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(54) Benævnelse: **ANTENNEINSPEKTIONSSYSTEM, ANTENNEINSPEKTIONSAPPARAT, ANTENNEINSPEKTIONSFREMGANGSMÅDE OG PROGRAM**

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DESCRIPTION

Technical Field

[0001] The present invention relates to an antenna inspection system, an antenna inspection apparatus, an antenna inspection method and program for diagnosing abnormal conditions of an antenna.

Background Art

[0002] There is a kind of antennas, that is, automatic tracking antennas either with a four-axis drive system consisting of an AZ (azimuth) drive axis, an EL (elevation) drive axis, a Cross-EL (cross-elevation) drive axis and a POL (polarization) drive axis, or with a three-axis drive system consisting of an AZ drive axis, an EL drive axis and a POL drive axis.

[0003] In particular, satellite tracking antenna apparatuses are needed to have mechanical strength that can be secured even under severe vibration conditions, and are needed to have long operating life and high reliability. Furthermore, being low in cost, small in size and low in weight is demanded (for example, see Patent Literature 1).

[0004] In maintaining of antennas, visual inspection is conducted to determine whether or not an antenna is in abnormal conditions by checking the appearance of the antenna. Patent Literature 2 discloses a method of performing maintenance by detaching units of an antenna with a three-axis drive system consisting of an AZ drive axis, a Cross-EL drive axis and an EL drive axis.

[0005] Additionally, a visual inspection apparatus that uses a camera to capture an image of an object to be inspected and uses this captured image to inspect the object is generally known. In using such a visual inspection apparatus, users are required to determine whether or not an antenna is in abnormal conditions by viewing.

[0006] In other ways, in the case of automatic detection of abnormal conditions, it is needed, for example, to capture an image of an object to be inspected that is in a normal state in advance, to execute image-processing on the image data captured in advance and image data of the object that is captured when visual inspection is conducted, and to determine whether or not the object is in abnormal conditions based on prescribed determination criteria.

[0007] For example, Patent Literature 3 discloses an appearance inspection apparatus that displays on a monitor an image of an object to be inspected captured by a CCD camera to allow observation and inspection of the state of the object.

[0008] Patent Literature 4 discloses an image processing device that has detection means for detecting image information regarding a test object, detects image information regarding a predetermined standard detection target that is used as the test object, obtains difference data that corresponds to differences from image information that is detected in advance regarding the predetermined standard detection target, and displays image information that is based on the difference data.

[0009] Patent Literature 5 is considered to be relevant prior art and discloses an inspection of a pick-up operation of a pick and place machine. In this inspection, pick up images are compared, before and after the pick up images are compared, and a determination is made as to whether the component has been correctly picked up on a nozzle.

[0010] Patent Literature 6 is also considered to be relevant prior art and discloses a mobile communication base station antenna control system for remote control of an antenna by sensing a change in horizontal sector directional angle or a tilt of the antenna due to an external environmental factor such as wind pressure, a camera module executes a capture operation of a surrounding nearby service area, a comparison is made between the presently captured image data and prestored reference image data, and determination is made as to whether the difference in the tilt and degree of rotation of the antenna are greater than or equal to predetermined ranges.

Citation List

Patent Literature

[0011]

Patent Literature 1: Unexamined Japanese Patent Application Kokai Publication JP-A-2008-228 045

Patent Literature 2: Unexamined Japanese Patent Application Kokai Publication JP-A-2011-087 044

Patent Literature 3: Unexamined Japanese Patent Application Kokai Publication JP-A-2000-171 224

Patent Literature 4: Examined Japanese Patent Application Publication JP-B-S61-012 311

Patent Literature 5: US 2006/075631 A1

Patent Literature 6: US 2011/151932 A1.

Summary of the Invention

Technical Problem

[0012] When inspecting an antenna apparatus by the above-described visual inspection method, it is necessary for a user to detect abnormal conditions by viewing. In the case of automatically detecting abnormal conditions of an antenna apparatus from a captured image of the antenna apparatus, storing a large amount of image data captured in various operation stages is needed to diagnose abnormal conditions of the antenna apparatus, and image-processing and determination criteria for determining whether or not the antenna apparatus is in abnormal conditions are needed.

[0013] Furthermore, in the case of automatically detecting abnormal conditions of an antenna apparatus from a captured image of the antenna apparatus having a flexible cable, the fact that a position of the cable may change for each image capture, may cause misdetection.

[0014] The present invention has been made in consideration of the foregoing circumstances and it is an objective of the present invention to detect abnormal conditions of an antenna automatically through a simple process using a small amount of data.

Solution to the Problem

[0015] The foregoing objective is achieved by an antenna inspection apparatus according to claim 1, an antenna inspection method according to claim 4 and an antenna inspection system according to claim 5.

Advantageous Effects of the Invention

[0016] The present invention is capable of detecting abnormal conditions of an antenna automatically through a simple process using a small amount of data.

Brief Description of the Drawings

[0017]

FIG. 1A
is a front view illustrating an example of an antenna apparatus according to an

embodiment of the present invention;

FIG. 1B

is a side view illustrating the example of the antenna apparatus according to the embodiment of the present invention;

FIG. 2

is a block diagram illustrating the example of the configuration of the antenna inspection system according to the embodiment;

FIG. 3

is a flow chart illustrating the example of the operation of the antenna inspection according to the embodiment; and

FIG. 4

is a block diagram illustrating the example of the hardware configuration of the image comparing device according to the embodiment of the present invention.

Description of Embodiments

[0018] An embodiment for carrying out the present invention will be explained in detail with reference to the drawings. In the drawings, the same or corresponding portions will be denoted by the same reference numerals.

[0019] FIG. 1A is a front view illustrating an example of an antenna apparatus according to an embodiment of the present invention. FIG. 1B is a side view illustrating the antenna apparatus according to the embodiment of the present invention. An antenna apparatus 11 includes an antenna with a four-axis drive system consisting of an AZ drive axis, an EL drive axis, a Cross-EL drive axis and a POL drive axis. The antenna that is included in the antenna apparatus 11 according to the present embodiment is an automatic tracking antenna.

[0020] The antenna apparatus 11 includes an antenna that includes a main reflector 3, a sub-reflector 4 that reflects reflected waves from the main reflector 3, an amplification device 5, a frequency conversion device 6, an AZ-axis drive motor, an EL-axis drive motor, a Cross-EL-axis drive motor and a POL-axis drive motor, a dome 1 that covers the antenna, and a base 2 that serves as a cradle for the antenna. Furthermore, a camera 7 is mounted on inside of the dome or the base 2 of the antenna apparatus 11. The camera 7 is mounted at a position that does not interfere with the operation of the antenna.

[0021] FIG. 2 is a block diagram illustrating the example of the configuration of the antenna inspection system according to the embodiment. The antenna inspection system 100 includes an antenna apparatus 11, a control apparatus 12 that controls the antenna apparatus 11 and the camera 7, and an antenna inspection apparatus 10 that detects abnormal conditions of the antenna apparatus based on an image of the antenna captured by the camera 7.

[0022] In the present embodiment, the antenna inspection system 100 includes a worker's terminal 8 that is connected with the antenna inspection apparatus 10 via the Internet. By configuring the antenna apparatus 11 to be accessible from the worker's terminal 8 via the Internet, a worker who performs the antenna maintenance is allowed to view image data of the antenna captured by the camera 7 and inspection result data, even from a remote location. Such visual checking is useful as a pre-inspection prior to the maintenance work.

[0023] The antenna apparatus 11 consists of, as a functional configuration, a transmitting/receiving unit 111, an amplifying unit 112, a frequency conversion unit 113, a POL-axis driving unit 114, an EL-axis driving unit 115, a Cross-EL-axis driving unit 116 and an AZ-axis driving unit 117.

[0024] The transmitting/receiving unit 111 includes a main reflector 3, a sub-reflector 4, and the like, and transmits and receives radio waves.

[0025] The amplifying unit 112 includes an amplification device 5 and the like, and amplifies the radio waves received by the transmitting/receiving unit 111.

[0026] The frequency conversion unit 113 includes a frequency conversion device 6 and the like, and converts the frequency of the radio waves amplified by the amplifying unit 112.

[0027] The POL-axis driving unit 114 includes a POL-axis drive motor and the like, and operates according to the instruction data transmitted from the control apparatus 12.

[0028] The EL-axis driving unit 115 includes an EL-axis drive motor and the like, and operates according to the instruction transmitted from the control apparatus 12.

[0029] The Cross-EL-axis driving unit 116 includes a Cross-EL-axis drive motor and the like, and operates according to instruction data transmitted from the control apparatus 12.

[0030] The AZ-axis driving unit 117 includes an AZ-axis drive motor and the like, and operates according to the instruction data transmitted from the control apparatus 12.

[0031] The POL-axis driving unit 114, the EL-axis driving unit 115, the Cross-EL-axis driving unit 116 and the AZ-axis driving unit 117 drive respective axis drive motors according to the instruction data received from the control apparatus 12 to control a position of the antenna directed to a satellite, that is, the position and attitude of the main reflector 3 and the sub reflector 4.

[0032] The camera 7 mounted on the antenna apparatus 11 captures an image of the antenna according to the instruction data transmitted from the control apparatus 12 and transmits image data that indicates the captured image to the control apparatus 12.

[0033] The control apparatus 12 includes, as a functional configuration, an antenna control

unit 121 and a camera control unit 122.

[0034] Based on programmed angle-data, the antenna control unit 121 generates instruction data for instructing each of the AZ-axis, EL-axis, Cross-EL-axis and POL-axis drive motors to rotate in a clockwise direction or in a counter-clockwise direction. Then, the antenna control unit 121 transmits the instruction data to each of the POL-axis driving unit 114, the EL-axis driving unit 115, the Cross-EL-axis driving unit 116 and the AZ-axis driving unit 117.

[0035] The antenna control unit 121 generates instruction data for executing a programmed initial operation, i.e., origin detection, during a startup sequence after the power is switched-on, and transmits the instruction data to the antenna apparatus 11. The origin detection is an operation for detecting the zero point of an axis.

[0036] Although the origin detection may be started in any attitude, this operation finally results in a predetermined attitude that refers to the zero point. The origin detection is executed for each axis. The predetermined attitude that refers to the zero point after the end of the origin detection is determined for each axis.

[0037] Upon activating the origin detection program after the power has been switched-on, the antenna control unit 121 transmits start notification data that notifies of the start of the origin detection, to the camera control unit 122. Furthermore, the antenna control unit 121 starts the origin detection for the next axis upon receiving from the camera control unit 122 image-capturing end notification data that notifies that the image-capturing has ended. In addition, each time an origin detection for each axis is ended, the antenna control unit 121 transmits end notification data that notifies of the end of the origin detection, to the camera control unit 122.

[0038] Each time receiving the start notification data and the end notification data from the antenna control unit 121, the camera control unit 122 generates instruction data that instructs the camera 7 to capture an image, and transmits the instruction data to the camera 7. Through this, the camera control unit 122 controls a timing at which the camera 7 captures an image.

[0039] Furthermore, upon receiving image data from the camera 7, the camera control unit 112 transmits the image data to the antenna inspection apparatus 10 and transmits the image-capturing end notification data that notifies that the image-capturing has ended, to the antenna control unit 121.

[0040] The antenna inspection apparatus 10 includes, as a functional configuration, an image acquisition unit 101, a comparing diagnosis unit 102, storage unit 103 and an outputting unit 104.

[0041] The image acquisition unit 101 acquires from the control apparatus 12 image data that indicates the image of the antenna captured by the camera 7. The image acquisition unit 101 makes the storage unit 103 store the acquired image.

[0042] For each axis, the comparing diagnosis unit 102 compares image data before origin detection that is stored in the storage unit 103 with image data after the origin detection that is stored in the storage unit 103, and diagnoses whether or not each of the axis driving units of the antenna is in a normal state. When each of the axis driving units has no abnormal conditions, the origin detection can be executed; thus, the compared image data should be different.

[0043] On the other hand, when each of the axis driving units has a trouble, the origin detection cannot be executed; thus, the compared image data is the same. The comparing diagnosis unit 102 generates inspection result data that indicates the diagnostic results, and causes the outputting unit 104 to output the inspection result data. The comparing diagnosis unit 102 makes the storage unit 103 store the inspection result data.

[0044] The storage unit 103 stores the image data acquired by the image acquisition unit 101. The storage unit 103 also stores normal image data that indicates an image of the antenna that is in a normal state and is in such an attitude that all of the axes are on the zero point. Furthermore, the storage unit 103 stores the inspection result data that indicates the diagnostic results of the comparing diagnosis unit 102.

[0045] The outputting unit 104 outputs, in the form of images and/or sounds, the inspection result data received from the comparing diagnosis unit 102. It should be noted that the worker's terminal 8 is not necessarily required when a worker who performs antenna maintenance can view the inspection result data that has been output with the outputting unit 104.

[0046] On the other hand, the outputting unit 104 is not necessarily required, when a worker who performs antenna maintenance from a remote place accesses the antenna apparatus 11 by the worker's terminal 8 via the Internet and views the image data of the antenna captured by the camera 7 and the inspection result data.

[0047] FIG. 3 is a flow chart illustrating the example of the operation of the antenna inspection of the antenna inspection system according to the embodiment. In the example shown in FIG. 3, the storage unit 103 of the antenna inspection apparatus 10 has two image memories (an image memory A and an image memory B), and stores the image data acquired by the image acquisition unit 101 in these two image memories alternately.

[0048] The antenna apparatus 11, the camera 7, the control apparatus 12, and the antenna inspection apparatus 10 are powered on (Steps S11, S41 and S51). Once powered-on, the antenna control unit 121 of the control apparatus 12 activates the origin detection program (Step S12) and transmits start notification data that notifies of the start of the origin detection, to the camera control unit 122.

[0049] Upon receiving the start notification data from the antenna control unit 121, the camera

control unit 122 generates instruction data that instructs the camera 7 to capture an image and transmits the instruction data to the camera 7 (Step S13).

[0050] Upon receiving from the control apparatus 12 the instruction data that instructs the camera 7 to capture an image, the camera 7 captures an image of the antenna (Step S42). The camera control unit 122 of the control apparatus 12 acquires from the camera 7 image data that indicates the captured image (Step S14), and transmits the image data to the antenna inspection apparatus 10 (Step S15). The image acquisition unit 101 of the antenna inspection apparatus 10 acquires the image data transmitted from the camera control unit 122 (Step S52), and the image is stored data in the image memory A of the storage unit 103.

[0051] Upon receiving the image data from the camera 7 (Step S14), the camera control unit 122 of the control apparatus 12 transmits to the antenna control unit 121 image-capturing end notification data that notifies that the image-capturing has ended. Upon receiving the image-capturing end notification data, the antenna control unit 121 starts EL-axis origin detection (Step S16).

[0052] When the EL-axis origin detection has ended (Step S17), the antenna control unit 121 transmits end notification data that notifies of the end of the origin detection, to the camera control unit 122. Upon receiving the end notification data from the antenna control unit 121, the camera control unit 122 generates instruction data that instructs the camera 7 to capture an image, and transmits the instruction data to the camera 7 (Step S18).

[0053] Upon receiving the instruction data that instructs the camera 7 to capture an image from the control apparatus 12, the camera 7 captures an image of the antenna (Step S43). The camera control unit 122 of the control apparatus 12 acquires image data that indicates the captured image from the camera 7 (Step S19), and transmits the image data to the antenna inspection apparatus 10 (Step S20). The image acquisition unit 101 of the antenna inspection apparatus 10 acquires the image data transmitted from the camera control unit 122 (Step S53), and the image data is stored in the image memory B.

[0054] The comparing diagnosis unit 102 compares the image data before the EL-axis origin detection that is stored in the image memory A with the image data after the EL-axis origin detection that is stored in the image memory B, and diagnoses whether or not the EL-axis driving unit 115 is in a normal state (Step S54).

[0055] Upon receiving the image data from the camera 7 (Step S19), the camera control unit 122 of the control apparatus 12 transmits the image-capturing end notification data that notifies that the image-capturing has ended, to the antenna control unit 121. Upon receiving the image-capturing end notification data, the antenna control unit 121 starts Cross-EL-axis origin detection (Step S21).

[0056] When the Cross-EL-axis origin detection has ended (Step S22), the antenna control unit 121 transmits end notification data that notifies of the end of the origin detection to the

camera control unit 122. Upon receiving the end notification data from the antenna control unit 121, the camera control unit 122 generates instruction data that instructs the camera 7 to capture an image, and transmits the instruction data to the camera 7 (Step S23).

[0057] Upon receiving from the control apparatus 12 the instruction data that instructs the camera 7 to capture an image, the camera 7 captures an image of the antenna (Step S44). The camera control unit 122 of the control apparatus 12 acquires image data that indicates the captured image from the camera 7 (Step S24), and transmits the image data to the antenna inspection apparatus 10 (Step S25). The image acquisition unit 101 of the antenna inspection apparatus 10 acquires the image data transmitted from the camera control unit 122 (Step S55), and the image data is stored in the image memory A.

[0058] The comparing diagnosis unit 102 compares the image data before the Cross-EL-axis origin detection that is stored in the image memory B (i.e., the image data after the EL-axis origin detection) with the image data after the Cross-EL-axis origin detection that is stored in the image memory A, and diagnoses whether or not the Cross-EL-axis driving unit 116 is in a normal state (Step S56).

[0059] Upon receiving image data from the camera 7 (Step S24), the camera control unit 122 of the control apparatus 12 transmits the image-capturing end notification data that notifies that image-capturing has ended, to the antenna control unit 121. Upon receiving the image-capturing end notification data, the antenna control unit 121 starts AZ-axis origin detection (Step S26).

[0060] When the AZ-axis origin detection has ended (Step S27), the antenna control unit 121 transmits the end notification data that notifies that the origin detection has ended, to the camera control unit 122. Upon receiving the end notification data from the antenna control unit 121, the camera control unit 122 generates instruction data that instructs the camera 7 to capture an image, and transmits the instruction data to the camera 7 (Step S28).

[0061] Upon receiving from the control apparatus 12 the instruction data that instructs the camera 7 to capture an image, the camera 7 captures an image of the antenna (Step S45). The camera control unit 122 of the control apparatus 12 acquires image data that indicates the captured image from the camera 7 (Step S29), and transmits the image data to the antenna inspection apparatus 10 (Step S30). The image acquisition unit 101 of the antenna inspection apparatus 10 acquires the image data transmitted from the camera control unit 122 (Step S57), and the image data is stored in the image memory B.

[0062] The comparing diagnosis unit 102 compares the image data before the AZ-axis origin detection that is stored in the image memory A (i.e., the image data after the Cross-EL-axis origin detection) with the image data after the AZ-axis origin detection that is stored in the image memory B, and diagnoses whether or not the AZ-axis driving unit 117 is in a normal state (Step S58).

[0063] Upon receiving the image data form the camera 7 (Step S29), the camera control unit 122 of the control apparatus 12 transmits image-capturing end notification data that notifies that the image-capturing has ended, to the antenna control unit 121. Upon receiving the image-capturing end notification data, the antenna control unit 121 starts POL-axis origin detection (Step S31).

[0064] When the POL-axis origin detection has ended (Step S32), the antenna control unit 121 transmits end notification data that notifies of the end of the origin detection, to the camera control unit 122. Upon receiving the end notification data from the antenna control unit 121, the camera control unit 122 generates instruction data that instructs the camera 7 to capture an image, and transmits the instruction data to the camera 7 (Step S33).

[0065] Upon receiving from the control apparatus 12 the instruction data that instructs the camera 7 to capture an image, the camera 7 captures an image of the antenna (Step S46) and completes the process. The camera control unit 122 of the control apparatus 12 acquires the image data that indicates the captured image from the camera 7 (Step S34), transmits the image data to the antenna inspection apparatus 10 (Step S35), and completes the process. The image acquisition unit 101 of the antenna inspection apparatus 10 acquires the image data transmitted from the camera control unit 122 (Step S59), and the image data is stored in the image memory A.

[0066] The comparing diagnosis unit 102 compares the image data before the POL-axis origin detection that is stored in the image memory B (i.e., the image data after the AZ-axis origin detection) with the image data after the POL-axis origin detection that is stored in the image memory A, and diagnoses whether or not the POL-axis driving unit 114 is in a normal state (Step S60).

[0067] The comparing diagnosis unit 102 is capable of determining whether or not each of the axis driving units is in a normal state, through a simple process of determining whether or not the image data most recently stored in the memory A coincides with the image data most recently stored in the memory B.

[0068] The comparing diagnosis unit 102 retrieves normal image data that indicates an image of the antenna that is in a normal state and is in such an attitude that all of the axes are on the zero point from the storage unit 103 (Step S61), compares the normal image data with the image data after the POL-axis origin detection that is stored in the image memory A, and diagnoses whether or not the origin detection was carried out normally (Step S62).

[0069] In addition to abnormal conditions of the driving units, all other abnormal conditions existing in the appearance of the antenna apparatus 11 can be detected, through the comparison with the normal image data that indicates the image of the antenna that is in a normal state and in such an attitude that all of the axes are on the zero point.

[0070] The comparing diagnosis unit 102 causes an outputting unit 104 to output inspection

result data that indicates the diagnostic results of Steps S54, S56, S58, S60 and S62 (Step S63). The comparing diagnosis unit 102 makes the storage unit 103 store the inspection result data and completes the process. The inspection result data may include the image data stored in the storage unit 103.

[0071] As explained above, according to the antenna inspection system 100 of the present embodiment, abnormal conditions of the antenna can be automatically detected through a simple process that uses a small amount of data.

[0072] In particular, automatic tracking antenna apparatuses are installed in mobile stations, such as automobiles, ships, trains and airplanes, in many cases. Since a place to locate an apparatus within a mobile station is limited, small antenna inspection apparatuses are demanded.

[0073] The antenna inspection apparatus 10 of the present embodiment can detect abnormal conditions of the antenna apparatus 11 through a simple process and can be realized with a small memory for storing data, and therefore allows a smaller size.

[0074] Furthermore, large ships, in particular, travel for a long time for each voyage, and thus performing maintenance work is not easy in view of transportation to get to the site. The antenna inspection system 100 of the present embodiment allows the worker's terminal 8 to access the antenna apparatus 11 via the Internet, so that the worker who performs the antenna maintenance can view the image data of the antenna captured by the camera 7 and the inspection result data, even from a remote location. This facilitates a pre-investigation prior to the maintenance work.

[0075] The present embodiment has illustrated an example of the antenna with a four-axis drive system consisting of an AZ drive axis, an EL drive axis, a Cross-EL drive axis and a POL drive axis. Not only this, automatic tracking antennas with a three-axis drive system consisting an AZ drive axis, an EL drive axis, and a POL drive axis and fixed antennas may also be used.

[0076] FIG. 4 is a block diagram illustrating the example of the hardware configuration of the antenna inspection apparatus according to the embodiment of the present invention. The antenna inspection apparatus 10 includes a control unit 31, a main storage unit 32, an external storage unit 33, an operation unit 34, a display unit 35, an inputting/outputting unit 36 and a transmitting/receiving unit 37, as shown in FIG. 4. The main storage unit 32, the external storage unit 33, the operation unit 34, the display unit 35, the inputting/outputting unit 36 and the transmitting/receiving unit 37 are all connected to the control unit 31 via internal buses.

[0077] The control unit 31 includes a CPU (Central Processing Unit) and the like, and executes the processing of the image acquisition unit 101 and the comparing diagnosis unit 102 of the antenna inspection apparatus 10, according to a control program 39 that is stored in the external storage unit 33.

[0078] The main storage unit 32 includes a RAM (Random-Access Memory) and the like, loads the control program 39 that is stored in the external storage unit 33, and is used as a work space of the control unit 31.

[0079] The external storage unit 33 includes a non-volatile memory, such as a flash memory, a hard disc, a DVD-RAM (Digital Versatile Disc Random-Access Memory) and a DVD-RW (Digital Versatile Disc Rewritable). In the external storage unit 33 a program that makes the control unit 31 execute the processing of the antenna inspection apparatus 10 is stored in advance.

[0080] The external storage unit 33 supplies data that is stored in this program to the control unit 31 according to instructions of the control unit 31, and stores the data supplied by the control unit 31. The storage unit 103 is configured in the external storage unit 33.

[0081] The operation unit 34 includes a keyboard, a pointing device such as a mouse, and the like, and an interface device for connecting the keyboard, the pointing device such as a mouse, and the like, to the internal buses 30. When a user inputs information directly to the antenna inspection apparatus 10, the input information is supplied to the control unit 31 via the operation unit 34.

[0082] The display unit 35 is a CRT (Cathode Ray Tube) or an LCD (Liquid Crystal Display) and the like, and displays image data of the antenna captured by the camera 7 and inspection result data. When the worker inputs information directly to the antenna inspection apparatus 10, the display unit 35 displays an operation screen. The display unit 35 functions as the outputting unit 104.

[0083] The inputting/outputting unit 36 includes either a serial interface or a parallel interface. The inputting/outputting unit 36 is connected with the control apparatus 12. The inputting/outputting unit 36 functions as the image acquisition unit 101.

[0084] The transmitting/receiving unit 37 consists of a network termination device or a wireless communication device that connects with a network, and a serial interface or a LAN (Local Area Network) that connects with the network termination device or the wireless communication device. The transmitting/ receiving unit 37 is connected with the worker's terminal 8 via a network. The transmitting/receiving unit 37 functions as an interface that allows access to the storage unit 103 from outside.

[0085] Processing of the image acquisition unit 101, the comparing diagnosis unit 102, the storage unit 103 and the inputting/outputting unit 104, of the antenna inspection apparatus 10 as shown in FIG. 2 is executed by the control program 39 using the control unit 31, the main storage unit 32, the external storage unit 33, the operation unit 34, the display unit 35, the inputting/outputting unit 36, the transmitting/receiving unit 37, and/or the like, as resources.

[0086] Besides, the above-described hardware configuration and flowchart are examples and may arbitrarily be changed and modified.

[0087] The core portion that executes the processing of the antenna inspection apparatus 10 that includes the control unit 31, the main storage unit 32, the external storage unit 33, the operation unit 34, the display unit 35, the inputting/outputting unit 36, the transmitting/receiving unit 37, the internal buses 30, and the like may be realized using an ordinary computer system, not using a special system.

[0088] For example, a computer program for executing the aforementioned operations may be stored on a computer-readable recording medium (flexible disk, CD-ROM, DVD-ROM and/or the like), and the antenna inspection apparatus 10 that executes the aforementioned processing may be configured with a computer to which the computer program, distributed by a computer-readable recording medium, is installed.

[0089] Furthermore, the antenna inspection apparatus 10 may be configured in such a way that the computer program is stored in the memory of a server computer connected to a network such as the Internet, and is downloaded by ordinary computer systems.

[0090] Furthermore, where functions of the antenna inspection apparatus 10 are divided between an OS (Operating System) and an application program, or are realized through cooperation between an OS and an application program, only an application program part may be stored in a recording medium or in a memory device.

[0091] Furthermore, a computer program may be superimposed on carrier waves and distributed via a communication network. For example, the above-described computer program may be posted on a BBS (Bulletin Board System) on a communication network, and distributed via the network. Then, the computer program may be configured in such a way that the above-described processing may be performed by activating this computer program and executing the program under control of OS in a similar manner as other application programs.

[0092] The present application claims the benefit of a priority based on Japanese Patent Application No. 2012-56450 filed on March 13, 2012, including the specification, claims, drawings and an abstract.

Industrial Applicability

[0093] The present invention can be used in, for example, an antenna inspection system for diagnosing abnormal conditions of an antenna.

List of Reference Signs

[0094]

1 Dome
2 Base
3 Main reflector
4 Sub reflector
5 Amplification device
6 Frequency conversion device
7 Camera
8 Worker's terminal
10 Antenna inspection apparatus
11 Antenna apparatus
12 Control apparatus
31 Control unit
32 Main storage unit
33 External storage unit
34 Operation unit
35 Display unit
36 Inputting/outputting unit
37 Transmitting/receiving unit
39 Control program
100 Antenna inspection system
101 Image acquisition unit
102 Comparing diagnosis unit

103
Storage unit
104
Outputting unit
111
Transmitting/receiving unit
112
Amplifying unit

REFERENCES CITED IN THE DESCRIPTION

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- JPS61012311B [0011]
- US2006075631A1 [0011]
- US2011151932A1 [0011]
- JP2012056450A [0092]

Patentkrav

1. Antenneinspektionsapparat (10), omfattende:

- en billedopoptagelsesenhed (101), der er indrettet til at registrere billeddata af en antenne (11), der optages af et kamera (7) ved hver timing før en begyndelse og efter en afslutning af en programmeret operation af antennen (11);
- en hukommelsesenhed (103), der er indrettet til at lagre billeddataen af antennen (11) registreret af billedoptagelsesenheden (101);
- en sammenlignende diagnoseenhed (102), der er indrettet til at sammenligne billeddata af antennen (11) før begyndelsen af den programmerede operation med billeddata af antennen (11) efter afslutningen af den programmerede operation,

kendetegnet ved at den sammenlignende diagnoseenhed er indrettet til at diagnosticere, hvorvidt hver af aksedriftsenhederne (114, 115, 116, 117) til at drive antennen (11) er i en normal tilstand,
hvor, når hver af aksedriftsenhederne (114, 115, 116, 117) ikke har nogen unormale betingelser, da er den sammenlignede billeddata forskellig, og når hver af aksedriftsenhederne (114, 115, 116, 117) har en forstyrrelse, da er den sammenlignede billeddata den samme,
hvor antennen (11) er indrettet til at drives rundt om en forudbestemt akse, og hvor den programmerede operation er en nulpunktsbestemmelsesoperation til at detektere et nulpunkt af den forudbestemte akse.

2. Antenneinspektionsapparat (10) ifølge krav 1,
hvor hukommelsesenheden (103) er indrettet til at lagre normal billeddata, der indikerer et billede af antennen (11), der er i en normal tilstand, og er i en sådan indstilling, at alle de forudbestemte akser er på nulpunktet, og hvor den sammenlignende diagnoseenhed (102) yderligere er indrettet til at sammenligne den normale billeddata med billeddata af antennen (11) efter afslutningen af nulpunktsbestemmelsen for alle af de forudbestemte akser, og at diagnosticere, hvorvidt antennen (11) er i den normale tilstand.

3. Antenneinspektionsapparat (10) ifølge krav 1 eller 2, yderligere omfattende en udlæsningsenhed (104), der er indrettet til at udlæse inspektionsresultatdata, der

indikerer diagnostiske resultater af den sammenlignende diagnoseenhed (102).

4. Antenneinspektionsfremgangsmåde omfattende de følgende trin:

- et antennestyringstrin til at styre en driftsenhed (114, 115, 116, 117), der er inkluderet i en antenne (11) til at drive antennen (11), så antennen (11) udfører en programmeret operation;
- et kamerastyringstrin til at styre et kamera (7) for at optage et billede af antennen (11) ved hver timing før en begyndelse og efter en afslutning af den programmerede operation;
- et billedregistreringstrin til at registrere billeddataen af antennen (11) optaget af kameraet før en begyndelse og efter en afslutning af den programmerede operation;
- et lagringstrin til at lagre billeddataen af antennen (11) registreret i billedregistreringstrinnet; og
- et sammenlignende diagnosetrin til at sammenligne billeddata af antennen (11) før begyndelsen af den programmerede operation med billeddata af antennen (11) efter afslutningen af den programmerede operation, og

at diagnosticere, hvorvidt hver af aksedriftsenhederne (114, 115, 116, 117) til driftsantennen (11) er i en normal tilstand,

hvor, når hver af aksedriftsenhederne (114, 115, 116, 117) ikke har nogen unormale betingelser, da er den sammenlignede billeddata forskellig, og når hver af aksedriftsenhederne (114, 115, 116, 117) har en forstyrrelse, da er den sammenlignede billeddata den samme,

hvor antennestyringstrinnet og kamerastyringstrinnet udføres af et styringsapparat (12), og billedregistreringstrinnet, lagringstrinnet og det sammenlignende diagnosetrin udføres af et antenneinspektionsapparat (10), hvor antennen (11) er indrettet til at drives rundt om en forudbestemt akse, og hvor den programmerede operation er en nulpunktsbestemmelsesoperation til at detektere et nulpunkt af den forudbestemte akse.

5. Antenneinspektionssystem (100) **kendetegnet ved at** omfatte:

- en antenne (11), der inkluderer en driftsenhed (114, 115, 116, 117) til at drive antennen (11);
- et kamera (7), der er indrettet til at optage et billede af antennen (11);

- et styringsapparat (12), der inkluderer
-- en antennestyringsenhed (121), der er indrettet til at styre driftsenheden (114, 115, 116, 117), så antennen (11) udfører en programmeret operation, og
-- en kamerastyringsenhed (122), der er indrettet til at styre kameraet (7) for at optage et billede af antennen (11) ved hver timing før en begyndelse og efter en afslutning af den programmerede operation; og
- antenneinspektionsapparat (10) ifølge et hvilket som helst af kravene 1 til 3.

6. Antenneinspektionssystem (100) ifølge krav 5,
hvor driftsenheden (114, 115, 116, 117) er indrettet til drive antennen (11) rundt om en forudbestemt akse, og
hvor den programmerede operation er en nulpunktsbestemmelsesoperation til at detektere et nulpunkt af den forudbestemte akse.

7. Antenneinspektionssystem (100) ifølge krav 5 eller 6,
hvor kameraet (7) er monteret på indersiden af en kuppel (1), der dækker antennen, (11) eller en base (2), der støtter antennen (11).

8. Antenneinspektionssystem (100) ifølge et hvilket som helst af kravene 5 til 7, yderligere omfattende en medarbejderterminal (8), der er indrettet til at forbindes med antenneinspektionsapparatet (10) via et netværk.

DRAWINGS

FIG.1A

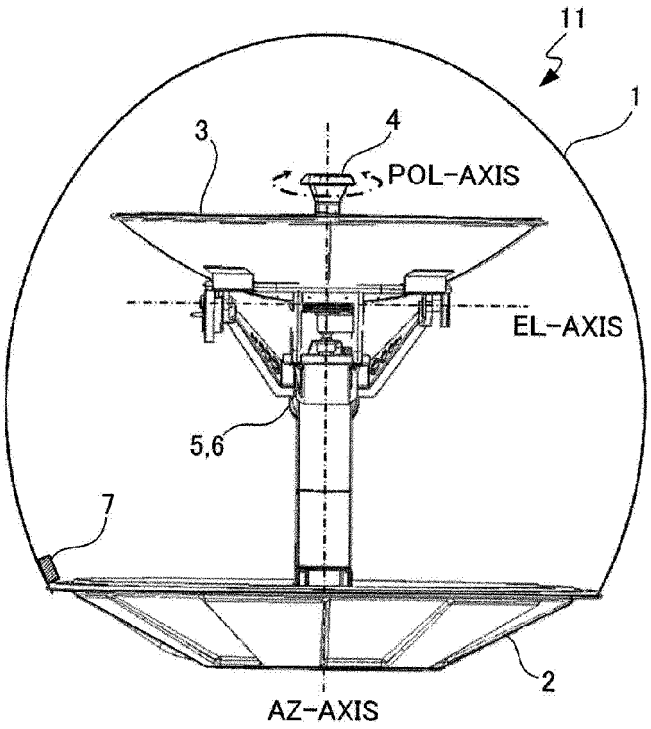


FIG.1B

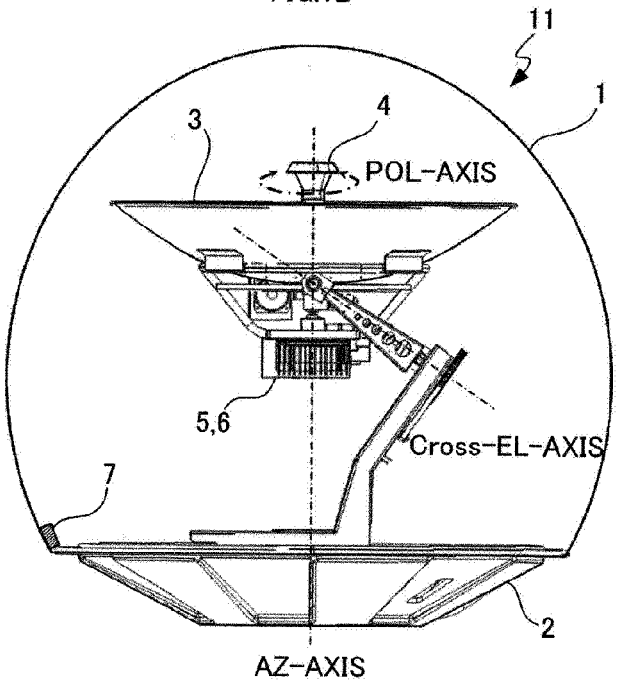


FIG.2

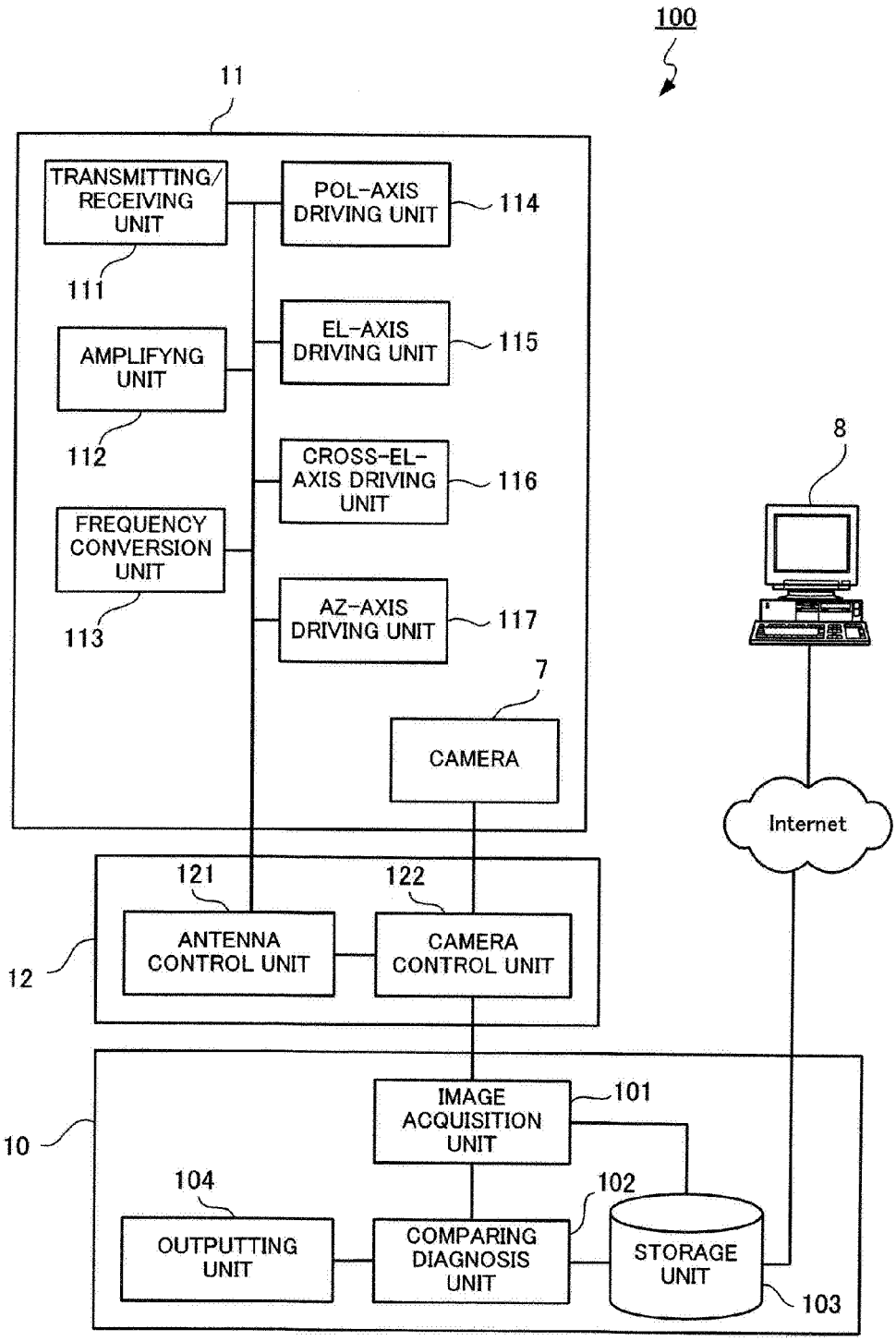

100
11
TRANSMITTING/ RECEIVING UNIT
111
POL-AXIS DRIVING UNIT
114
AMPLIFYNG UNIT
112
EL-AXIS DRIVING UNIT
115
CROSS-EL-AXIS DRIVING UNIT
116
FREQUENCY CONVERSION UNIT
113
AZ-AXIS DRIVING UNIT
117
7
CAMERA
8
Internet
121
122
ANTENNA CONTROL UNIT
CAMERA CONTROL UNIT
12
10
IMAGE ACQUISITION UNIT
101
104
102
OUTPUTTING UNIT
COMPARING DIAGNOSIS UNIT
STORAGE UNIT
103

FIG.3

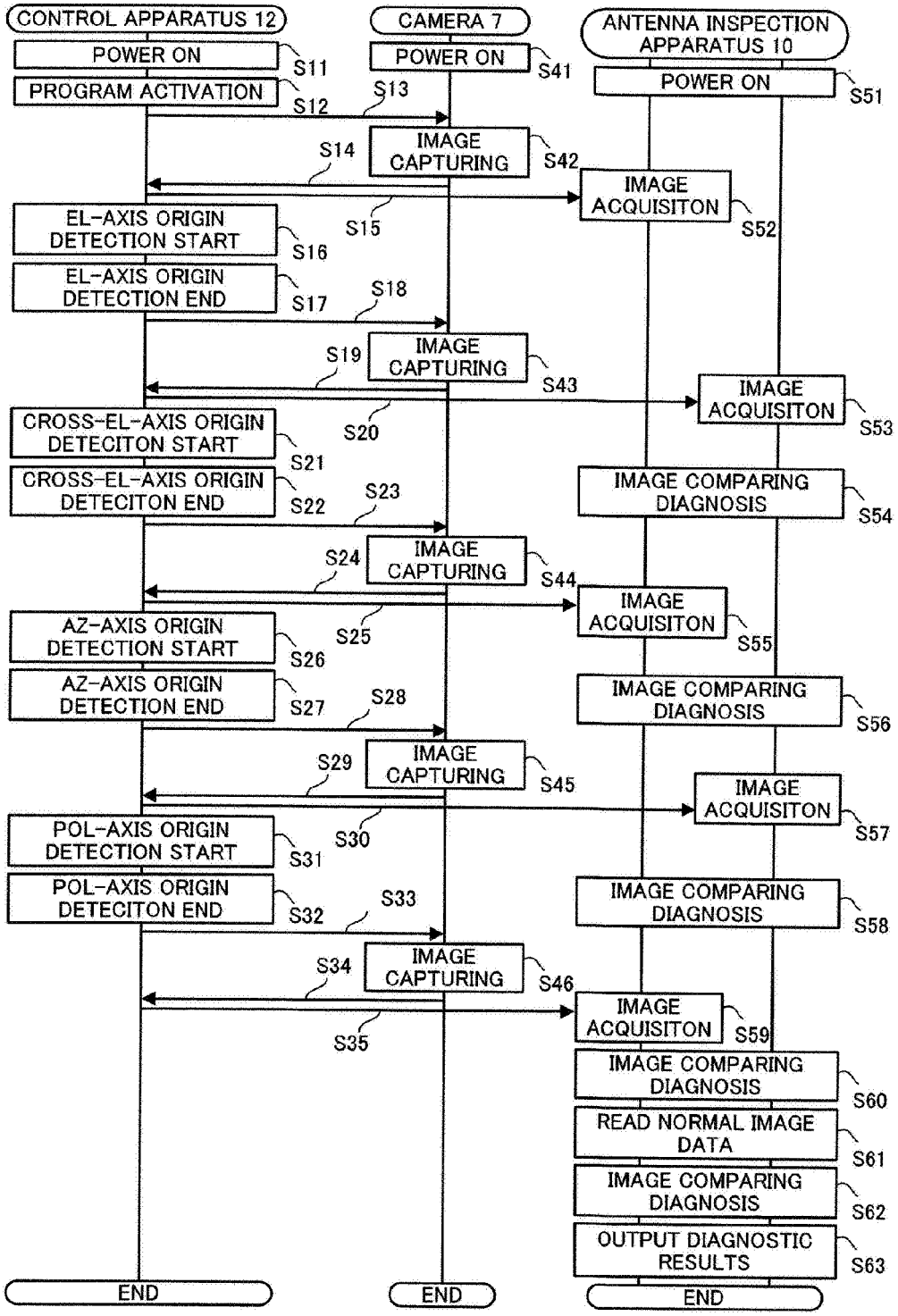
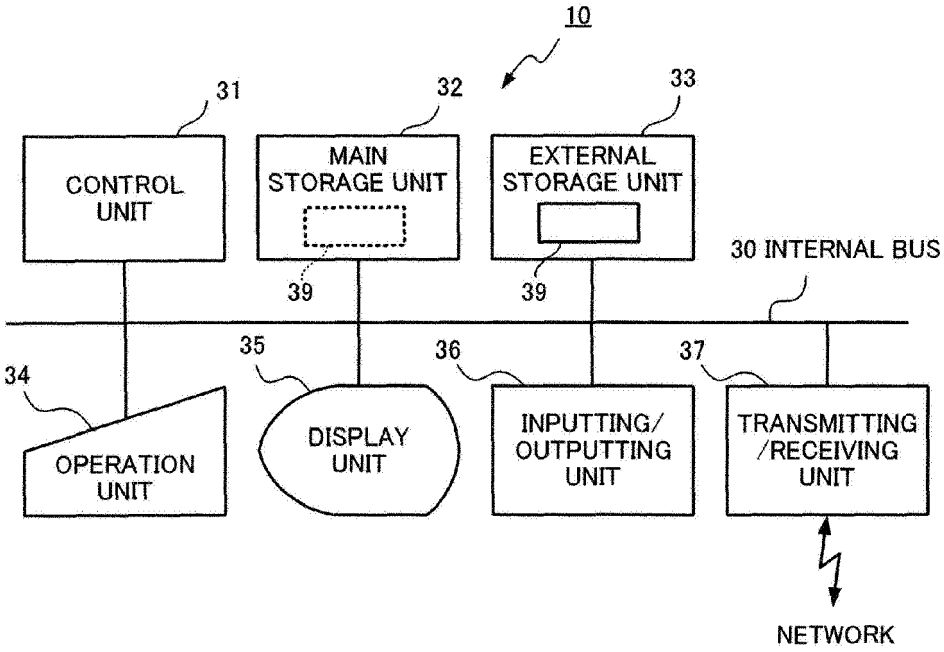

CONTROL APPARATUS 12
CAMERA 7
ANTENNA INSPECTION APPARATUS 10
POWER ON
S11
POWER ON
S41
POWER ON
S51
PROGRAM ACTIVATION
S12
S13
IMAGE CAPTURING
S42
S14
IMAGE ACQUISITON
S52
S15
EL-AXIS ORIGIN DETECTION START
S16
EL-AXIS ORIGIN DETECTION END
S17
S18
IMAGE CAPTURING
S43
S19
IMAGE ACQUISITON
S53
S20
CROSS-EL-AXIS ORIGIN DETECITON START
S21
CROSS-EL-AXIS ORIGIN DETECITON END
S22
S23
IMAGE COMPARING DIAGNOSIS
S54
IMAGE CAPTURING
S44
S24
IMAGE ACQUISITON
S55
S25
AZ-AXIS ORIGIN DETECTION START
S26
AZ-AXIS ORIGIN DETECTION END
S27
S28
IMAGE COMPARING DIAGNOSIS
S56
IMAGE CAPTURING
S45
S29
IMAGE ACQUISITON
S57
S30
POL-AXIS ORIGIN DETECTION START
S31
POL-AXIS ORIGIN DETECITON END
S32
S33
IMAGE COMPARING DIAGNOSIS
S58
IMAGE CAPTURING
S46
S34
IMAGE ACQUISITON
S59
S35
IMAGE COMPARING DIAGNOSIS
S60
READ NORMAL IMAGE DATA
S61
IMAGE COMPARING DIAGNOSIS
S62
OUTPUT DIAGNOSTIC RESULTS
S63
END
END
END

FIG.4


10
31
32
33
CONTROL UNIT
MAIN STORAGE UNIT
EXTERNAL STORAGE UNIT
39
39
30 INTERNAL BUS
34
35
36
37
OPERATION UNIT
DISPLAY UNIT
INPUTTING/ OUTPUTTING UNIT
TRANSMITTING /RECEIVING UNIT
NETWORK