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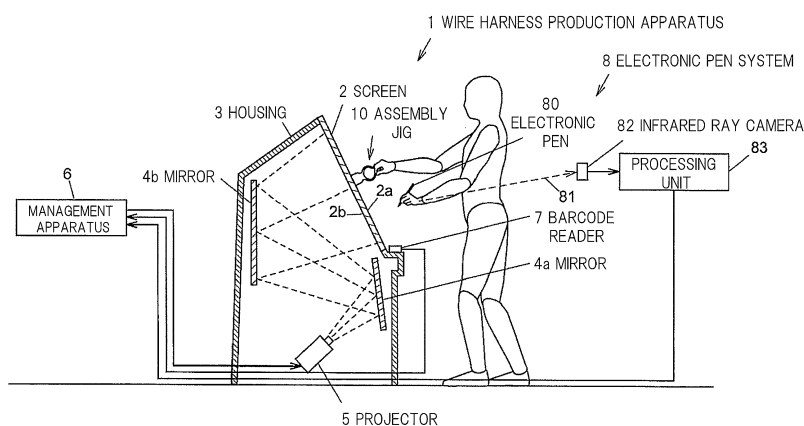
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(54) **METHOD OF INSPECTING WIRE HARNESS**

(57) A method of inspecting a wire harness, includes steps of: switching an image corresponding to an assembly step of the wire harness in accordance with an advancement of the assembly step to display the image on a display unit; reading connector identification information attached to a connector to be connected to an electric cable configuring the wire harness and connector identification information displayed on a connector image included in the image; determining whether or not the read connector identification information attached to the con-

necter and the read connector identification information displayed on the connector image match each other; making a correspondence between a determination result and identification information about an assembly product of the wire harness, and accepting the determination result as operation history information for each assembly step; and inspecting the assembly product of the wire harness on the basis of the operation history information for each assembly step.

FIG. 1



Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese Patent Application No. 2015-179470 filed on September 11, 2015, the content of which is hereby incorporated by reference into this application.

TECHNICAL FIELD OF THE INVENTION

[0002] The present invention relates to a method of inspecting a wire harness.

BACKGROUND OF THE INVENTION

[0003] In an assembly of a wire harness, generally, a full scale drawing of a wire harness is adhered to an assembly drawing board to make a wiring board, and the wiring board attached with a wiring board jig is used. An operation procedure of assembly and operation instruction such as instruction on attachment of accessory components are indicated in the full scale drawing, and an operator wires electric cables in accordance with the operation instructions, and an accessory component is attached to a predetermined position of the wired electric cable and electric cable bundle, so that a wire harness is assembled.

[0004] However, since it is required to replace a full scale drawing in accordance with a design change, a wire harness assembly drawing apparatus without the requirement of such an operation has been suggested (for example, see Japanese Patent Application Laid-Open Publication No. 2000-195352 (Patent Document 1)).

[0005] This wire harness assembly drawing apparatus includes: a wiring board in which various jigs required for assembly of a wire harness can be arranged; an assembly jig attached to the wiring board and receiving the wired electric cable; a screen arranged on a back surface of the wiring board; and an optical projector for projecting an image required for the assembly of the wire harness on the back surface of the screen.

[0006] Images of assembly steps of the wire harness are automatically switched in accordance with three steps which are a wiring step of an electric cable, an attachment step of an accessory component, and a tape wrapping step.

SUMMARY OF THE INVENTION

[0007] However, a conventional wire harness assembly drawing apparatus does not switch images in assembly steps of the wire harness in accordance with the operation step in the wiring step of the electric cable. Therefore, when electric cables having similar lengths to each other are wired, there is a risk of a mistake in the electric cable and a wiring position. The projected images do not

include a connector image indicating a connector, and therefore, there is a risk of a mistake in connection of connectors. Further, generally, a wire harness is inspected while an inspector reads a wire harness operation instruction document, and therefore, it is required to shorten the inspection time and improve the reliability of the inspection.

[0008] Accordingly, an object of the present invention is to provide a method of inspecting a wire harness capable of shortening the inspection time and improving the reliability of the inspection.

[1] A method of inspecting a wire harness, includes: a step of switching an image corresponding to an assembly step of the wire harness in accordance with an advancement of the assembly step to display the image on a display unit; a step of reading connector identification information attached to a connector to be connected to an electric cable configuring the wire harness and connector identification information displayed on a connector image included in the image; a step of determining whether or not the read connector identification information attached to the connector and the read connector identification information displayed on the connector image match each other; a step of making a correspondence between a determination result and identification information about an assembly product of the wire harness, and accepting the determination result as operation history information for each of the assembly steps; and a step of inspecting the assembly product of the wire harness on the basis of the operation history information for each of the assembly steps.

[2] A method of inspecting a wire harness, includes: a step of switching an image corresponding to an assembly step of the wire harness in accordance with an advancement of the assembly step to display the image on a display unit; a step of reading electric cable identification information attached to an electric cable configuring the wire harness and electric cable identification information displayed on an electric cable image included in the image; a step of determining whether or not the read electric cable identification information attached to the electric cable and the read electric cable identification information displayed on the electric cable image match each other; a step of making a correspondence between a determination result and identification information about an assembly product of the wire harness, and accepting the determination result as operation history information for each of the assembly steps; and a step of inspecting the assembly product of the wire harness on the basis of the operation history information for each of the assembly steps.

[3] A method of inspecting a wire harness, includes: a step of switching an image corresponding to an assembly step of the wire harness in accordance

with an advancement of the assembly step to display the image on a display unit; a step of reading electric cable identification information attached to an electric cable configuring the wire harness and electric cable identification information displayed on an electric cable image included in the image; a step of determining whether or not the read electric cable identification information attached to the electric cable and the read electric cable identification information displayed on the electric cable image match each other; a step of reading connector identification information attached to a connector to be connected to an electric cable and connector identification information displayed on a connector image included in the image; a step of determining whether or not the read connector identification information attached to the connector and the read connector identification information displayed on the connector image match each other; a step of making a correspondence between a determination result about the electric cable and the connector and identification information about an assembly product of the wire harness, and accepting the determination result as operation history information for each of the assembly steps; and a step of inspecting the assembly product of the wire harness on the basis of the operation history information for each of the assembly steps.

[0009] According to the present invention, the inspection time can be shortened, and the reliability of the inspection can be improved.

BRIEF DESCRIPTIONS OF THE DRAWINGS

[0010]

FIG. 1 is a cross-sectional view illustrating an example of a configuration of an overview of a wire harness production apparatus according to a first embodiment of the present invention;
 FIG. 2 is a block diagram illustrating an example of a control system of a management apparatus;
 FIG. 3 is a block diagram illustrating an example of a control system of a projector;
 FIG. 4 is a block diagram illustrating an example of a configuration of a barcode reader;
 FIG. 5A is a diagram illustrating an example of a configuration of an electronic pen system;
 FIG. 5B is an external view illustrating a configuration of an overview of an electronic pen;
 FIG. 6A is a front view illustrating an assembly jig before it is attached to the screen;
 FIG. 6B is a plan view of FIG. 6A;
 FIG. 6C is a partial cross-sectional view illustrating the assembly jig after it is attached to the screen;
 FIG. 7A is a diagram illustrating an example of a projection image of a first page;

FIG. 7B is a diagram illustrating an example of a projection image of a second page;
 FIG. 7C is a diagram illustrating an example of a projection image of a third page;
 FIG. 7D is a diagram illustrating an example of a projection image of a fourth page;
 FIG. 7E is a diagram illustrating an example of a projection image of a fifth page;
 FIG. 8 is a cross-sectional view illustrating an example of a configuration of an overview of a wire harness production apparatus according to a second embodiment of the present invention;
 FIG. 9A is a plan view of a principal part illustrating a first modification of a screen; and
 FIG. 9B is a cross-sectional view of a principal part illustrating a second modification of the screen.

DESCRIPTIONS OF THE PREFERRED EMBODIMENTS

[0011] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. Note that components substantially having the same function in each drawing are denoted by the same reference symbols, and the repetitive description thereof will be omitted.

[First embodiment]

[0012] FIG. 1 is a cross-sectional view illustrating an example of a configuration of an overview of a wire harness production apparatus according to the first embodiment of the present invention.

(Entire configuration)

[0013] This wire harness production apparatus 1 includes: a screen 2; a housing 3 supporting a screen 2; a plurality of (in the present embodiment, two) mirrors 4a, 4b arranged in the housing 3; a projector 5 that is also arranged in the housing 3 and that projects a projection image onto a back surface 2b of the screen 2 via the mirrors 4a and 4b; a management apparatus 6 for managing an assembly of a wire harness; a barcode reader 7 for reading a barcode; and an electronic pen system 8 having an electronic pen 80 for selecting or inputting information for a projection image projected on the screen 2. Note that the management apparatus 6 may be arranged in the housing 3. The number of mirrors is not limited to two, but may be three or more. When the two or more mirrors are provided, the housing 3 can be downsized in the depth direction.

[0014] Here, later-described projection means 50 of the projector 5 and the screen 2 are an example of a display unit. A "wire harness" is the one obtained by bundling a plurality of electric cables and having a connector or a terminal for connecting a print circuit board and a device to both end portions of each electric cable. "A step

of assembling the wire harness" includes, for example: a step of attaching an assembly jig; a harness wiring step including a step of wiring an electric cable and a step of attaching a connector to both ends of the electric cable; and a step of bundling the wired electric cables. Note that the steps are not limited them. "A wire harness assembly product" is the one that is assembled through the step of assembling the wire harness.

[0015] For the screen 2, a transparent plate such as an acryl plate and a glass plate can be used. The front surface 2a of the screen 2 is formed as a smooth surface so that, for example, the assembly jig 10 can be adhered thereto by a negative pressure, and the back surface 2b thereof is formed as a light scattering surface so that the projection image can be visually checked from the front surface 2a. Note that the screen 2 is not particularly limited as long as it is a back surface projection type. For example, the screen 2 may be configured so that a light scattering sheet is adhered to the back surface of the transparent plate.

[0016] The projector 5 receives projection image data from a communication unit 64 of the management apparatus 6, and stores the projection image data in the memory 58, and starts projection of a projection image, feeds or returns the projection image, erases the projection image data, and performs others by operations of an input unit 62 and the electronic pen 80, on the basis of a projection start signal, a page feeding signal, a page returning signal, an assembly end signal, and others supplied from the management apparatus 6.

[0017] The management apparatus 6 is achieved by, for example, a personal computer (PC). The detailed configuration of the management apparatus 6 will be described later.

[0018] The barcode reader 7 has a function of reading a barcode, a function of determining whether the two read barcodes match each other or not, and a function of displaying a determination result. The detailed configuration of the barcode reader 7 will be described later.

[0019] The electronic pen system 8 includes an electronic pen 80 emitting infrared ray 81 and capable of selecting a mode, an infrared ray sensor 82 receiving the infrared ray 81 and outputting a light reception signal, and a processing unit 83 outputting, to the management apparatus 6, coordinate information on the front surface 2a of the screen 2 at the end portion of the electronic pen 80 and mode information indicating the mode on the basis of the light reception signal from the infrared ray sensor 82. The detailed configuration of the electronic pen system 8 will be described later. Here, the infrared ray sensor 82 and the processing unit 83 configure coordinate obtaining means.

(Configuration of management apparatus)

[0020] FIG. 2 is a block diagram illustrating an example of a control system of the management apparatus 6. The management apparatus 6 is configured by a central

processing unit (CPU) and others, and includes: a control unit 60 for controlling each unit of the wire harness production apparatus 1; a storage unit 61 storing various pieces of information; an input unit 62 achieved by a keyboard, a mouse, or others; a display unit 63 achieved by a liquid crystal display or others; and a communication unit 64 for communicating with external apparatuses such as the projector 5, the barcode reader 7, and the processing unit 83 configuring the electronic pen system 8.

[0021] The storage unit 61 is configured by a read only memory (ROM), a random access memory (RAM), a hard disk, and others, and stores a program 610 of the CPU, projection image data 611, management data 612, and others.

[0022] The CPU of the control unit 60 operates in accordance with the program 610, and controls each unit of the management apparatus 6 and the entire wire harness production apparatus 1.

[0023] To the projector 5, the control unit 60 transmits a page feeding signal, a page returning signal, and an assembly end signal on the basis of selection for a feeding button 26b, a returning button 26c, an end button 26d, by the electronic pen 80. To the projector 5, the control unit 60 transmits a projection start signal on the basis of an operation for instructing a projection start by the input unit 62. When an operator ID is input by an operation of a numeric-key button 26e by the electronic pen 80, and when the start button 26a and the end button 26d are selected by the electronic pen 80, the control unit 60 stores the management information about the operator ID, the assembly start date and time, and the assembly end date and time in a storage unit 61 as the management data 612 so as to correspond to a wire harness assembly product ID.

[0024] The projection image data 611 is configured by a plurality of pages corresponding to a wire harness assembly product ID (identification information) for identifying the wire harness assembly product and corresponding to an assembly step and a detailed operation step in the assembly step. The projection image data 611 includes a jig image displaying a position of the assembly jig 10 that can be adhered to the front surface 2a of the screen 2 by a negative pressure. The projection image data 611 is previously corrected so that, when the projection image data 611 is projected onto the screen 2, it is displayed in an undistorted square or rectangular shape at the same magnification as much as the full scale drawing of the wire harness. The projection image data 611 includes a step name, a content of a step, image information as an image for displaying a button for an operation instruction, character information as a character for displaying an operation content of a step, and others.

[0025] Into the storage unit 61, the management data 612 stores, for example, an operator ID (identification information) for identifying an operator, a wire harness assembly product ID, an operation start date and time

(for example, date and time at which the start button is selected by using the electronic pen 80), an operation end date and time (for example, date and time at which the end button is selected by using the electronic pen 80), a determination result about a barcode of an electric cable and a connector, and others, so that they are corresponded to each other as history information.

(Configuration of projector)

[0026] FIG. 3 is a block diagram illustrating an example of a control system of the projector 5. The projector 5 is configured by the projection means 50 for projecting a projection image, a CPU, and others, and includes a control unit 57 for controlling each unit of the projector 5, a memory 58 for storing the projection image data 611 transmitted from the management apparatus 6.

[0027] The projection means 50 includes: three LED light sources 51 emitting red color light, green color light, and blue color light, respectively; three liquid crystal panels 52 for R, G, B generating red color image light, green color image light, and blue color image light upon receiving the red color light, the green color light, and the blue color light emitted from the LED light sources 51, respectively; a light source driving unit 53 for driving the LED light source 51; a liquid crystal panel driving unit 54 for driving the liquid crystal panel 52; a synthesis optical system 55 for synthesizing the red color image light, the green color image light, and the blue color image light generated by the three liquid crystal panels 52; and a projection lens 56 for projecting a projection image synthesized by the synthesis optical system 55 onto the screen 2 via the mirrors 4a and 4b.

[0028] When the control unit 57 of the projector 5 receives the projection image data transmitted from the management apparatus 6, the control unit 57 of the projector 5 stores the projection image data into the memory 58. The control unit 57 reads the projection image data of the first page from the memory 58 on the basis of a projection start signal from the management apparatus 6, and projects a projection image onto the screen 2 on the basis of the projection image data. The control unit 57 projects the projection image based on the projection image data of the corresponding page onto the screen 2 on the basis of a page feeding signal or a page returning signal from the management apparatus 6.

(Configuration of barcode reader)

[0029] FIG. 4 is a block diagram illustrating an example of a configuration of the barcode reader 7. The barcode reader 7 is configured by a CPU and others, and includes: a control unit 70 for controlling each unit of the barcode reader 7; a barcode sensor 71 for optically reading the barcode; a determination unit 72 for determining whether or not the barcode attached to the electric cable or the connector read by the barcode sensor 71 and the barcode displayed on the electric cable image or the con-

nector image included in the projection image match each other; a determination result display unit 73 for displaying a determination result of the determination unit 72; and a communication unit 74 for transmitting a determination result to the management apparatus 6 by using the control unit 70. Here, the barcode attached to the electric cable or the connector and the barcode displayed on the electric cable image or the connector image are an example of the connector identification information. The connector identification information is not limited to one-dimensional code such as a barcode, and may be a two-dimensional code such as a QR code (registered trademark), a PDF 417, Data Matrix and Maxi Code, a mechanically-readable code such as a unique code, and a pattern such as a dot pattern. A plurality of types of codes may be combined with each other in accordance with the purpose.

[0030] When both of the barcodes match each other, the determination result display unit 73 may generate a sound such as "ding dong" indicating that the barcodes match each other, and, when both of the barcodes do not match each other, the determination result display unit 73 may generate a sound such as "beep" indicating that the barcodes do not match each other. Alternatively, when both of the barcodes match each other, the determination result display unit 73 may turn on, for example, a green color lamp, and, when both of the barcodes do not match each other, the determination result display unit 73 may turn on, for example, a red color lamp. Further, a determination result may be displayed by using both of the sound and the color.

(Configuration of electronic pen system)

[0031] FIG. 5A is a diagram illustrating an example of a configuration of the electronic pen system 8, and FIG. 5B is an external view illustrating a configuration of an overview of the electronic pen 80.

[0032] The electronic pen 80 includes: a cylindrical case 80a; an end portion 80b having transparency and provided so as to be able to come in and out at the end side of the case 80a; a light emitting element 80c provided inside the end portion 80b; a driving circuit (not illustrated) for driving the light emitting element 80c; a pressure sensor 80d for detecting the pressure received from the screen 2 to the end portion 80b when the end portion 80b comes into contact with the screen 2; an external switch 80e provided on the front surface of the case 80a; a central processing unit (CPU) 80f provided inside the case 80a; and a battery such as a dry cell battery and a secondary battery provided inside the case 80a and supplying electric power to each unit of the electronic pen 80. Note that a contact sensor for detecting the contact between the end portion 80b and the screen 2 may be used instead of the pressure sensor 80d.

[0033] The light emitting element 80c emits light ray with a specific wavelength region, such as infrared ray 81, to the outside via the end portion 80b.

[0034] The pressure sensor 80d has a function similar to a click in a mouse. In the pressure sensor 80d, for example, when the end portion 80b is lightly pressed once against the front surface 2a of the screen 2, a left click (for example, a selection mode) is performed, and, when the end portion 80b is kept on being pressed for a predetermined period of time (for example, two seconds) or more, a right click (for example, an input mode) is performed.

[0035] The external switch 80e has a function similar to a click in a mouse. For example, when the external switch 80e is lightly pressed once, a left click (for example, a selection mode) is performed, and, when the external switch 80e is kept on being pressed for a predetermined period of time (for example, two seconds) or more, a right click (for example, an input mode) is performed.

[0036] The CPU 80f determines which of the selection mode and the input mode is selected on the basis of the pressure detected by the pressure sensor 80d, and controls the driving circuit so as to cause the light emitting element 80c to emit the infrared ray 81 in a pulse modulated in accordance with the selected mode. The CPU 80f determines which of the selection mode and the input mode is selected on the basis of an operation of the external switch 80e, and controls the driving circuit so as to cause the light emitting element 80c to emit the infrared ray 81 in a pulse modulated in accordance with the selected mode.

[0037] The infrared ray sensor 82 receives the infrared ray 81 with the pulse modulated in accordance with the mode, so that the position information and the mode on the infrared ray sensor 82 at the end portion 80b of the electronic pen 80 are detected, and a light reception signal including the position information and the mode are output to the processing unit 83. As such an infrared ray sensor 82, for example, the one having a filter through which the infrared ray 81 can pass and a plurality of sensor elements arranged in a matrix form at a back side of the filter to detect the infrared ray 81 can be used. The position information on the infrared ray sensor 82 corresponds to the coordinate information on the screen 2.

[0038] The processing unit 83 converts the position information on the infrared ray sensor 82 into the coordinate information on the screen 2 on the basis of a reception signal from the infrared ray sensor 82, and transmits the coordinate information and the mode information indicating the mode to the management apparatus 6.

(Operation of electronic pen system)

[0039] Next, an example of operation of the electronic pen system 8 will be explained. When the end portion 80b of the electronic pen 80 is lightly pressed once against the front surface 2a corresponding to a specific portion (for example, a button) of the projection image projected on the back surface 2b of the screen 2, the pressure sensor 80d detects the pressure, and the de-

tection result is sent to the CPU 80f. The CPU 80f determines that the selection mode is selected on the basis of the pressure detected by the pressure sensor 80d, and controls the driving circuit so as to cause the light emitting element 80c to emit the infrared ray 81 in the pulse modulated in accordance with the selection mode. The light emitting element 80c emits the infrared ray 81 in the pulse modulated in accordance with the selection mode.

[0040] The infrared ray sensor 82 receives the infrared ray 81 emitted from the light emitting element 80c, and outputs the light reception signal to the processing unit 83. To the management apparatus 6, the processing unit 83 transmits the coordinate information on the screen 2 and the mode information indicating the selected mode on the basis of the light reception signal from the infrared ray sensor 82. The control unit 60 of the management apparatus 6 recognizes that a button and others corresponding to the coordinate information is selected on the basis of the coordinate information and the mode information which are output from the processing unit 83.

[0041] When a line is drawn by pressing the end portion 80b of the electronic pen 80 against the front surface 2a corresponding to a specific region of the projection image projected on the back surface 2b of the screen 2 for a predetermined time (for example, two seconds) or more, the pressure sensor 80d detects the pressure, and sent the detection result to the CPU 80f. The CPU 80f determines that the input mode is selected on the basis of the pressure detected by the pressure sensor 80d, and controls the driving circuit so as to cause the light emitting element 80c to emit the infrared ray 81 in a pulse modulated in accordance with the input mode. The light emitting element 80c emits the infrared ray 81 in the pulse modulated in accordance with the input mode.

[0042] The infrared ray sensor 82 receives the infrared ray 81 emitted from the light emitting element 80c, and outputs a light reception signal to the processing unit 83. To the management apparatus 6, the processing unit 83 transmits the continuous coordinate information (line information) on the screen 2 and the mode information indicating the input mode on the basis of the light reception signal from the infrared ray sensor 82. The control unit 60 of the management apparatus 6 recognizes that the line indicated by the line information is input on the basis of the line information and the mode information which are output from the processing unit 83. Accordingly, for example, the projection image data can be edited.

(Configuration of assembly jig)

[0043] FIG. 6A is a front view of the assembly jig 10 before it is attached to the screen 2, FIG. 6B is a plan view of FIG. 6A, FIG. 6C is a partial cross-sectional view of the assembly jig 10 after it is attached to the screen 2.

[0044] The assembly jig 10 includes: a dome-shaped main body 11; a suction pad 12 arranged inside the main body 11; a lever unit 13; a slide shaft 15 for supporting the lever unit 13 so as to be rotatable around a support

shaft 14; and a seat unit 16 provided at the end of the slide shaft 15 and fixing the slide shaft 15 to the suction pad 12.

[0045] At a center of the the main body 11, an opening 11a through which the slide shaft 15 penetrates so as to be able to slide in an up-and-down direction is formed.

[0046] The lever unit 13 includes: a pair of support pieces 130 for supporting an electric cable or wire harness; and a fulcrum unit 131 connected to the pair of support pieces 130 and serving as the center of rotation of the lever unit 13. In the fulcrum unit 131, a cam surface 131a is formed. In the state as illustrated in FIG. 6A, the cam surface 131a is in a non-contact state with the upper surface of the main body 11. When the lever unit 13 is rotated as illustrated in FIG. 6C, the cam surface 131a comes into contact with the upper surface of the main body 11, so that the slide shaft 15 is pulled upward. When the slide shaft 15 is pulled upward, the central portion of the suction pad 12 is lifted upward, so that the space inside the suction pad 12 is expanded to cause a negative pressure, and the assembly jig 10 is adhered to the front surface 2a of the screen 2.

[0047] Each of the main body 11, the lever unit 13, the support shaft 14, the slide shaft 15, and the seat unit 16 is made of, for example, a resin or a metal. The suction pad 12 is made of, for example, an elastic member such as rubber.

(Assembly method)

[0048] Next, an example of an assembly method of a wire harness assembly product will be explained with reference to FIGs. 7A to 7E. FIGs. 7A to 7E are diagrams each illustrating an example of a projection image obtained when the screen 2 is viewed from the front side. Note that a case in which the wiring step is configured by a wiring step for three wire harnesses.

[0049] A manager operates the input unit 62 of the management apparatus 6 to input the wire harness identification information. The control unit 60 reads, from the storage unit 61, the projection image data corresponding to the wire harness identification information that is input by the input unit 62, and transmits the projection image data to the projector 5. The control unit 57 of the projector 5 stores the projection image data transmitted from the management apparatus 6 into the memory 58. The manager operates the input unit 62 of the management apparatus 6 to instruct a projection start. The control unit 60 of the management apparatus 6 transmits a projection start signal to the projector 5. The control unit 57 of the projector 5 reads the projection image data of the first page from the memory 58 on the basis of the projection start signal, and controls the projection means 50 to project a projection image onto the screen 2 on the basis of the projection image data of the first page.

(1) Assembly jig attachment step (including input of management information)

[0050] FIG. 7A is a diagram illustrating an example of a projection image in an "assembly jig attachment" step of the first page. The projection image 20 illustrated in this drawing displays a step name 20a that is "assembly jig attachment", a jig image 21 of the assembly jig 10 indicating an attachment position of the assembly jig 10, a wiring instruction line 22 indicating a wiring position of the electric cable, a start button 26a meaning a start of an assembly operation of a wire harness, a feeding button 26b instructing a page feeding, a returning button 26c instructing a page returning, an end button 26d indicating an end of the assembly operation of the wire harness, and a numeric keypad button 26e serving as buttons for operation. At this time, the jig image 21 may be displayed to be highlighted.

[0051] The operator operates the numeric keypad button 26e displayed on the screen 2 by using the electronic pen 80 to input the operator ID identifying the operator. The processing unit 83 transmits the coordinate information and the mode information corresponding to the operator ID to the management apparatus 6. Subsequently, the operator selects the start button 26a displayed on the screen 2 by using the electronic pen 80. To the management apparatus 6, the processing unit 83 transmits the coordinate information and the mode information indicating the mode corresponding to the start button 26a. The control unit 60 of the management apparatus 6 stores the management information about the operation start date and time and the operator ID into the storage unit 61 as the management data 612 so as to correspond to the wire harness assembly product ID on the basis of the coordinate information and the mode information transmitted from the processing unit 83.

[0052] The operator confirms the step name 20a that is the "assembly jig attachment" in the projected projection image 20, and attaches the assembly jig 10 at the position of the jig image 21 projected on the screen 2. When the operator finishes the attachment operation of the assembly jig 10, the operator performs an operation to select the feeding button 26b by using the electronic pen 80. To the management apparatus 6, the processing unit 83 transmits the coordinate information and the mode information indicating the selection mode corresponding to the feeding button 26b. The control unit 60 of the management apparatus 6 recognizes that the feeding button 26b is selected on the basis of the coordinate information and the mode information that is output from the processing unit 83, and transmits a page feeding signal to the projector 5.

(2) Wiring step of harness 1

[0053] The control unit 57 of the projector 5 reads projection image data of the second page from the memory 58 on the basis of the page feeding signal from the man-

agement apparatus 6, and controls the projection means 50 to project the projection image based on the projection image data of the second page onto the second screen 2. The page is similarly fed in the harness wiring step described later.

[0054] FIG. 7B is a diagram illustrating a projection image of a "harness 1 wiring" step of the second page. The projection image 20 illustrated in the drawing displays not only the step name 20a "harness 1 wiring", the jig image 21, and the wiring instruction line 22 as similar to FIG. 7A, but also an electric cable image 23a including a barcode 28a, connector images 24a, 24b including connector types and barcodes 27a, 27b, and buttons 26a to 26e for operation. At this time, the electric cable image 23a and the connector images 24a, 24b may be displayed to be highlighted. In the wiring step, note that the specification of the electric cable (type, color, length, and others) is displayed on the projection image. The same goes for the following wiring step.

[0055] The operator confirms the step name 20a "harness 1 wiring" of the projected projection image 20, selects an electric cable having a similar color to and having almost the same length as the electric cable image 23a, and arranges the selected electric cable on the electric cable image 23a passing through a portion between the pair of support pieces 130 of the assembly jig 10. At this time, the operator confirms that an electric cable number displayed on a tag attached to the electric cable matches an electric cable number (not illustrated) displayed on the electric cable image 23a. Next, by using the barcode reader 7, the operator reads the barcode 28a put on the electric cable number at each of the tag side of the electric cable and the electric cable image 23a side. The determination unit 72 determines whether the barcodes 28a match each other or not, the determination result display unit 73 displays a determination result to notify the operator of the determination result. The control unit 70 of the barcode reader 7 transmits the determination result to the management apparatus 6 via the communication unit 74.

[0056] Next, the connectors corresponding to the connector images 24a and 24b are connected to both ends of the electric cable. At this time, the operator confirms that the connector numbers attached to the connector match with the connector numbers displayed on the connector images 24a and 24b, and then, the operator connects the connectors. More specifically, by using the barcode reader 7, the operator reads the barcodes 27a and 27b put on the connector numbers on the connector side and on the connector images 24a, 24b side. The determination unit 72 determines whether the barcodes match each other or not, the determination result display unit 73 displays a determination result to notify the operator of the determination result. The control unit 70 of the barcode reader 7 transmits the determination result to the management apparatus 6 via the communication unit 74.

[0057] The control unit 60 of the management apparatus 6 receives the determination result about the con-

nector and the electric cable via the communication unit 64, and stores the determination result together with the step name into the management data 612 as the history information. The reading of the barcode, the display of the determination result, and the storage of the history information are similarly performed in the wiring step of the harness described later.

[0058] The wiring of the harness 1 is finished as described above. When the operator finishes the wiring of the harness 1, the operator selects the feeding button 26b by using the electronic pen 80. The management apparatus 6 transmits a page feeding signal to the projector 5 on the basis of the mode information and the coordinate signal received from the processing unit 83.

(3) Wiring step of harness 2

[0059] The control unit 57 of the projector 5 reads the projection image data of the third page from the memory 58 on the basis of the page feeding signal from the management apparatus 6, and controls the projection means 50 to project a projection image based on the projection image data of the third page onto the screen 2.

[0060] FIG. 7C is a diagram illustrating a projection image of a "harness 2 wiring" step of the third page. The projection image 20 illustrated in the drawing displays not only a step name 20a "harness 2 wiring", a jig image 21, and a wiring instruction line 22 as similar to FIG. 7A, but also electric cable images 23b, 23c including barcodes 28b, 28c, connector images 24c, 24d, 24e including connector types and barcodes 27c to 27e, and buttons 26a to 26e for operation, and further displays a tape image 25 indicating a tape. At this time, the electric cable images 23b, 23c, the connector images 24a to 24e, and the tape image 25 may be displayed to be highlighted, or only the tape image 25 may be displayed to be highlighted. Note that the image of the harness 1 is not displayed.

[0061] The operator confirms the step name 20a "harness 2 wiring" of the projected projection image 20, selects two electric cables having a similar color to and having almost the same length as the respective two electric cable image 23b and 23c, and arranges the selected two electric cables on the electric cable images 23b and 23c passing through a portion between the pair of support pieces 130 of the assembly jig 10. At this time, the operator confirms that electric cable numbers displayed on a tag attached to the electric cables match electric cable numbers displayed on the electric cable images 23b and 23c.

[0062] Next, the connectors corresponding to the connector images 24c, 24d, and 24e are connected to both ends of the two electric cables. At this time, the operator confirms that the connector numbers attached to the connectors match with the connector numbers displayed on the connector images 24c, 24d, and 24e, and then, the operator connects the connectors. Next, the electric cables are bundled by wrapping the tape at a plurality of

positions where the tape image 25 is displayed. Note that the wrapping operation of the tape may be performed in a later step, for example, in a step of bundling the electric cables.

[0063] The wiring of the harness 2 is finished as described above. When the operator finishes the wiring of the harness 2, the operator selects the feeding button 26b by using the electronic pen 80. The management apparatus 6 transmits a page feeding signal to the projector 5 on the basis of the mode information and the coordinate signal transmitted from the processing unit 83.

(4) Wiring step of harness 3

[0064] The control unit 57 of the projector 5 reads projection image data of the fourth page from the memory 58 on the basis of the page feeding signal from the management apparatus 6, and controls the projection means 50 to project the projection image based on the projection image data of the fourth page onto the second screen 2.

[0065] FIG. 7D is a diagram illustrating a projection image of a "harness 3 wiring" step of the fourth page. The projection image 20 illustrated in the drawing displays not only the step name 20a "harness 3 wiring", the jig image 21, and the wiring instruction line 22 as similar to FIG. 7A, but also an electric cable image 23d including a barcode 28d, connector images 24f, 24g including connector types and barcodes 27f, 27g, and buttons 26a to 26e for operation. At this time, the electric cable image 23d and the connector images 24f, 24g may be displayed to be highlighted. Note that the images of the harnesses 1 and 2 are not displayed.

[0066] In accordance with the step name 20a "harness 3 wiring" of the projected projection image 20, the operator selects an electric cable having a similar color to and having almost the same length as the electric cable image 23d, and arranges the selected electric cable on the electric cable image 23d passing through a portion between the pair of support pieces 130 of the assembly jig 10. At this time, the operator confirms that an electric cable number displayed on a tag attached to the electric cable matches an electric cable number displayed on the electric cable image 23d.

[0067] Next, the connectors corresponding to the connector images 24f and 24g are connected to both ends of the electric cable. At this time, the operator confirms that the connector numbers attached to the connector match with the connector numbers displayed on the connector images 24f and 24g, and then, the operator connects the connectors.

[0068] The wiring of the harness 3 is finished as described above. When the operator finishes the wiring of the harness 3, the operator selects the feeding button 26b by using the electronic pen 80. The management apparatus 6 transmits a page feeding signal to the projector 5 on the basis of the mode information and the coordinate signal received from the processing unit 83.

(5) Step of bundling electric cables

[0069] The control unit 57 of the projector 5 reads the projection image data of the fifth page from the memory 58 on the basis of the page feeding signal from the management apparatus 6, and controls the projection means 50 to project a projection image based on the projection image data of the fifth page onto the screen 2.

[0070] FIG. 7E is a diagram illustrating a projection image of an "electric cable bundling" step of the fifth page. The projection image 20 illustrated in the drawing displays not only a step name 20a "electric cable bundling" and a jig image 21 as similar to FIG. 7A, but also electric cable images 23a to 23d of all harnesses 1 to 3, connector images 24a to 24g, and buttons 26a to 26e for operation, and further displays a tube image 26 indicating a tube with a slit. Note that the tube image 26 is displayed to be highlighted so as to be highly visible.

[0071] The operator confirms the step name 20a "electric cable bundling" of the projected projection image 20, bundles the electric cables at the position of the tube image 26 by using the tube with the slit.

[0072] The wire harness assembly product is completed as described above. When the operator completes the wire harness assembly product, the operator selects the end button 26d by using the electronic pen 80. The management apparatus 6 transmits an assembly operation end signal to the projector 5 on the basis of the mode information and the coordinate signal transmitted from the processing unit 83, and registers an assembly end date and time into the memory 58.

[0073] The control unit 57 of the projector 5 erases the projection image data stored in the memory 58 on the basis of the assembly end signal from the management apparatus 6.

(Action and effect of first embodiment)

[0074] According to the first embodiment, the following action and effect are achieved.

(a) When an electric cable is wired on a screen, a barcode displayed on a tag attached to the electric cable and a barcode displayed on an electric cable image included in a projection image are read, and a determination result as to whether the barcodes match each other or not is used as history information in inspection, and therefore, the inspection time can be shortened, and the reliability of the inspection can be improved.

(b) When a connector is connected to an electric cable, a barcode attached to the connector and a barcode displayed on a connector image included in a projection image are read, and a determination result as to whether the barcodes match each other or not is used as history information in inspection, and therefore, the inspection time can be shortened, and the reliability of the inspection can be improved.

(c) Since an assembly jig is attached to a screen by suction, risks of damage on the screen and breaking of the assembly jig become small, so that the attachment operation becomes easy.

[Second embodiment]

[0075] FIG. 8 is a cross-sectional view illustrating an example of a configuration of an overview of a wire harness production apparatus according to the second embodiment of the present invention. In the first embodiment, one screen 2 and a projector 5 are used as the display unit. However, in the second embodiment, two screens 2F, 2R and a projector 5 are used, and others are configured as similar to those of the first embodiment.

[0076] A wire harness production apparatus 1 according to the present embodiment includes: two screens 2F, 2R; one housing 3a for supporting the screens 2F, 2R; a half mirror 4c arranged inside the housing 3a; a projector 5 also arranged inside the housing 3a and projecting a projection image onto each of back surfaces 2b of the two screens 2F, 2R via the half mirror 4c; a management apparatus 6 for managing assembly of a wire harness; and two electronic pen systems 8 having an electronic pen 80 for selecting or inputting information to a projection image projected on the screens 2F, 2R.

[0077] The half mirror 4c allows the projection image of the projector 5 to pass through to project the projection image onto the screen 2F, and allows the projection image of the projector 5 to reflect and project the projection image onto the screen 2R. Note that intensities of the reflection light and the transmission light of the half mirror 4c are assumed to be almost the same as each other.

(Action and effect of second embodiment)

[0078] According to the second embodiment, the above-described (a) to (c) actions and effects can be achieved as similar to those of the first embodiment, and besides, the wire harness production efficiency can be improved since the number of screens is two to allow the operations at the same time.

[First modification]

[0079] In each of the above-described embodiments, those that are adhered to the front surface of the screen by a negative pressure have been explained as the assembly jig. However, a screen having a property in which the assembly jig is magnetically adhered to a surface of the screen by a magnetic force may be used.

[0080] FIG. 9A is a plan view of a principal part illustrating a first modification of the screen. As illustrated in FIG. 9A, as the screen 2 having the magnetic adhesion property, a screen obtained by arranging metal lines 2c in a matrix form may be used. In this case, for example, an assembly jig having a permanent magnet provided to be rotatable and a knob for rotating the permanent mag-

net to turn ON and OFF the magnetic force can be used. When the assembly jig is adhered to the front surface 2a of the screen 2, the knob is rotated to turn ON the magnetic force. When the assembly jig is detached from the screen 2, the knob is rotated to turn OFF the magnetic force. Note that an electric magnet may be used instead of the permanent magnet.

[Second modification]

[0081] FIG. 9B is a plan view of a principal part illustrating a second modification of the screen. As illustrated in FIG. 9B, a screen obtained by forming a transparent sheet 2d containing magnetic powder 2c on the front surface 2a of the screen 2 may be used. In this case, the same assembly jig as that of the first modification is used.

[Third modification]

[0082] In the above-described embodiment, the projection image data is prepared for each assembly step. However, as the projection image data 611, an object (including text) which is to be projected may be changed for each assembly step. The image can be switched for each page in a step of rough classification, and for each object in a step of fine classification.

[Fourth modification]

[0083] In the above-described embodiment, the projection image is switched on the basis of the operation of the electronic pen 80. However, the projector 5 may be controlled to switch and display the projection image for each of predetermined periods of time.

[Other modification]

[0084] Note that the embodiments of the present invention are not limited to each of the above-described embodiments, and various embodiments are applicable within the scope of the gist of the present invention. The image is switched in each of the wiring step of the harness 1, the wiring step of the harness 2, and the wiring step of the harness 3 in each of the above-described embodiments. However, the image emphasized display such as a highlight display may be provided so that a portion related to the harness is visually prominent by reducing the brightness of all the harnesses in the display but brightly displaying only the portion related to the harness.

[0085] As the electronic pen system 8, other methods may be used as long as a coordinate on the front surface 2a of the screen 2 can be read. For example, a pointing device may be used, the pointing device emitting a pointing light (for example, infrared ray, laser light) from the electronic pen onto the screen 2 without the contact of the electronic pen with the screen 2, and detecting the coordinate of the light emission point by using a camera.

[0086] The electronic pen system according to each of

the above-described embodiments is the infrared ray type using the electronic pen emitting the infrared ray and using the infrared ray camera detecting the infrared ray. However, an ultrasonic wave type using an electronic pen emitting an ultrasonic wave and using a sensor detecting the ultrasonic wave and a camera type using an electronic pen having a camera and formed by adhering a semi-transparent sheet having a special pattern lightly printed thereon for identifying the coordinate of the electronic pen to the front surface 2a of the screen 2.

[0087] In each of the above-described embodiments, the wire harness identification information is input by operating the input unit 62 of the management apparatus 6. However, the wire harness identification information may be input by operating the electronic pen 80.

[0088] Each of the above-described embodiments has described the case of the usage of the screen and the projector as the display unit. However, a liquid crystal display, a touch panel display, and others may be used. When the touch panel display is used, the electronic pen system may not be used.

[0089] Some of the components of the embodiments of the present invention may be omitted within the scope of the gist of the present invention.

[0090] In the assembly steps of the above-described embodiments, the steps may be added, eliminated, changed, and replaced with the scope of the gist of the present invention.

[0091] The present invention is applicable to a harness for rail vehicle, a harness for automobile, a harness for medical care, a harness inside a device, and others.

Claims

1. A method of inspecting a wire harness, comprising steps of:

switching an image corresponding to an assembly step of the wire harness in accordance with an advancement of the assembly step to display the image on a display unit;
reading connector identification information attached to a connector to be connected to an electric cable configuring the wire harness and connector identification information displayed on a connector image included in the image;
determining whether or not the read connector identification information attached to the connector and the read connector identification information displayed on the connector image match each other;
making a correspondence between a determination result and identification information about an assembly product of the wire harness, and accepting the determination result as operation history information for each of the assembly steps; and

inspecting the assembly product of the wire harness on the basis of the operation history information for each of the assembly steps.

2. A method of inspecting a wire harness, comprising steps of:

switching an image corresponding to an assembly step of the wire harness in accordance with an advancement of the assembly step to display the image on a display unit;
reading electric cable identification information attached to an electric cable configuring the wire harness and electric cable identification information displayed on an electric cable image included in the image;
determining whether or not the read electric cable identification information attached to the electric cable and the read electric cable identification information displayed on the electric cable image match each other;
making a correspondence between a determination result and identification information about an assembly product of the wire harness, and accepting the determination result as operation history information for each of the assembly steps; and
inspecting the assembly product of the wire harness on the basis of the operation history information for each of the assembly steps.

3. A method of inspecting a wire harness, comprising steps of:

switching an image corresponding to an assembly step of the wire harness in accordance with an advancement of the assembly step to display the image on a display unit;
reading electric cable identification information attached to an electric cable configuring the wire harness and electric cable identification information displayed on an electric cable image included in the image;
determining whether or not the read electric cable identification information attached to the electric cable and the read electric cable identification information displayed on the electric cable image match each other;
reading connector identification information attached to a connector to be connected to the electric cable and connector identification information displayed on a connector image included in the image;
determining whether or not the read connector identification information attached to the connector and the read connector identification information displayed on the connector image match each other;

making a correspondence between a determination result about the electric cable and the connector and identification information about an assembly product of the wire harness, and accepting the determination result as operation history information for each of the assembly steps; and
inspecting the assembly product of the wire harness on the basis of the operation history information for each of the assembly steps.

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FIG. 1

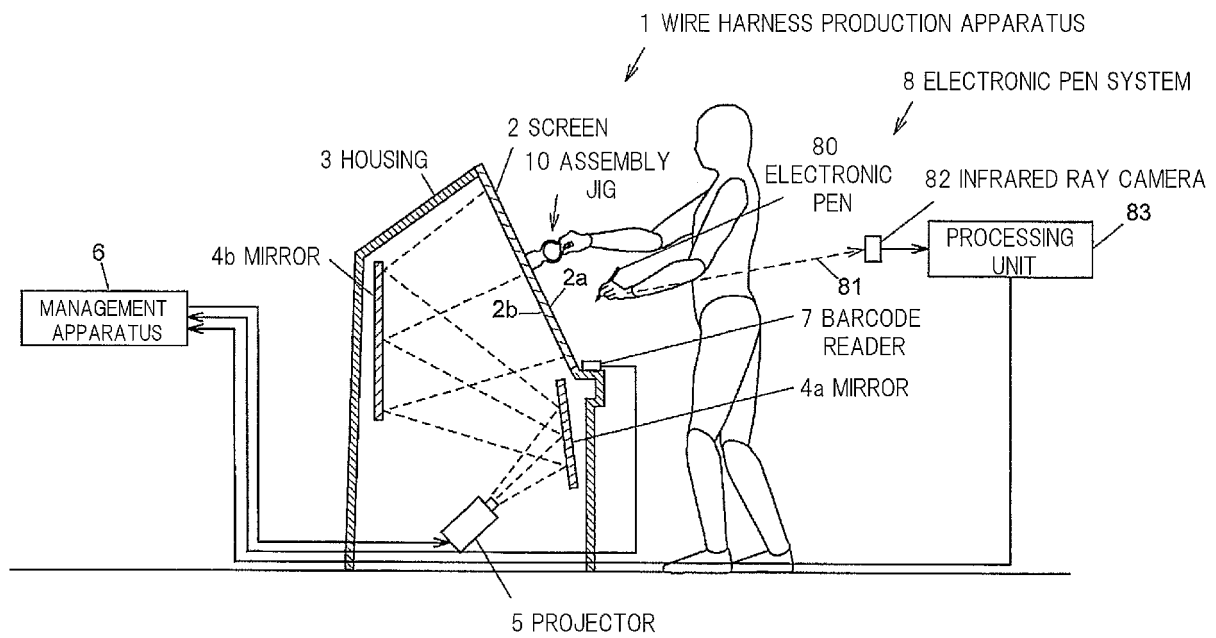


FIG. 2

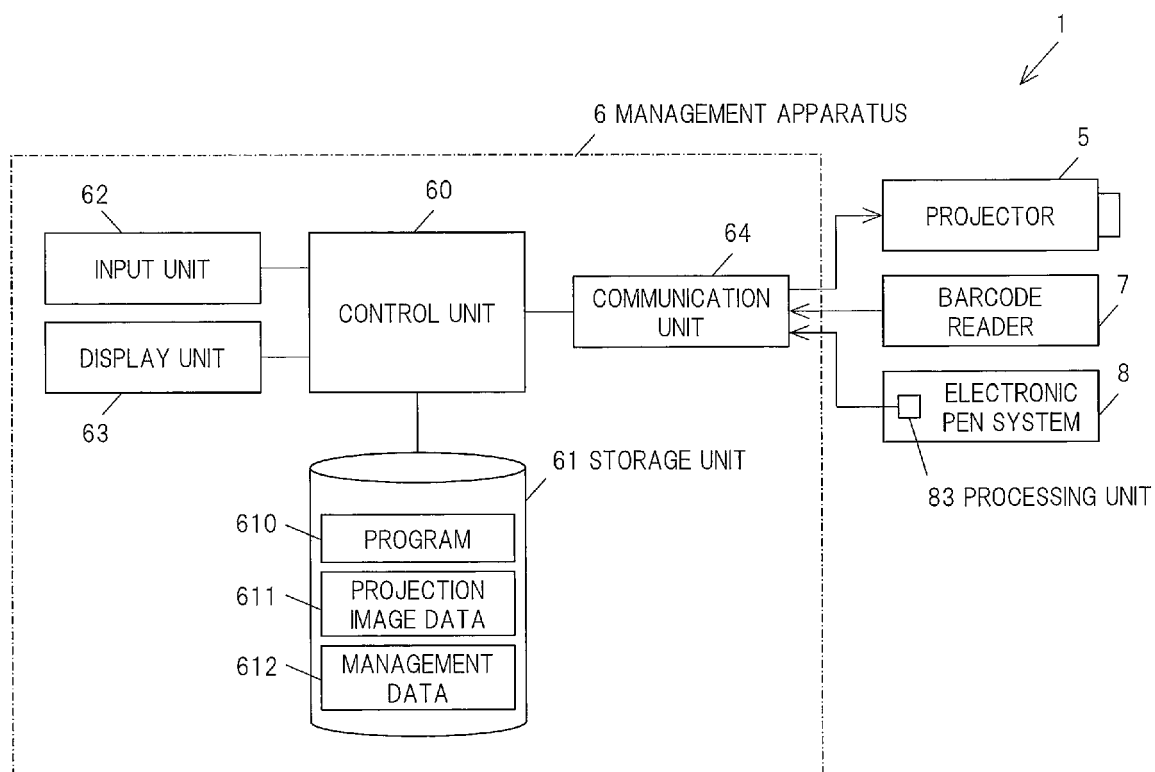


FIG. 3

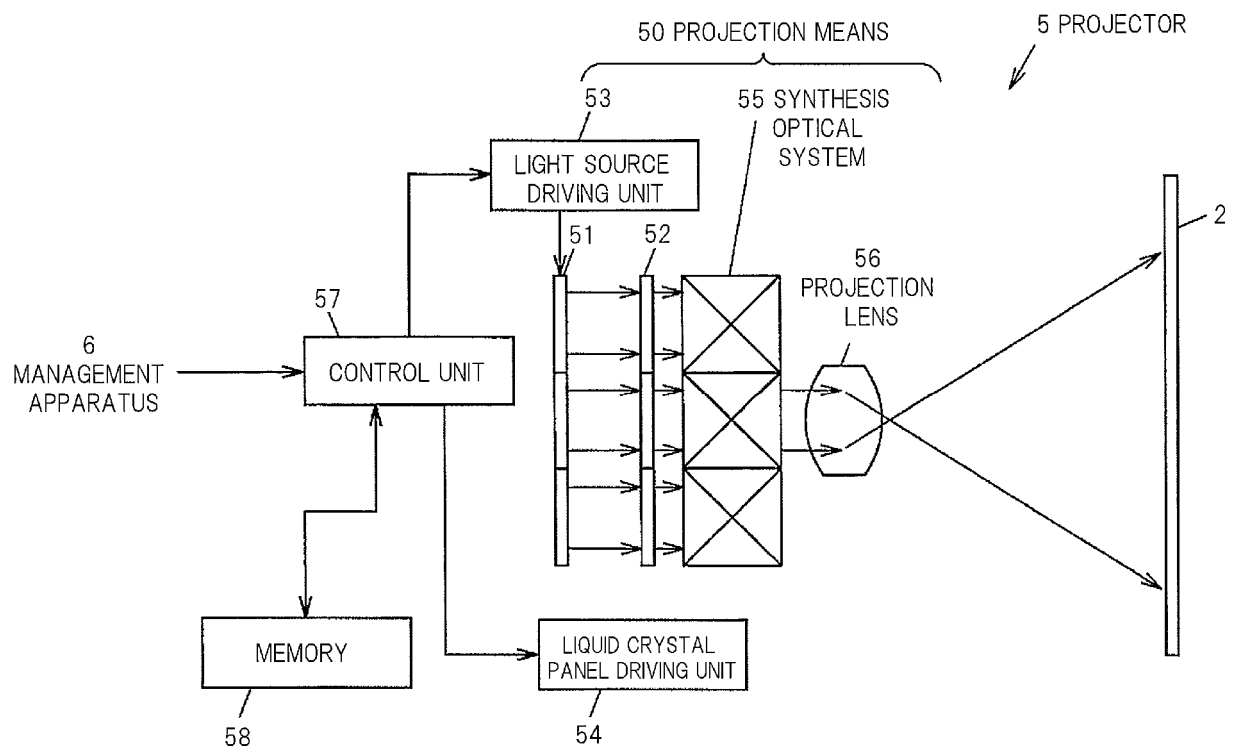


FIG. 4

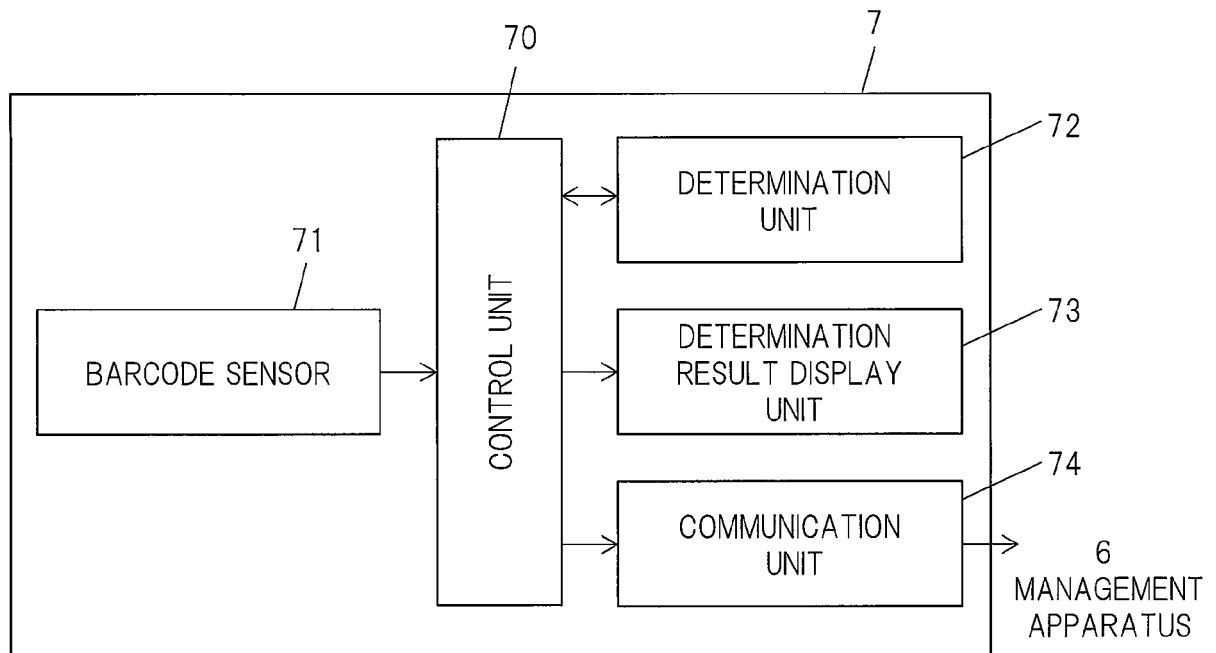


FIG. 5A

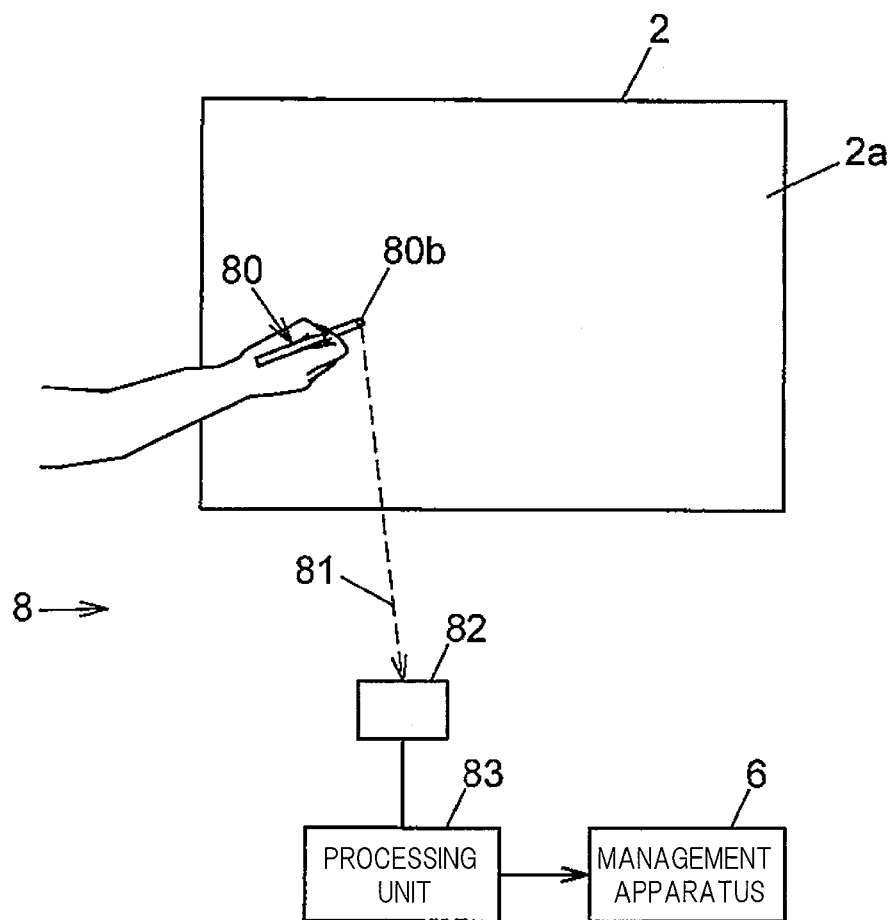


FIG. 5B

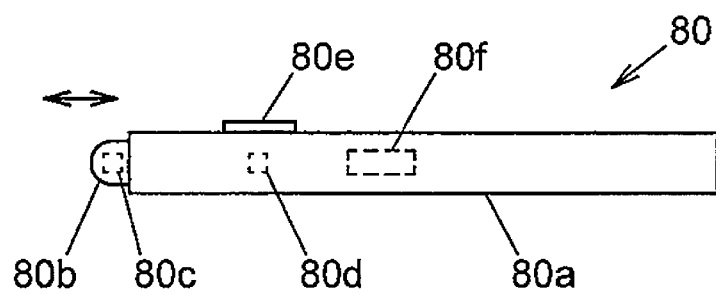


FIG. 6A

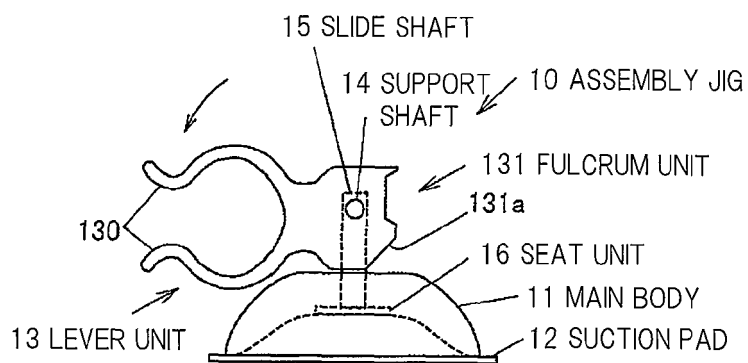


FIG. 6B

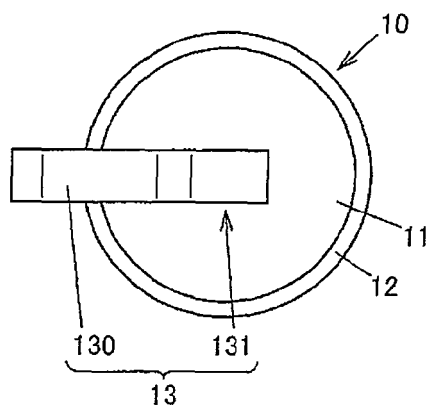


FIG. 6C

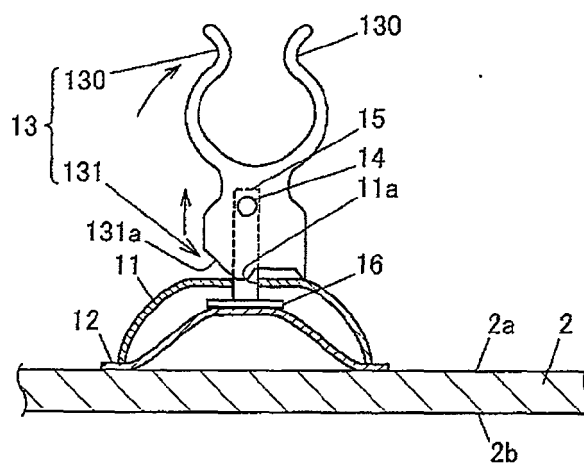


FIG. 7A

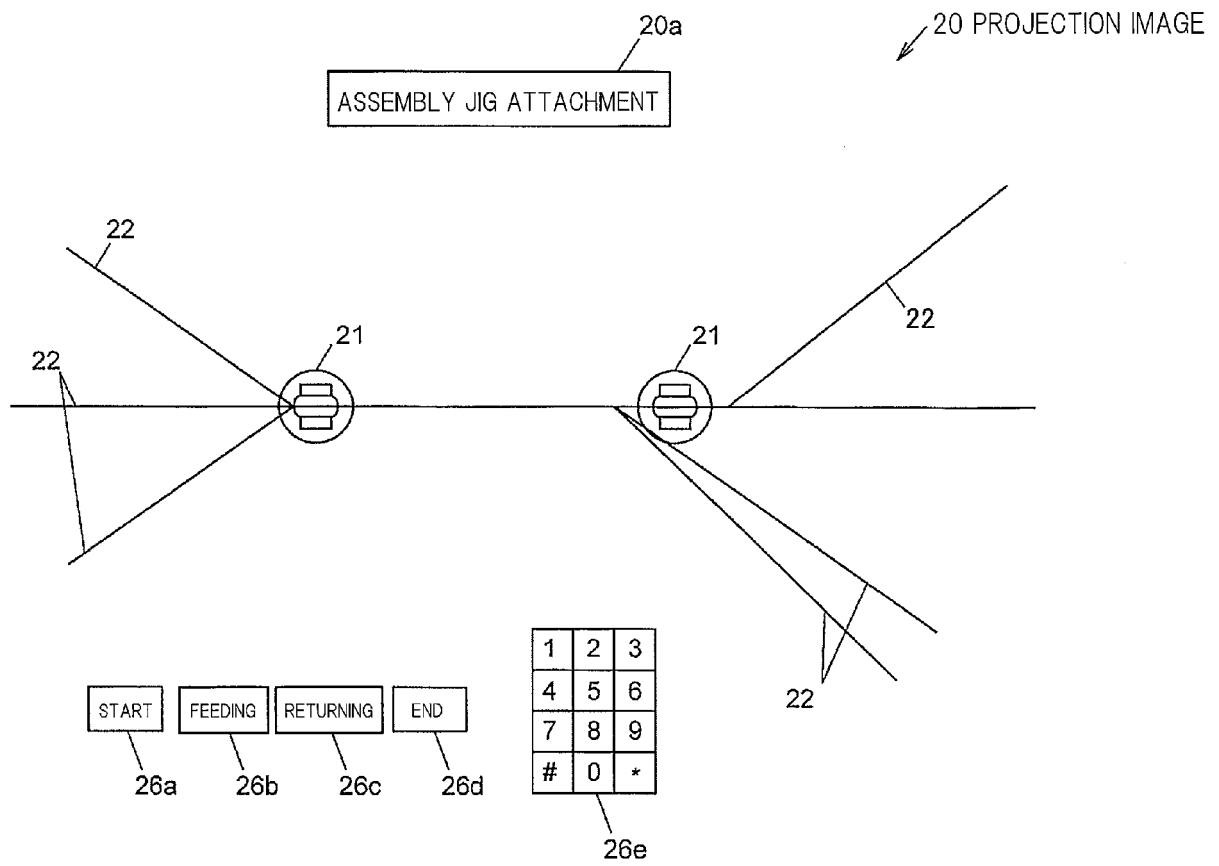


FIG. 7B

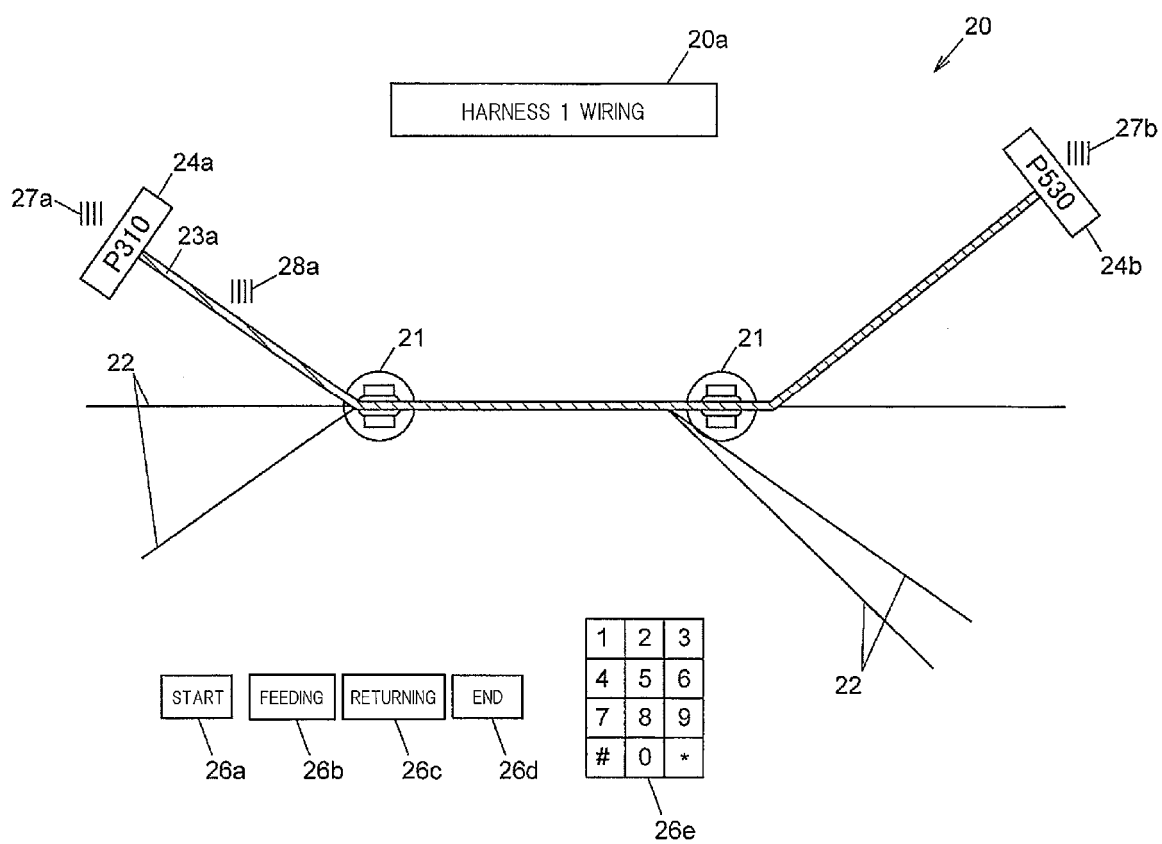


FIG. 7C

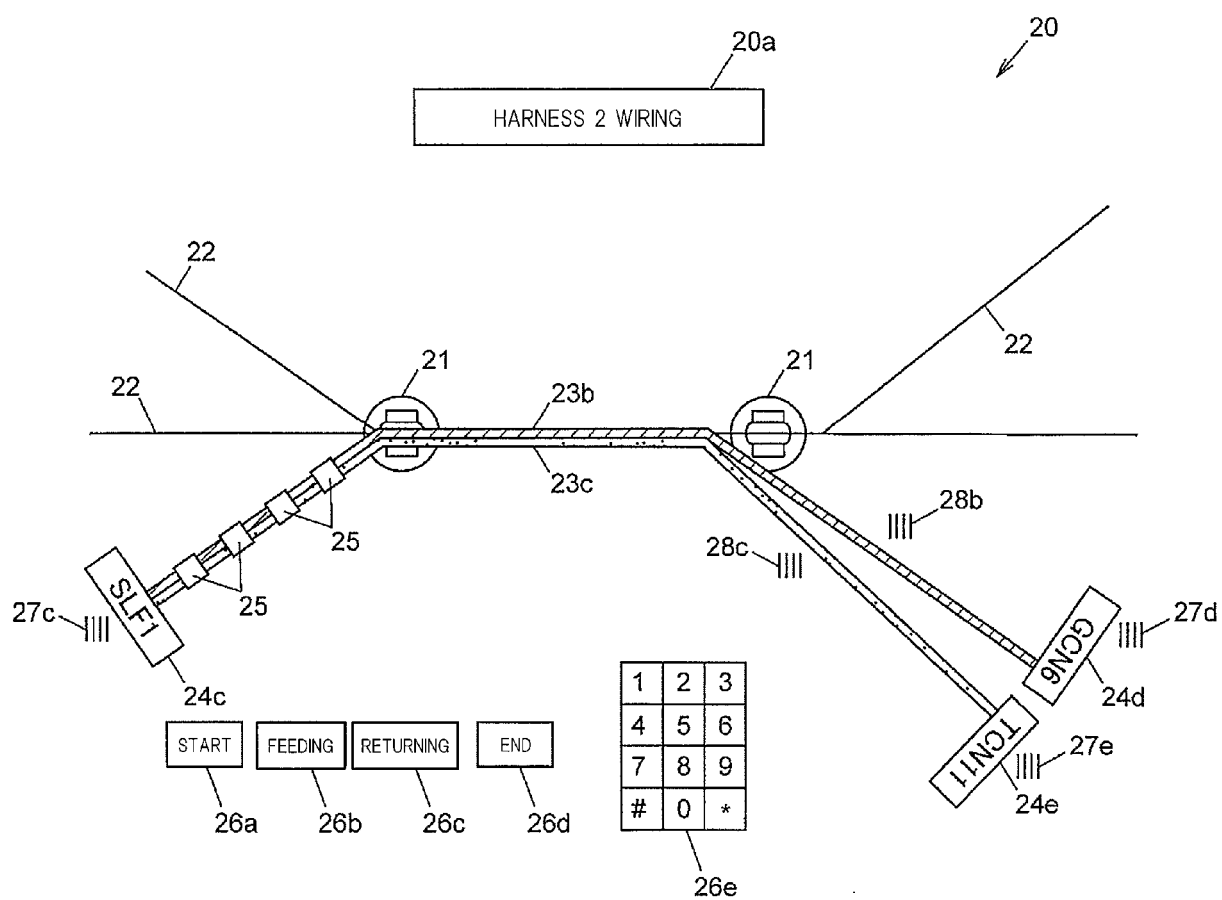


FIG. 7D

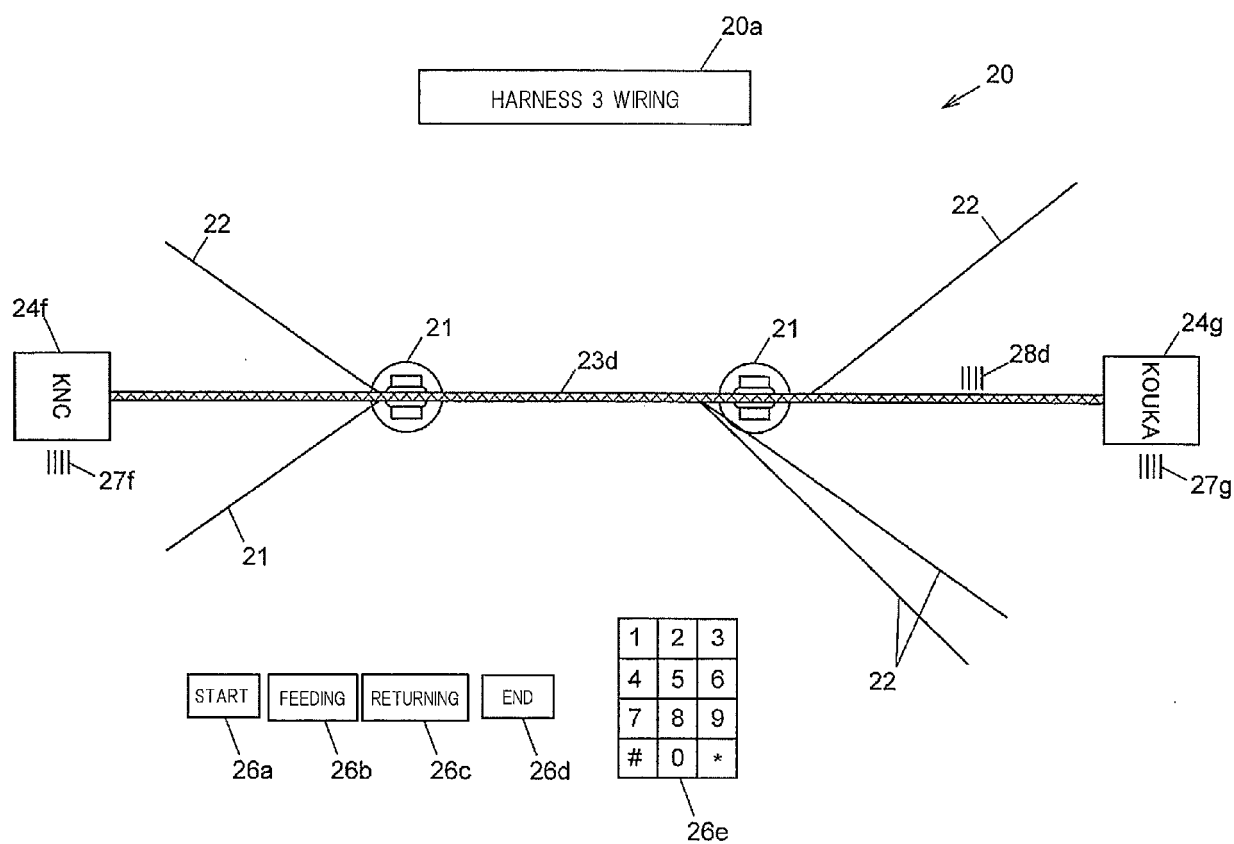


FIG. 7E

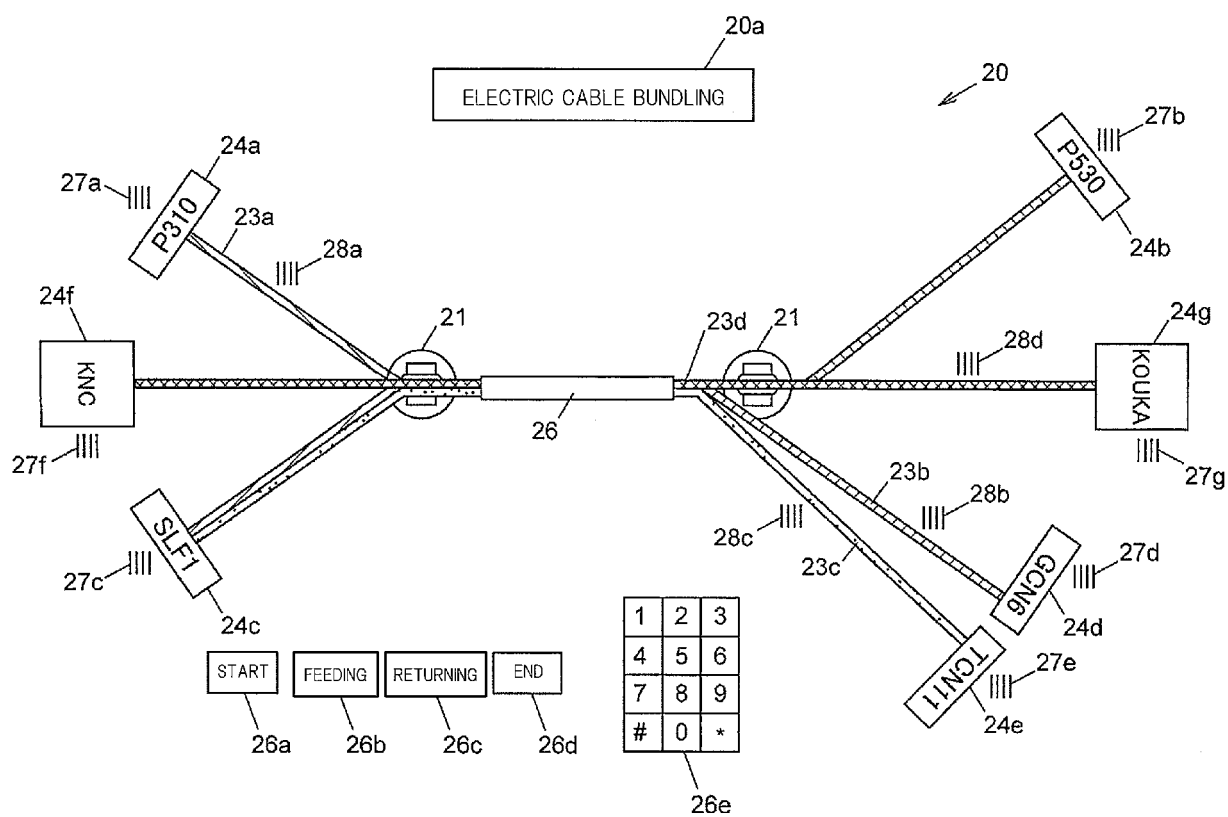


FIG. 8

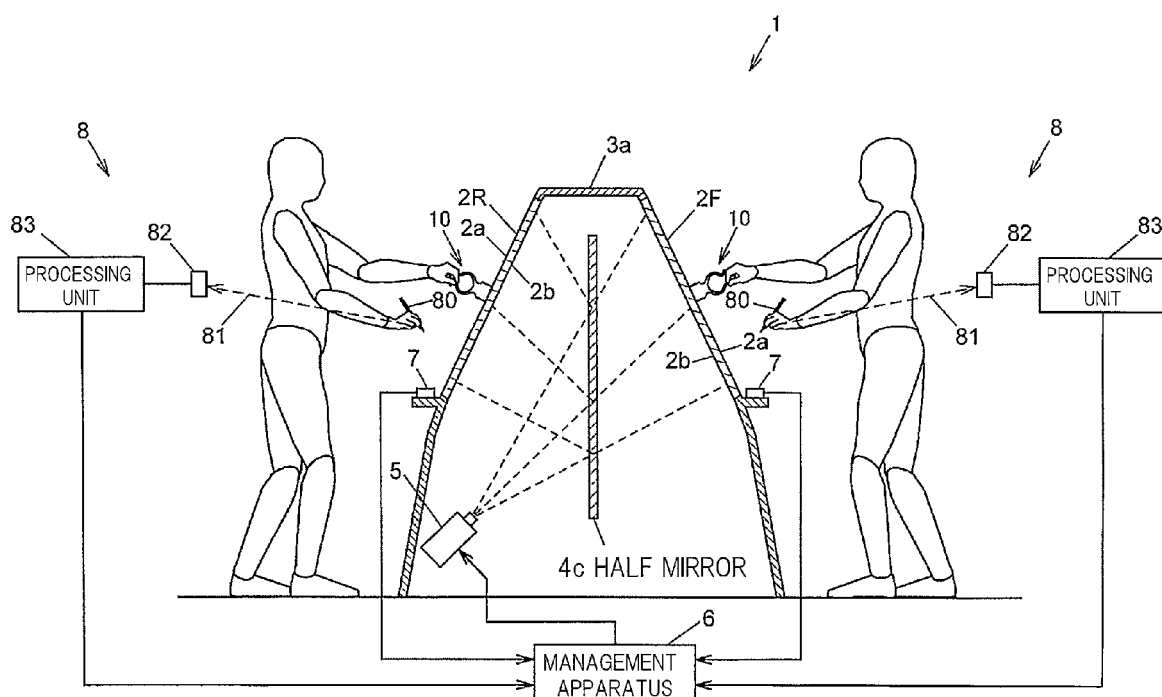


FIG. 9A

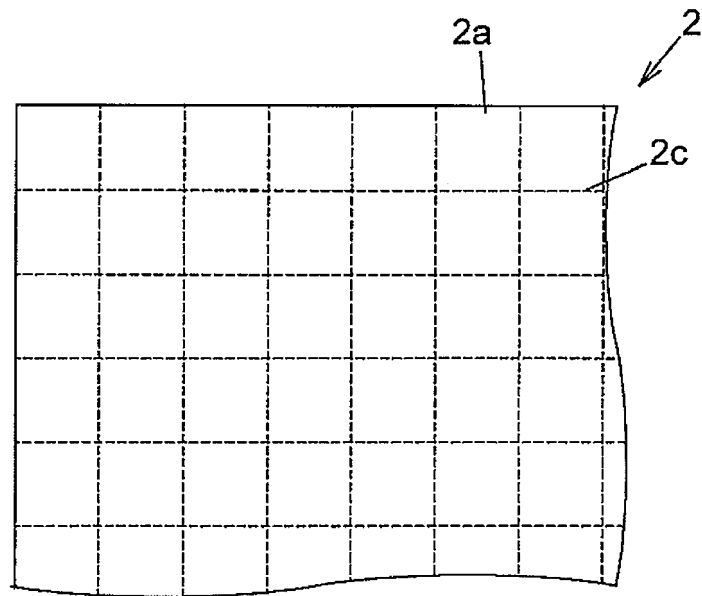
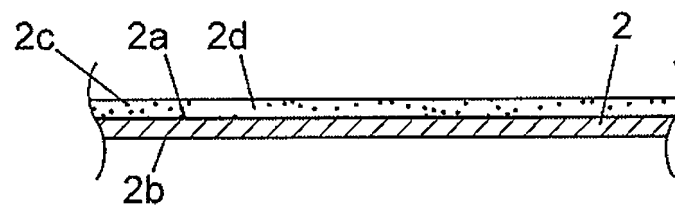


FIG. 9B





EUROPEAN SEARCH REPORT

Application Number
EP 16 18 7480

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2009/120295 A2 (MACLEAN GREG A [US]; SPELLMAN MICHAEL J [US]) 1 October 2009 (2009-10-01) * page 10, line 13 - line 15 * -----	1-3	INV. H01B13/012
			TECHNICAL FIELDS SEARCHED (IPC)
			H01B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 December 2016	Examiner Salm, Robert
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 18 7480

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15-12-2016

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		WO 2009120295 A2	01-10-2009

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- JP 2000195352 A [0004]