (S411). While moving the antenna main body 21 to the receiving position, the measuring module 103 measures the time during which the antenna main body 21 is being moved, and calculates the time by adding the measured time to the total time stored in the memory 17 as the total time (S412). The measuring module 103 waits until the demodulator 12 is locked, until the level of the signal supplied to the demodulator 12 reaches the maximum, or until the C/N ratio of the signal supplied to the demodulator 12 becomes good (S413).

[0055] If the demodulator 12 is locked, if the level of the signal supplied to the demodulator 12 reaches the maximum, or if the C/N ratio of the signal supplied to the demodulator 12 becomes good (Yes at S413), or if the total step is equal to or smaller than the reference step (No at S405), the measuring module 103 measures the absolute value of the total time stored in the memory 17 as the moving time (S414). The measuring module 103 then stores the measured moving time and the moving direction in the memory 17 (S415). The controller 16 performs the processes described above on all the satellites from which the satellite antenna 20 receives satellite broadcast radio waves.

[0056] The moving process of the antenna main body 21 when a channel is selected while satellite broadcasting is being viewed, and a satellite from which satellite broadcast radio waves are received is changed from the satellite B to the satellite A is described below with reference to FIGS. 5 and 6. FIG. 5 is a flowchart of a moving process of the antenna main body when a channel is selected while satellite broadcasting is being viewed, and a satellite from which satellite broadcast radio waves are received is changed from the satellite B to the satellite A. FIG. 6 illustrates the movement of the antenna main body when a channel is selected while satellite broadcasting is being viewed, and a satellite from which satellite broadcast radio waves are received is changed from the satellite B to the satellite A.

[0057] The acquiring module 104 acquires the moving time and the moving direction (FTIME and FDIR) measured or determined for the satellite B from the memory 17 (S501). FTIME is the moving time from the reference position to a receiving position B capable of receiving satellite broadcast radio waves from the satellite B. FDIR is the moving direction from the reference position to the receiving position B. The acquiring module 104 also acquires the moving time and the moving direction (TTIME and TDIR) measured or determined for the satellite A from the memory 17 (S502). TTIME is the moving time from the reference position to a receiving position A capable of receiving satellite broadcast radio waves from the satellite A. TDIR is the moving direction from the reference position to the receiving position A.

[0058] The acquiring module 104 then determines whether the moving directions determined for the satellites A and B are the same (S503). If the moving directions determined for the satellites A and B are the same (Yes at S503), as illustrated in FIG. 6, the antenna main body 21 need not be passed through the reference position while being moved from the receiving position B to the receiving position A. Accordingly, the acquiring module 104 acquires the time obtained by subtracting the moving time measured for the satellite A based on the moving time measured for the satellite B as the timeout period (S504).

[0059] If the moving directions determined for the satellites A and B are different (No at S503), as illustrated in FIG. 6, the antenna main body 21 needs to pass through the reference position while being moved from the receiving position B to the receiving position A. Accordingly, the acquiring module 104 acquires the time obtained by adding the moving time measured for the satellite A to the moving time measured for the satellite B as the timeout period (S505).

[0060] When the timeout period is acquired, the setting module 101 temporarily sets the polarization of the satellite broadcast radio waves received from the satellite A to the horizontally polarized wave (S506), and the movement controller 102 rotationally drives the motor 22 and moves the antenna main body 21 to the receiving position A (S507). In the first embodiment, the moving time when the horizontally polarized wave is set as the polarization of the satellite broadcast radio waves received from the satellites A and B is measured. Accordingly, the highest LNB voltage (18 V) among the LNB voltages (13 V and 18 V) to be applied to the LNB 23 by the LNB controller 15 is applied to the LNB 23 by setting the horizontally polarized wave as the polarization of the satellite broadcast radio waves received from the satellite A. Consequently, the rotational driving speed of the motor 22 is increased, thereby increasing the moving speed of the antenna main body 21. As a result, it is possible to reduce the time required for selecting a channel.

[0061] While the antenna main body 21 is being moved to the receiving position A, the setting module 101 waits for as much as the time obtained by adding the time re-

quired for finely adjusting the antenna main body 21 to the timeout period acquired at S505 (timeout period+ α) (S508). During the time, the display controller 105 may display a message as illustrated in FIG. 7 or 10 on the display module 14. FIGS. 7 and 10 illustrate examples of messages displayed on the display module while the antenna is being moved.

[0062] After waiting for the timeout period+ α , the setting module 101 sets the polarization and band of the satellite broadcast radio waves received from the satellite A (S509). The setting module 101 also resets the tuning time stored in the memory 17 to "0" (S510).

[0063] The setting module 101 then selects a channel of satellite broadcasting received from the satellite A based on the set polarization and band, and performs tuning (S511). During that time, the setting module 101 determines whether the demodulator 12 is locked (S512). If the demodulator 12 is locked (Yes at S512), the setting module 101 finishes the tuning, and the display controller 105 supplies a signal demodulated by the demodulator 12 to the decoder 13, and outputs a digital video signal and a digital audio signal on which TS decoding is performed by the decoder 13 to the display module 14.

[0064] If the demodulator 12 is not locked (No at S512), the setting module 101 determines whether the tuning time stored in the memory 17 is shorter than the maximum tuning time set in advance (S513). If the tuning time is equal to or longer than the maximum tuning time (No at S513), the setting module 101 finishes the tuning. The display controller 105 may display a message as illustrated in FIG. 8 or FIG. 9 on the display module 14. FIGS. 8 and 9 illustrate examples of messages displayed on the display module after the timeout period has passed.

[0065] If the tuning time is shorter than the maximum tuning time (Yes at S513), the setting module 101 calculates the time by adding a predetermined time to the tuning time as a new tuning time, and after waiting for a predetermined period of time, the setting module 101 determines whether the demodulator 12 is locked again (S514).

[0066] In this manner, in the receiving system 1 of satellite broadcasting according to the first embodiment, the motor 22 is rotationally driven, the antenna main body 21 is moved from the reference position to the receiving position, and the moving time required for moving the antenna main body 21 from the reference position to the receiving position is measured for each satellite from which the antenna main body 21 receives satellite broadcasting. If a satellite from which the antenna main body 21 receives satellites broadcasting is changed, the timeout period required for moving the antenna main body 21 from the receiving position capable of receiving satellite broadcasting from the satellite before being changed to the receiving position capable of receiving satellite broadcasting from the satellite after being changed is acquired based on the moving time measured for the satellite before being changed and the moving time measured for

the satellite after being changed. Accordingly, when satellite broadcasting of a channel selected by a user cannot be received, there is no need to wait for the longest timeout period required for moving the antenna main body 21. Consequently, it is possible to reduce the timeout period while a channel is selected.

[0067] A second embodiment is an example of setting the polarization by which the LNB voltage applied to the LNB by the LNB controller becomes highest among the polarizations of the satellite broadcast radio waves received from the satellite, when the satellite antenna is moved to the reference position during the set-up of the receiving device. In the following explanation, descriptions of the same portions as those in the first embodiment will be omitted, and only the portions different from those in the first embodiment are described.

[0068] When the antenna main body 21 is moved to the reference position during the set-up of the receiving device 10, the setting module 101 sets the polarization of the satellite broadcast radio waves received from the satellites A and B to the horizontally polarized wave. Accordingly, the LNB voltage applied to the LNB 23 by the LNB controller 15 is the highest LNB voltage among the LNB voltages applied to the LNB 23, thereby increasing the rotation speed of the motor 22. Consequently, the time required for moving the antenna main body 21 to the reference position is reduced. After the antenna main body 21 has been moved to the reference position, the setting module 101 resets the polarization of satellite broadcast radio waves received from the satellites A and B, and the satellite broadcast band received from the satellites A and B.

[0069] During the set-up of the receiving device 10, the movement controller 102 rotationally drives the motor 22 and moves the antenna main body 21 to the reference position. The movement controller 102 then rotationally drives the motor 22 by the Step mode, and moves the antenna main body 21 from the reference position to the receiving position. If the demodulator 12 is locked and the C/N ratio of the signal supplied to the demodulator 12 becomes good, the movement controller 102 stores the present position as the receiving position of the antenna main body 21 in the storage 22b of the motor 22.

[0070] In the second embodiment, during the set-up of the receiving device 10, the movement controller 102 rotationally drives the motor 22 and temporarily moves the antenna main body 21 to the reference position. However, if the receiving position is already stored in the storage 22b of the motor 22, the receiving position may be used as the starting position, and the antenna main body 21 may be moved from the starting position to another receiving position. Accordingly, the antenna main body 21 need not be moved to the reference position every time the total step is calculated. Consequently, it is possible to reduce the time required for calculating the total step.

[0071] During the set-up of the receiving device 10 and before the antenna main body 21 starts to be moved to

the receiving position, the measuring module 103 resets the total step stored in the memory 17. When the antenna main body 21 starts to be moved from the receiving position already stored in the storage 22b of the motor 22, the total step required for moving the antenna main body 21 to the receiving position already stored in the storage 22b of the motor 22 is used as the total step.

[0072] Similarly to the first embodiment, while the motor 22 is rotationally driven by the Step mode, the measuring module 103 calculates the number of steps by adding or subtracting the number of steps of the motor 22 being rotationally driven to and from the total step as the total step.

[0073] When a channel is selected while satellite broadcasting is being viewed and a satellite from which satellite broadcast radio waves are received is changed, the acquiring module 104 acquires the total step and the moving direction calculated for the satellite before being changed, and the total step and the moving direction calculated for the satellite after being changed (other satellite) from the memory 17. The acquiring module 104 then calculates the number of moving steps required for moving the antenna main body 21 from the receiving position capable of receiving satellite broadcasting from the satellite before being changed to the receiving position capable of receiving satellite broadcasting from the satellite after being changed based on the total step and moving direction calculated for the satellite before being changed and the total step and moving direction calculated for the satellite after being changed (other satellite).

[0074] Specifically, the acquiring module 104 determines whether the moving directions determined for the satellite before being changed and the satellite after being changed are the same. If the moving directions determined for the satellite before being changed and the satellite after being changed are the same, the acquiring module 104 calculates the number of steps by subtracting the total step calculated for the satellite after being changed from the total step calculated for the satellite before being changed as the number of moving steps. The acquiring module 104 then acquires the time by multiplying the time corresponding to one step of the motor 22 by the number of moving steps thus calculated as the timeout period.

[0075] If the moving directions determined for the satellite before being changed and the satellite after being changed are different, the acquiring module 104 calculates the number of steps by adding the total step calculated for the satellite after being changed to the total step calculated for the satellite before being changed as the number of moving steps. The acquiring module 104 then acquires the time by multiplying the time corresponding to one step of the motor 22 by the number of moving steps thus calculated as the timeout period.

[0076] In the second embodiment, the time corresponding to one step of the motor 22 is a constant. Accordingly, because of the characteristics of the motor 22 and the like, the acquired timeout periods fluctuate. How-

ever, in the second embodiment, the timeout period can be acquired from the number of steps required for moving the antenna main body 21 by rotationally driving the motor 22 by the Step mode during the set-up of the receiving device 10. Consequently, it is possible to measure the moving time with relatively easy control compared with that of the first embodiment.

[0077] The measurement process of the moving time and the moving direction during the set-up of the receiving device 10 is described below with reference to FIG. 11. FIG. 11 is a flowchart of the measurement process of the moving time and the moving direction during the set-up of the receiving device.

[0078] The setting module 101 sets the polarization of the satellite broadcast radio waves to the horizontally polarized wave (S1101). The movement controller 102 outputs a command to the controller 22a of the motor 22, rotationally drives the motor 22, and moves the antenna main body 21 to the reference position (S1102). The measuring module 103 then waits until the antenna main body 21 is moved to the reference position and resets the total step (S1103 and S1104). The setting module 101 sets the polarization of the satellite broadcast radio waves received from the satellite A and the satellite broadcast band received from the satellite A (S1105), and selects a channel based on the set polarization and band (S1106).

[0079] The movement controller 102 rotationally drives the motor 22 by the Step mode, and moves the antenna main body 21 eastward or westward (S1107). While the antenna main body 21 is being moved, the measuring module 103 determines whether the moving direction of the antenna main body 21 is east or west (S1108). If the antenna main body 21 has been moved eastward (EAST at S1108), the measuring module 103 calculates a value by adding the number of steps of the motor 22 being rotationally driven to the total step as a new total step, and stores the new total step in the memory 17 (S1109). If the antenna main body 21 has been moved westward (WEST at S1108), the measuring module 103 calculates a value by subtracting the number of steps of the motor 22 being rotationally driven from the total step as a new total step, and stores the new total step in the memory 17 (S1110).

[0080] While moving the antenna main body 21, if the demodulator 12 is locked and the C/N ratio of the signal supplied to the demodulator 12 becomes good (Yes at S1111 and Yes at S1112), the movement controller 102 stops the rotational drive of the motor 22, and stores the present position of the antenna main body 21 as the receiving position in the storage 22b of the motor 22 (S1113).

[0081] When the receiving position of the antenna main body 21 is stored in the storage 22b of the motor 22, the measuring module 103 determines whether the total step stored in the memory 17 is greater than "0" (S1114). If the total step stored in the memory 17 is greater than "0" (Yes at S1114), the measuring module 103

determines that "east" is the moving direction of the antenna main body 21 (S1115). If the total step stored in the memory 17 is smaller than "0" (No at S1114), the measuring module 103 determines that "west" is the moving direction of the antenna main body 21 (S1116).

[0082] When the moving direction is determined, the measuring module 103 stores the calculated total step and the determined moving direction in the memory 17 (S1117). The controller 16 performs the processes described above on all the satellites from which the satellite antenna 20 receives satellite broadcast radio waves.

[0083] The moving process of the antenna main body 21 when a channel is selected while satellite broadcasting is being viewed and a satellite from which satellite broadcast radio waves are received is changed from the satellite B to the satellite A is described below with reference to FIG. 12. FIG. 12 is a flowchart of the moving process of the antenna main body when a channel is selected while satellite broadcasting is being viewed, and a satellite from which satellite broadcast radio waves are received is changed from the satellite B to the satellite A.

[0084] The acquiring module 104 acquires the total step and the moving direction (Fstep and FDIR) calculated or determined for the satellite B from the memory 17 (S1201). Fstep is the number of steps from the reference position to the receiving position B capable of receiving satellite broadcast radio waves from the satellite B. FDIR is the moving direction from the reference position to the receiving position B. The acquiring module 104 also acquires the total step and the moving direction (Tstep and TDIR) calculated or determined for the satellite A from the memory 17 (S1202). Tstep is the number of steps from the reference position to the receiving position A capable of receiving satellite broadcast radio waves from the satellite A. TDIR is the moving direction from the reference position to the receiving position A.

[0085] The acquiring module 104 determines whether the moving directions determined for the satellites A and B are the same (S1203). If the moving directions determined for the satellites A and B are the same (Yes at S1203), as illustrated in FIG. 6, the antenna main body 21 need not be passed through the reference position while being moved from the receiving position B to the receiving position A. Accordingly, the acquiring module 104 calculates the number of moving steps by subtracting the total step calculated for the satellite A from the total step calculated for the satellite B. The acquiring module 104 also acquires the time by multiplying the time corresponding to one step of the motor 22 by the number of moving steps as the timeout period (S1204).

[0086] If the moving directions determined for the satellites A and B are different (No at S1203), as illustrated in FIG. 6, the antenna main body 21 needs to be passed through the reference position while being moved from the receiving position B to the receiving position A. Accordingly, the acquiring module 104 calculates the number of moving steps by adding the total step calculated for the satellite A to the total step calculated for the

satellite B. The acquiring module 104 also acquires the time by multiplying the time corresponding to one step of the motor 22 by the number of moving steps as the timeout period (S1205).

[0087] When the timeout period is acquired, the setting module 101 temporarily sets the polarization of the satellite broadcast radio waves received from the satellite A to the horizontally polarized wave (S1206), and the movement controller 102 rotationally drives the motor 22 and moves the antenna main body 21 to the receiving position A (S1207). In the second embodiment, the measuring module 103 calculates the total step required for moving the antenna main body 21 to the receiving position of each of the satellites. Accordingly, the polarization of the satellite broadcast radio waves received from the satellite A is set to the horizontally polarized wave, and the highest LNB voltage (18 V) among the LNB voltages (13 V and 18 V) applied to the LNB 23 by the LNB controller 15 is applied to the LNB 23. Consequently, the rotational driving speed of the motor 22 is increased, thereby increasing the moving speed of the antenna main body 21. As a result, it is possible to reduce the time required for selecting a channel.

[0088] While the antenna main body 21 is being moved to the receiving position A, the setting module 101 waits for as much as the time obtained by adding the time required for finely adjusting the antenna main body 21 to the timeout period acquired at S1205 (timeout period + α) (S1208). During that time, similarly to the first embodiment, the display controller 105 may display a message as illustrated in FIG. 7 or 10 on the display module 14.

[0089] After waiting for the timeout period + α , the setting module 101 sets the polarization and band of the satellite broadcast radio waves received from the satellite A (S1209), and resets the tuning time stored in the memory 17 to "0" (S1210).

[0090] The setting module 101 then selects a channel of the satellite broadcasting received from the satellite A based on the set polarization and band, and performs tuning (S1211). During the time, the setting module 101 determines whether the demodulator 12 is locked (S1212). If the demodulator 12 is locked (Yes at S1212), the display controller 105 supplies a signal demodulated by the demodulator 12 to the decoder 13, and outputs a digital video signal and a digital audio signal on which TS decoding is performed by the decoder 13 to the display module 14.

[0091] If the demodulator 12 is not locked (No at S1212), the setting module 101 determines whether the tuning time stored in the memory 17 is shorter than the maximum tuning time set in advance (S1213). If the tuning time is equal to or longer than the maximum tuning time (No at S1213), the setting module 101 determines that the satellite broadcasting of the selected channel cannot be received from the satellite A, and finishes the process. Similarly to the first embodiment, the display controller 105 may display a message as illustrated in FIG. 8 or FIG. 9 on the display module 14.

[0092] If the tuning time is shorter than the maximum tuning time (Yes at S1213), the setting module 101 calculates the time by adding a predetermined time to the tuning time as a new tuning time. After waiting for the predetermined period of time, the setting module 101 determines whether the demodulator 12 is locked again (S1214).

[0093] In this manner, in the receiving system 1 of satellite broadcasting according to the second embodiment, when the satellite antenna 20 is moved to the reference position during the set-up of the receiving device 10, the polarization by which the LNB voltage applied to the LNB 23 by the LNB controller 15 becomes highest is set among the polarizations of the satellite broadcast radio waves received from the satellite. Accordingly, the LNB voltage applied to the LNB 23 by the LNB controller 15 is the highest LNB voltage among the LNB voltages applied to the LNB 23, thereby increasing the rotation speed of the motor 22. Consequently, it is possible to reduce the time required for moving the antenna main body 21 to the reference position.

[0094] As described above, with the first and second embodiments, it is possible to reduce the timeout period required for selecting a channel.

[0095] Moreover, the various modules of the systems described herein can be implemented as software applications, hardware and/or software modules, or components on one or more computers, such as servers. While the various modules are illustrated separately, they may share some or all of the same underlying logic or code.

[0096] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the invention. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

1. An antenna control apparatus (16), comprising:

a movement controller (102) configured to control a moving module (22) to move an antenna (21) from a reference position to a receiving position at which the antenna (21) can receive satellite broadcasting, the moving module (22) configured to move the antenna (21) to the receiving position in response to a change of a target satellite from which the antenna (21) receives the satellite broadcasting;
a measuring module (103) configured to measure a moving time required to move the antenna

(21) from the reference position to the receiving position for each satellite from which the antenna (21) receives the satellite broadcasting; and an acquiring module (104) configured to acquire, when the target satellite changes from a first satellite to a second satellite, a timeout period required to move the antenna (21) from a receiving position of the first satellite to a receiving position of the second satellite based on a moving time measured for the first satellite and a moving time measured for the second satellite.

2. The antenna control apparatus (16) of Claim 1, further comprising a display controller (105) configured to display the timeout period acquired by the acquiring module (104) on a display module (14) while the antenna (21) is being moved in response to a change of a satellite from which the antenna (21) receives the satellite broadcasting.

3. The antenna control apparatus (16) of Claim 1 or 2, further comprising:

a setting module (101) configured to set polarization of a satellite broadcast radio wave; and an applying module (15) configured to apply a voltage corresponding to the polarization set by the setting module (101) to a switching device (23) that switches polarization of the satellite broadcast radio wave received by the antenna (21) according to the voltage being applied, wherein

the moving module (22) is configured to increase speed for moving the antenna (21) corresponding to an increase of the voltage applied to the switching device (23), and

the measuring module (103) is configured to measure the moving time when a highest voltage is applied among voltages applied to the switching device (23) by the applying module (15).

4. The antenna control apparatus (16) of Claim 3, wherein the setting module (101) is configured to set polarization by which the voltage applied to the switching device (23) by the applying module (15) becomes highest among polarizations of the satellite broadcast radio wave when the antenna (21) is moved to the receiving position in response to a change of a satellite from which the antenna (21) receives the satellite broadcasting.

5. The antenna control apparatus (16) of Claim 3 or 4, wherein the setting module (101) is configured to set polarization by which the voltage applied to the switching device (23) by the applying module (15) becomes highest among polarizations of the satellite broadcast radio wave when the antenna (21) is

moved to the reference position.

6. The antenna control apparatus (16) of one of Claims 1 to 5, wherein the movement controller (102) is configured to use one of receiving positions of the antenna (21) as the reference position, and move the antenna (21) from the receiving position used as the reference position to another receiving position. 5
7. The antenna control apparatus (16) of one of Claims 1 to 6, wherein 10
the measuring module (103) is configured to measure a moving direction in which the antenna (21) has been moved from the reference position to the receiving position for each satellite from which the antenna (21) receives the satellite broadcasting, and when the first satellite from which the antenna (21) receives the satellite broadcasting is changed to the second satellite, the acquiring module (104) acquires the timeout period required to move the antenna (21) from the receiving position of the first satellite to the receiving position of the second satellite based on the moving time and a moving direction measured for the first satellite and the moving time and a moving direction measured for the second satellite. 20 25
8. An antenna control apparatus (16), comprising:
a setting module (101) configured to set polarization of a satellite broadcast radio wave received by an antenna (21); 30
an applying module (15) configured to apply a voltage corresponding to the polarization set by the setting module (101) to a switching device (23) that switches polarization of the satellite broadcast radio wave received by the antenna (21) according to the voltage being applied; 35
a movement controller (102) configured to move the antenna (21) to a receiving position at which the antenna (21) can receive satellite broadcasting in response to a change of a target satellite from which the antenna (21) receives the satellite broadcasting, and control a moving module (22) that increases a speed of moving the antenna (21) according to an increase of the voltage applied to the switching device (23) to move the antenna (21) from a reference position to the receiving position; 40
a measuring module (103) configured to measure a moving time required to move the antenna (21) from the reference position to the receiving position for each satellite from which the antenna (21) receives satellite broadcasting; and 45
an acquiring module (104) configured to acquire, when the target satellite changes from a first satellite to a second satellite, a timeout period required to move the antenna (21) from a 50 55

receiving position of the first satellite to a receiving position of the second satellite based on a moving time measured for the first satellite and a moving time measured for the second satellite, wherein

the setting module (101) is configured to set polarization by which the voltage applied to the switching device (23) by the applying module (15) becomes highest among polarizations of the satellite broadcast radio wave when the antenna (21) is moved to the reference position.

9. A method for controlling an antenna applied to an antenna control apparatus comprising a controller and a storage module, the method comprising, in the controller: 15

controlling, by a movement controller, a moving module to move an antenna from a reference position to a receiving position at which the antenna can receive satellite broadcasting, the moving module configured to move the antenna to the receiving position in response to a change of a target satellite from which the antenna receives the satellite broadcasting;

measuring, by a measuring module, a moving time required to move the antenna from the reference position to the receiving position for each satellite from which the antenna receives the satellite broadcasting; and

acquiring, by an acquiring module, when the target satellite changes from a first satellite to a second satellite, a timeout period required to move the antenna from a receiving position of the first satellite to a receiving position of the second satellite based on a moving time measured for the first satellite and a moving time measured for the second satellite.

FIG.1

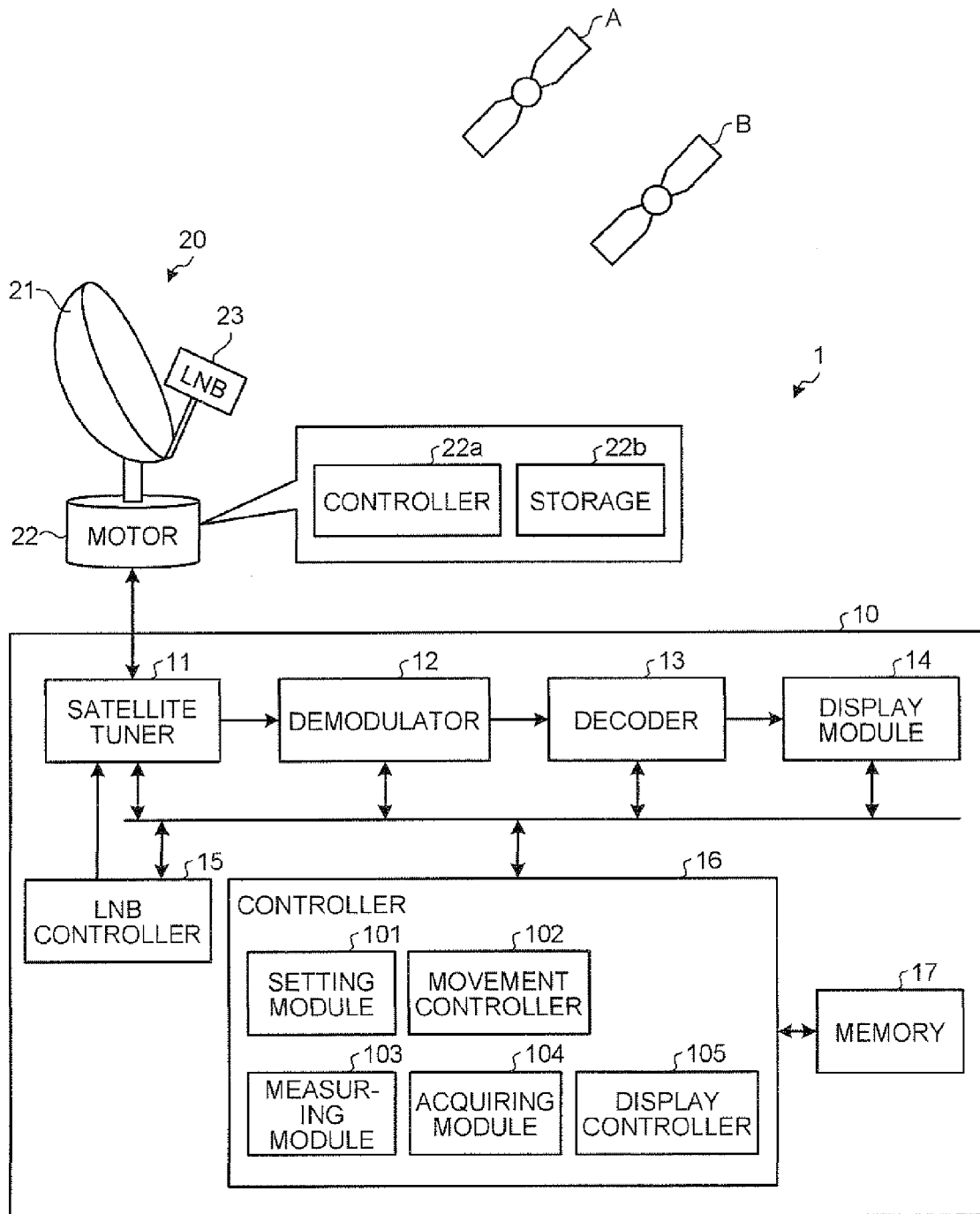


FIG.2

CHANNEL	SATELLITE	POLARIZATION	LNB VOLTAGE
CHANNEL 1	SATELLITE A	VERTICAL	13 V
CHANNEL 2	SATELLITE A	HORIZONTAL	18 V
CHANNEL 3	SATELLITE B	VERTICAL	13 V
CHANNEL 4	SATELLITE B	HORIZONTAL	18 V

FIG.3

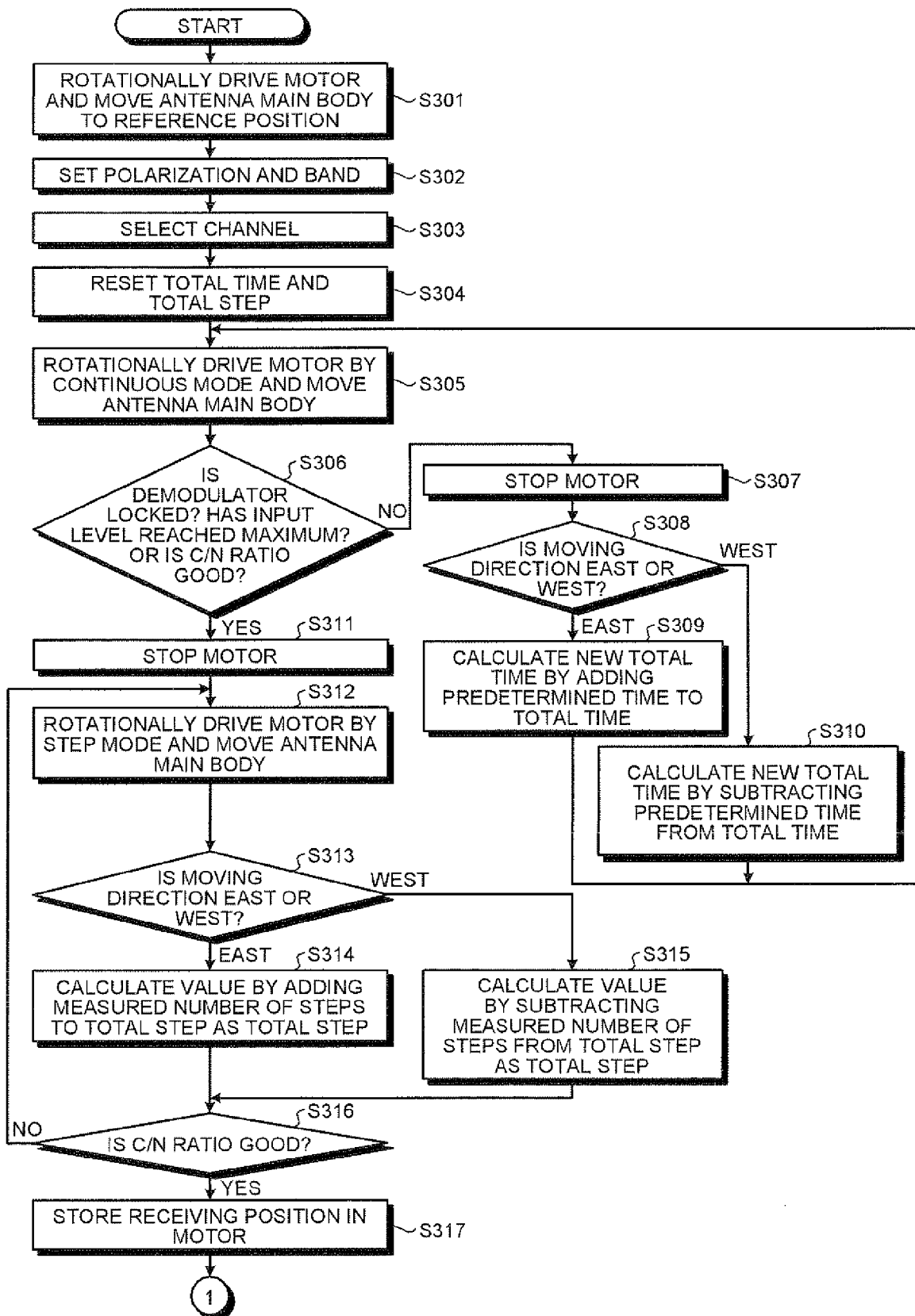


FIG.4

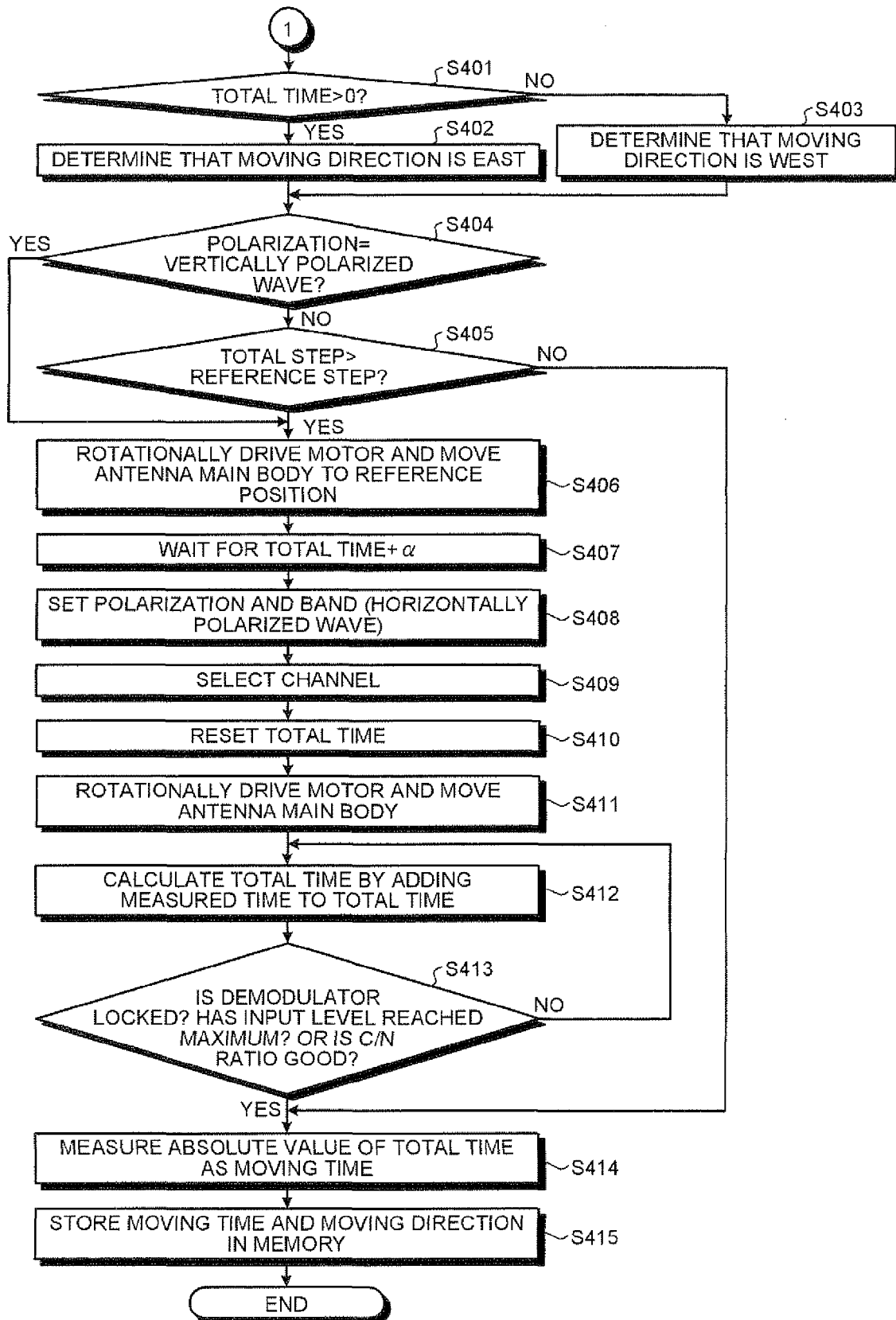


FIG.5

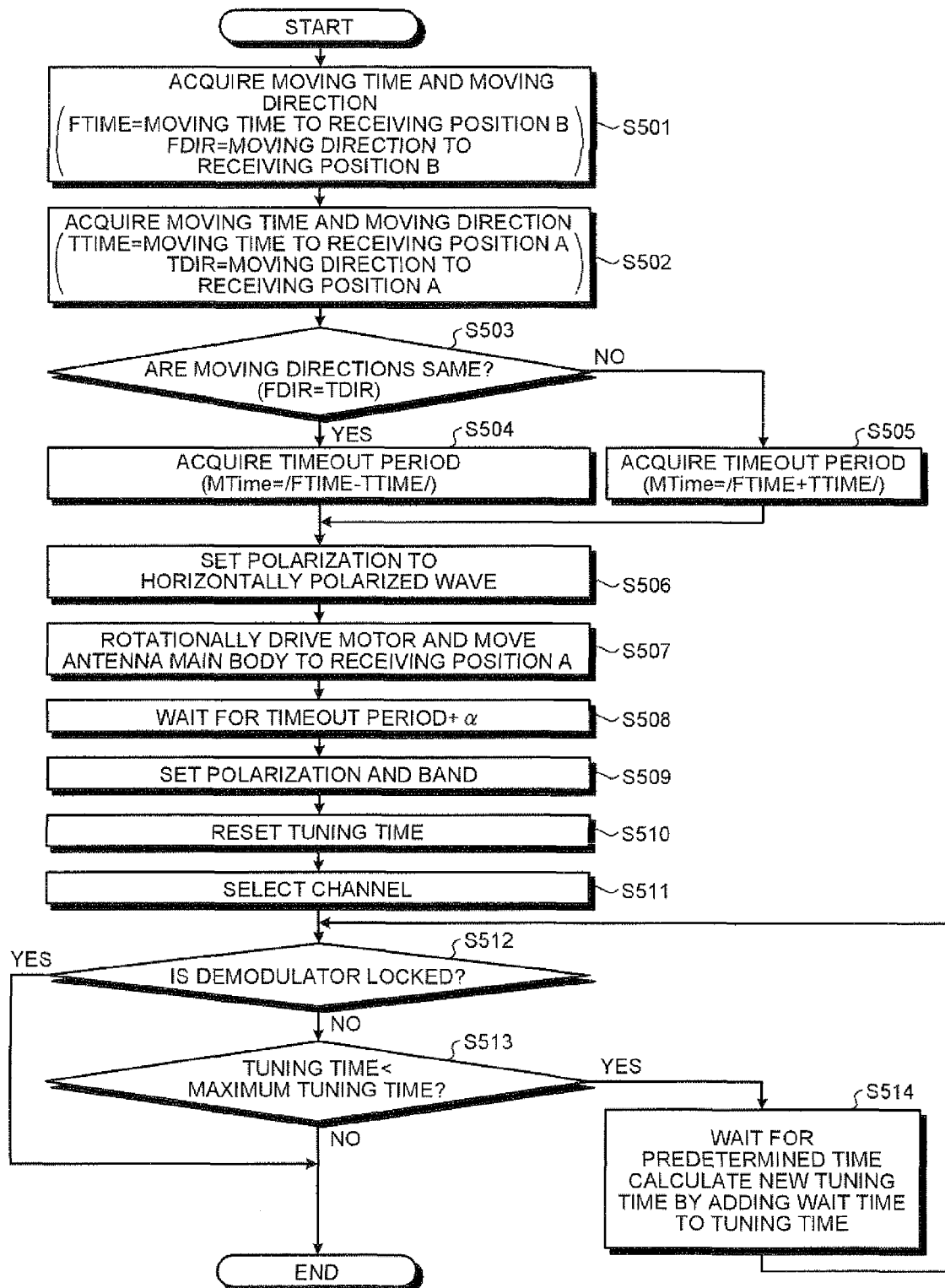


FIG.6

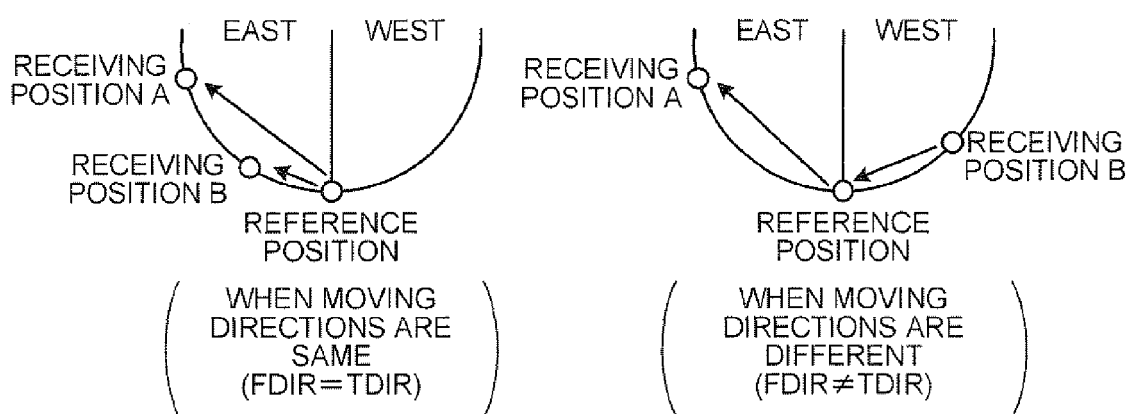


FIG.7

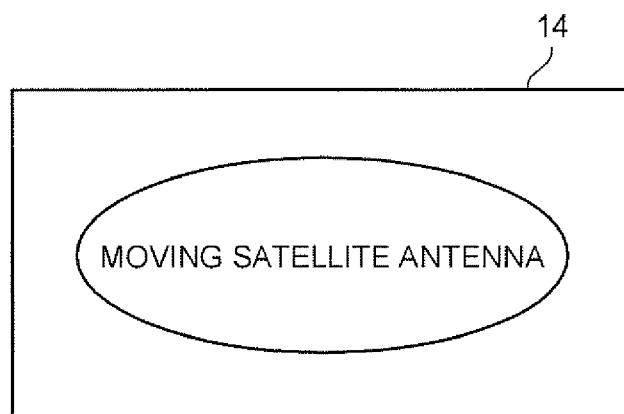


FIG.8

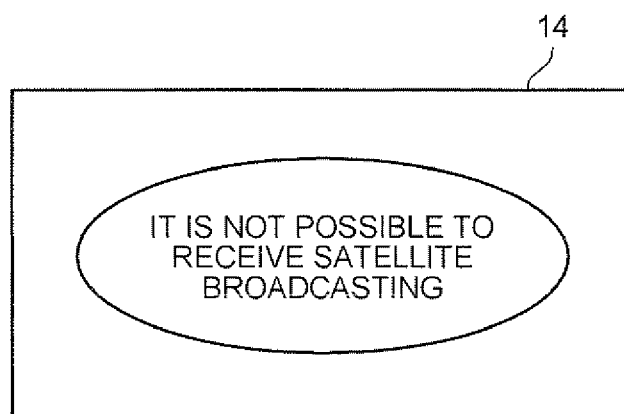


FIG.9

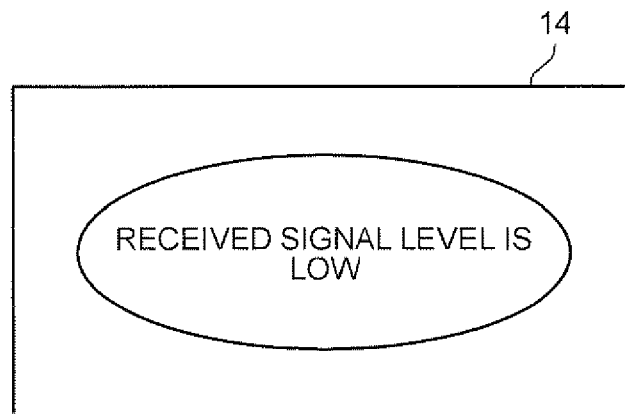


FIG.10

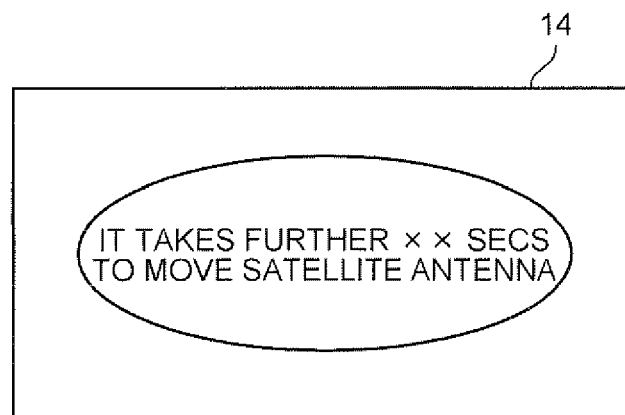


FIG.11

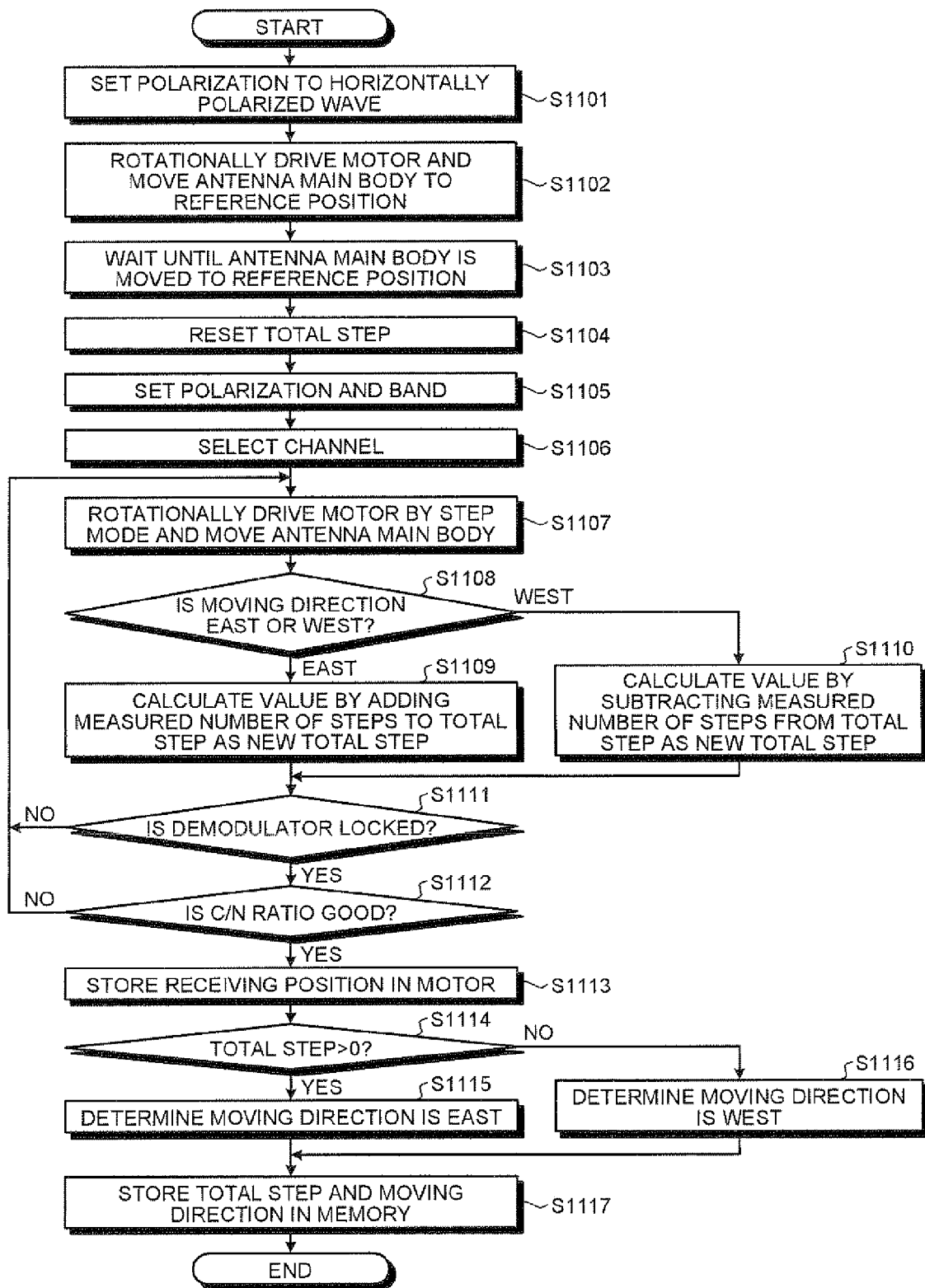


FIG. 12

