

Description

Title of Invention: WIRING CONVERSION ADAPTER

Technical Field

[0001] The present invention relates to a wiring conversion adapter configured to allow, for example, when a programmable controller (hereinafter referred to as "PLC") serving as a control device is changed from an old model to a new model, electric wires including a connector, a terminal block, or other such components and being connected thereto (hereinafter referred to as "wiring group"), which are used in the old model, to be connected to the new model.

Background Art

[0002] An existing control device of an old model may be replaced with a new, different model, for example, in such a circumstance that the old model is required to be replaced due to little time left before the end of service life or any failure. Further, in particular, when an existing control device of an old model is required to upgrade its control function, for example, the old model may be replaced with a new model having a more recent version of the function.

[0003] Upon such replacement, when existing wirings used in the old model are applicable to the new model, the wiring connection time can be reduced, and erroneous wiring connection can be prevented.

[0004] As one related art that facilitates changing of electric connection patterns, there is known a flexible printed circuit (FPC) relay (see, for example, Patent Literature 1). In Patent Literature 1, the following configuration is described. That is, guide portions are provided on both ends of the FPC relay so as to

receive inserted FPCs. In addition, the guide portions can be shifted in position.

[0005] With this configuration, an electric connection pattern between the two FPCs can be easily changed by suitably shifting the guide portions.

Citation List

Patent Literature

[0006] [PTL 1] JP 2004-363001 A

Summary of Invention

Technical Problem

[0007] However, the related art has the following problem.

For example, considering a case in which an existing PLC as a control device is to be replaced with a new model, it is desired to directly apply to the new model a wiring group connected to each module of the PLC. Accordingly, when the wiring group is applied as described above, an FPC adapter described in Patent Literature 1 cannot be used.

[0008] In order to apply an existing wiring group to a new model and switch wirings thereto, a wiring conversion adapter may be used, in which a first printed wiring board and a second printed wiring board are connected to each other by a printed wiring board connector. The first printed wiring board has mounted thereon a connector connectable to the existing wiring group, and the second printed wiring board has mounted thereon a connector connectable to the new model.

[0009] When such a wiring conversion adapter is used, wiring patterns of the

first printed wiring board and the second printed wiring board are suitably designed, so that the wirings of the existing wiring group can be switchingly adapted to a connector of the new model.

[0010] However, when a PLC of an old model is replaced with a new model, for example, a plurality of different modules are generally incorporated into a control system including the PLC. Further, a wiring switching pattern may vary among the modules. Hitherto, the following two approaches have been employed so as to achieve the different patterns above.

[0011] (Approach 1)

The first printed wiring board and the second printed wiring board are individually designed and produced for each module, and a wiring conversion adapter is produced for each module.

(Approach 2)

One type of first printed wiring board and one type of second printed wiring board are produced, which have a common wiring pattern adaptable to a plurality of modules. Then, corresponding components are selectively mounted or unmounted on the printed wiring boards, to thereby be able to switch wirings in accordance with the modules.

[0012] Regarding Approach 1, however, different wiring conversion adapters are required to be produced and stocked for each module, leading to a problem of increasing a development cost and a component cost.

[0013] Further, regarding Approach 2, circuit switching component(s) are required to be mounted on printed wiring boards so as to enable common use in the plurality of modules. This configuration has a problem in that a component cost increases as the number of components increases. In addition, a certain

space is required to mount the circuit switching component(s), leading to a problem of increasing a size of each printed wiring board.

[0014] The present invention has been made to solve the above-mentioned problems, and it is therefore an object of the present invention to provide a wiring conversion adapter that can be adapted to a plurality of switching patterns as well as suppress increases in size of each printed wiring board and the number of components thereof in a limited wiring pattern area.

Solution to Problem

[0015] According to one embodiment of the present invention, there is provided a wiring conversion adapter, including: a first printed wiring board; a second printed wiring board; and a printed wiring board connector configured to electrically connect the first printed wiring board and the second printed wiring board to each other, the wiring conversion adapter being configured to allow, when an old device is replaced with a new device, a wiring group used in the old device to be applicable to the new device, the first printed wiring board including: a first connector connectable to the wiring group of the old device; and a first through-hole group to which pins of the printed wiring board connector, which are to be inserted into the first printed wiring board, are to be inserted, the second printed wiring board including: a second connector connectable to a connector of the new device; and a second through-hole group to which pins of the printed wiring board connector, which are to be inserted into the second printed wiring board, are to be inserted, the first through-hole group including a larger number of through-holes than the number of pins of the printed wiring board connector so as to allow the printed wiring board connector

to be mounted thereto at a plurality of different positions, the first through-hole group further including a first common through-hole group that is used in common even when the printed wiring board connector is mounted at any one of the plurality of different positions, the second through-hole group including a larger number of through-holes than the number of pins of the printed wiring board connector so as to allow the printed wiring board connector to be mounted thereto at a plurality of different positions, the second through-hole group further including a second common through-hole group that is used in common even when the printed wiring board connector is mounted at any one of the plurality of different positions, the wiring conversion adapter being configured such that a position at which the pins of the printed wiring board connector are mounted to each of the first through-hole group and the second through-hole group is changed when the first printed wiring board and the second printed wiring board are connected to each other by the printed wiring board connector, to thereby enable switching of a wiring connection pattern between the first connector and the second connector.

Advantageous Effects of Invention

[0016] According to the present invention, the wiring patterns on the first printed wiring board and the second printed wiring board are designed separately for wiring portions common to the plurality of wiring patterns and individual wiring portions, and the mounting position of the printed wiring board connector can be changed such that the common wiring portions of the two printed wiring boards are connected together all the time, while the individual wiring portions of the two printed wiring boards are connected

together in accordance with a desired wiring connection pattern. As a result, there can be provided a wiring conversion adapter which can be adapted to a plurality of switching patterns as well as suppress increases in size and the number of components of a printed wiring board in a limited wiring pattern area.

Brief Description of Drawings

[0017] FIG. 1 is an explanatory view for illustrating configurations of components that form a wiring conversion adapter according to a first embodiment of the present invention.

FIGS. 2 are explanatory views for illustrating how to achieve two wiring switching patterns in accordance with a mounting position of a printed wiring board connector in the wiring conversion adapter according to the first embodiment of the present invention.

FIGS. 3 are views for illustrating Example 1 of the wiring conversion adapter according to the first embodiment of the present invention.

FIGS. 4 are views for illustrating Example 2 of the wiring conversion adapter according to the first embodiment of the present invention.

FIGS. 5 are views for illustrating Example 3 of the wiring conversion adapter according to the first embodiment of the present invention.

FIG. 6 is a view for illustrating Example 4 of the wiring conversion adapter according to the first embodiment of the present invention.

FIG. 7 is a view for illustrating Example 5 of the wiring conversion adapter according to the first embodiment of the present invention.

FIG. 8 is an image for showing an actual arrangement of through-holes of a first printed wiring board, which is adopted to achieve Example 5 of the

wiring conversion adapter according to the first embodiment of the present invention.

FIG. 9 is a view for illustrating Example 6 of the wiring conversion adapter according to the first embodiment of the present invention.

FIG. 10 is a view for illustrating Example 7 of the wiring conversion adapter according to the first embodiment of the present invention.

FIGS. 11 are explanatory views for illustrating how to achieve two wiring switching patterns in accordance with a mounting position of a printed wiring board connector in a wiring conversion adapter according to a second embodiment of the present invention.

FIGS. 12 are explanatory views for illustrating how to achieve two wiring switching patterns in accordance with a mounting position of a printed wiring board connector with use of a configuration different from that of FIGS. 11, in the wiring conversion adapter according to the second embodiment of the present invention.

Description of Embodiments

[0018] A description is now given below of a wiring conversion adapter according to preferred embodiments of the present invention referring to the accompanying drawings.

[0019] First Embodiment

FIG. 1 is an explanatory view for illustrating configurations of components that form a wiring conversion adapter according to a first embodiment of the present invention. The wiring conversion adapter of the first embodiment includes a first printed wiring board 10, a second printed

wiring board 20, and a printed wiring board connector 30. The first printed wiring board 10 and the second printed wiring board 20 are connected to each other via the printed wiring board connector 30, to thereby form the wiring conversion adapter.

[0020] The first printed wiring board 10 includes a first connector 11 and a first through-hole area 12. The first connector 11 is connectable to an existing wiring group used in an old model. The first through-hole area 12 includes a through-hole group 12a to be connected to a plurality of pins of the printed wiring board connector 30.

[0021] Meanwhile, the second printed wiring board 20 includes a second connector 21 and a second through-hole area 22. The second connector 21 is connectable to modules of a new model. The second through-hole area 22 includes a through-hole group 22a to be connected to a plurality of pins of the printed wiring board connector 30. The through-hole group 12a or the through-hole group 22a may be replaced by a pad used for a surface-mount type printed wiring board connector.

[0022] The printed wiring board connector 30 includes the plurality of pins used for connecting between the through-hole group 12a of the first through-hole area 12 and the through-hole group 22a of the second through-hole area 22. The plurality of pins stick out of both of front and rear surfaces of the printed wiring board connector 30.

[0023] The plurality of pins on the front surface are inserted into the through-hole group 12a, the plurality of pins on the rear surface are inserted into the through-hole group 22a, and the pins are each subsequently soldered. With this process, the wiring conversion adapter including the first printed wiring

board 10, the second printed wiring board 20, and the printed wiring board connector 30 is completed.

[0024] Although not illustrated, through suitable designing of a wiring pattern on the first printed wiring board 10 for connection between the first connector 11 and the through-hole group 12a, and a wiring pattern on the second printed wiring board 20 for connection between the second connector 21 and the through-hole group 22a, desired wiring switching can be achieved between the first connector 11 and the second connector 21.

[0025] Here, the present invention has a feature in that the number of through-holes of the through-hole group 12a and the number of through-holes of the through-hole group 22a are larger than the number of plurality of pins of the printed wiring board connector 30, and a wiring switching pattern between the first connector 11 and the second connector 21 can be changed in accordance with a mounting position of the printed wiring board connector 30. The feature is described in detail below.

[0026] FIGS. 2 are explanatory views for illustrating how to achieve two wiring switching patterns in accordance with a mounting position of the printed wiring board connector 30 in the wiring conversion adapter according to the first embodiment of the present invention. More specifically, part (a) of FIG. 2 is a view for illustrating an example of a mounting position of the printed wiring board connector 30, which enables a first wiring pattern. Part (b) of FIG. 2 is a view for illustrating an example of another mounting position of the printed wiring board connector 30, which enables a second wiring pattern. The printed wiring board connector 30 is implemented by the same component both at the mounting position that allows connection to the first wiring pattern, and at the

another mounting position that allows connection to the second wiring pattern.

[0027] In FIGS. 2, for ease of illustration and description, twelve through-holes that form the through-hole group 12a and twelve through-holes that form the through-hole group 22a are illustrated as being arranged vertically in line, by way of example.

[0028] The through-hole group 12a formed in the first printed wiring board 10 includes three types of through-holes, i.e., through-holes 12a1, through-holes 12a2, and through-holes 12a3. In FIGS. 2, the through-holes 12a2 located at a central portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern common to the first wiring pattern and the second wiring pattern.

[0029] Meanwhile, in FIGS. 2, the through-holes 12a1 located at an upper end portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern specific to the first wiring pattern. Further, in FIGS. 2, the through-holes 12a3 located at a lower end portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern specific to the second wiring pattern.

[0030] Similarly, the through-hole group 22a formed in the second printed wiring board 20 includes three types of through-holes, i.e., through-holes 22a1, through-holes 22a2, and through-holes 22a3. In FIGS. 2, the through-holes 22a2 located at a central portion of the through-hole group 22a correspond to through-holes connected to a wiring pattern common to the first wiring pattern and the second wiring pattern.

[0031] Meanwhile, in FIGS. 2, the through-holes 22a1 located at an upper end portion of the through-hole group 22a correspond to through-holes connected to

a wiring pattern specific to the first wiring pattern. Further, in FIGS. 2, the through-holes 22a3 located at a lower end portion of the through-hole group 22a correspond to through-holes connected to a wiring pattern specific to the second wiring pattern.

[0032] In part (a) of FIG. 2, the printed wiring board connector 30 is connected at a position at which the through-holes 12a2 and the through-holes 22a2 that are common portions are connected, and the through-holes 12a1 and the through-holes 22a1 specific to the first wiring pattern are connected, whereas the through-holes 12a3 and the through-holes 22a3 specific to the second wiring pattern are not connected. With the connection configuration of part (a) of FIG. 2, the wirings can be switchingly connected in accordance with the first wiring pattern.

[0033] Meanwhile, in part (b) of FIG. 2, the printed wiring board connector 30 is connected at a position at which the through-holes 12a2 and the through-holes 22a2 that are common portions are connected, and the through-holes 12a3 and the through-holes 22a3 specific to the second wiring pattern are connected, whereas the through-holes 12a1 and the through-holes 22a1 specific to the first wiring pattern are not connected. With the connection configuration of part (b) of FIG. 2, the wirings can be switchingly connected in accordance with the second wiring pattern.

[0034] In other words, one type of first printed wiring board and one type of second printed wiring board are used in common, and further, a connection position of the printed wiring board connector 30 is changed, to thereby allow the first wiring pattern and the second wiring pattern to be easily switched without providing a circuit switching component such as a rotary switch or a

jumper pin on the printed wiring boards.

[0035] In order to enable the printed wiring board connector to adapt to a plurality of wiring patterns by changing the mounting position of the printed wiring board connector, the present invention has been devised as follows. That is, common portions of the plurality of wiring patterns are first extracted. Then, wiring patterns of the first printed wiring board 10 and the second printed wiring board 20 are designed so that the extracted common portions are located at central portions of the first through-hole area 12 and the second through-hole area 22.

[0036] Next, specific portions of the wiring patterns are extracted. Then, wiring patterns of the first printed wiring board 10 and the second printed wiring board 20 are designed so that the extracted specific portions are collectively located at the end portions of the first through-hole area 12 and the second through-hole area 22.

[0037] In addition, silk-screen printing is performed on the surfaces of the first printed wiring board 10 and the second printed wiring board 20 so as to clearly indicate connection positions of the printed wiring board connector 30, which correspond to the wiring patterns of the two boards. The connection positions may be indicated clearly by other methods than the silk-screen printing, for example, through use of a solder resist, printer printing, or a copper foil.

[0038] Specific examples of the wiring conversion adapter of the present invention, which is devised in the above-mentioned manner and manufactured, are described with reference to the drawings.

[0039] FIGS. 3 are views for illustrating Example 1 of the wiring conversion adapter according to the first embodiment of the present invention.

Specifically, FIGS. 3 are explanatory views for illustrating positions of pins for the first printed wiring board, and silk-screen printing, which correspond to different mounting positions of the printed wiring board connector 30.

[0040] Unlike the example above of FIGS. 2, in an illustrated example of FIGS. 3, a plurality of (2×6) pins are arranged in lines on the printed wiring board connector 30. Further, in the illustrated example of FIGS. 3, the through-hole group 12a of the first printed wiring board 10 is illustrated by way of example, and the same configuration is applicable to the second printed wiring board 20 although not illustrated.

[0041] In FIGS. 3, the through-hole group 12a formed in the first printed wiring board 10 includes three types of through-holes, i.e., through-holes 12a1, through-holes 12a2, and through-holes 12a3. In FIGS. 3, the through-holes 12a2 located at a central portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern common to the first wiring pattern and the second wiring pattern.

[0042] Meanwhile, in FIGS. 3, the through-holes 12a1 located at a left end portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern specific to the first wiring pattern. Further, in FIGS. 3, the through-holes 12a3 located at a right end portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern specific to the second wiring pattern.

[0043] Moreover, a silk-screen print outline portion 101 for the first wiring pattern, and a silk-screen print outline portion 102 for the second wiring pattern are formed on the first printed wiring board 10 so as to clearly indicate a mounting position of the printed wiring board connector 30 to achieve the first

wiring pattern, and to clearly indicate a mounting position of the printed wiring board connector 30 to achieve the second wiring pattern, respectively.

[0044] As described above, the through-holes 12a1 and the through-holes 12a3, which are specific portions for which wirings are required to be switched in accordance with the modules, are both collectively arranged at end portions of the through-hole group 12a, so that the wiring patterns can be switched only by changing the mounting position of the printed wiring board connector 30 without changing the wirings on the printed wiring boards.

[0045] With this configuration, a plurality of wiring patterns can be switched only by changing the mounting position of the printed wiring board connector 30 while one pair of printed wiring boards, i.e., the first printed wiring board 10 and the second printed wiring board 20, are used in common. Moreover, upon manufacturing the wiring conversion adapter of the present invention, a mounting position suitable for a target wiring pattern, of the printed wiring board connector 30 can be easily identified based on the silk-screen print. Thus, misinsertion, such as mounting the printed wiring board connector 30 to a wrong position, can be prevented.

[0046] FIGS. 4 are views for illustrating Example 2 of the wiring conversion adapter according to the first embodiment of the present invention. Specifically, FIGS. 4 are explanatory views for illustrating positions of pins for the first printed wiring board, and silk-screen printing, which correspond to different mounting positions of the printed wiring board connector 30.

[0047] The through-hole arrangement of the through-hole group 12a on the first printed wiring board 10 of FIGS. 4 is the same as the arrangement above in Example 1 of FIGS. 3, except that a configuration in Example 2 of FIGS. 4

employs some measure to easily determine which wiring pattern the printed wiring board connector 30 corresponds to after the printed wiring board connector 30 is mounted.

[0048] As illustrated in part (b) of FIG. 4, the printed wiring board connector 30 in Example 2 has an extended-shape portion 31 having no pins. The extended-shape portion 31 is obtained by extending one end portion of the printed wiring board connector 30. In Example 2, the extended-shape portion 31 is formed by extending the printed wiring board connector 30 by an area corresponding to 2×2 pins. The area size corresponds to an amount by which the printed wiring board connector 30 is shifted so as to switch the first wiring pattern and the second wiring pattern.

[0049] As compared to Example 1 of FIGS. 3, in Example 2 of part (a) of FIG. 4, a silk-screen print portion 111 is further provided at a right end portion of the first through-hole area 12 of the first printed wiring board 10 so as to identify the first wiring pattern, and a silk-screen print portion 112 is further provided at a left end portion thereof so as to identify the second wiring pattern.

[0050] In part (c) of FIG. 4, the printed wiring board connector 30 is mounted at the position at which the first wiring pattern is achieved. As a result, the silk-screen print portion 112 is covered, to thereby allow only the silk-screen print portion 111 to be identified. In contrast, in part (d) of FIG. 4, the printed wiring board connector 30 is mounted at the position at which the second wiring pattern is achieved. As a result, the silk-screen print portion 111 is covered, to thereby allow only the silk-screen print portion 112 to be identified.

[0051] In part (d) of FIG. 4, the extended-shape portion 31 is required to be located on the right side. Accordingly, in the configuration of part (c) of FIG. 4,

which enables the first wiring pattern, and the configuration of part (d) of FIG. 4, which enables the second wiring pattern, the printed wiring board connector 30 is rotated by 180 degrees and mounted.

[0052] With the configuration above in Example 2, the mounting position of the printed wiring board connector 30 can be identified with reference to the silk-screen print portions 111 and 112 indicating information for identifying the wiring pattern in addition to the silk-screen print outline portions 101 and 102 indicating an approximate mounting position of the printed wiring board connector 30, so that misinsertion of the printed wiring board connector 30 can be prevented.

[0053] The position and size of the extended-shape portion 31 of FIGS. 4 and the positions of the silk-screen print portions 111 and 112 are given merely by way of example, and therefore can be suitably changed.

[0054] FIGS. 5 are views for illustrating Example 3 of the wiring conversion adapter according to the first embodiment of the present invention. Specifically, FIGS. 5 are explanatory views for illustrating a configuration in which the first printed wiring board 10 side has a portion in which no through-hole is formed, and the printed wiring board connector 30a side has a portion in which no pin is provided, so as to prevent misinsertion.

[0055] As illustrated in part (a) of FIG. 5, the first printed wiring board 10 side has free areas 12b having no through-hole between the through-holes 12a2 and the through-holes 12a1 and between the through-holes 12a2 and the through-holes 12a3, respectively.

[0056] Moreover, a silk-screen print outline portion 103 for the first wiring pattern, and a silk-screen print outline portion 104 for the second wiring pattern

are formed on the first printed wiring board 10 so as to clearly indicate a mounting position of the printed wiring board connector 30a to achieve the first wiring pattern, and to clearly indicate a mounting position of the printed wiring board connector 30a to achieve the second wiring pattern, respectively.

[0057] Meanwhile, as illustrated in part (b) of FIG. 5, the printed wiring board connector 30a side has a free area 32 in which no pin is provided, at a position corresponding to each free area 12b in which no through-holes are formed.

[0058] As described above, through the formation of the free areas 12b having no through-hole and the free area 32 having no pin, the printed wiring board connector 30a can be inserted only at a position corresponding to the silk-screen print outline portion 103 or the silk-screen print outline portion 104.

[0059] In the above-mentioned configuration of Example 1 of FIGS. 3 or Example 2 of FIGS. 4, the printed wiring board connector 30 can be inserted even at a position not corresponding to the silk-screen print outline portion. In contrast, with the configuration in Example 3 of FIGS. 5, the printed wiring board connector 30a can only be inserted at a position corresponding to the silk-screen print outline portion, to thereby more reliably prevent misinsertion.

[0060] The description of Example 1 to Example 3 above is made focusing on how to prevent misinsertion of the printed wiring board connectors 30 and 30a. In Example 4 to Example 7 below, a description is given of variations of how to arrange the through-holes and the pins so as to successfully switch a plurality of wiring patterns.

[0061] FIG. 6 is a view for illustrating Example 4 of the wiring conversion adapter according to the first embodiment of the present invention. Specifically, arrangement of the through-holes and the pins of FIG. 6

corresponds to those in Example 1 to Example 3 as illustrated in FIGS. 3 to FIGS. 5.

[0062] According to Example 4, two types of wiring patterns can be switched by one type of printed wiring board connector 30 being horizontally shifted and mounted with respect to a group of through-holes arranged in lines.

[0063] FIG. 7 is a view for illustrating Example 5 of the wiring conversion adapter according to the first embodiment of the present invention. Specifically, arrangement of the through-holes and the pins of FIG. 7 corresponds to a combination of the above-mentioned arrangement in Example 1 of FIGS. 3 and the above-mentioned arrangement in Example 3 of FIGS. 5.

[0064] FIG. 8 is an image for showing an actual arrangement of through-holes of the first printed wiring board 10, which is adopted to achieve Example 5 of the wiring conversion adapter according to the first embodiment of the present invention. In the configuration of FIG. 8, the common through-holes 12a2 formed at the central portion of the through-hole group 12a includes 2×16 through-holes, and the through-holes 12a1, 12a3, and 12a4 specific to the different wiring patterns include 2×2 through-holes.

[0065] According to Example 5, three types of wiring patterns corresponding to the silk-screen print outline portions 101, 102, and 104 can be switched by shifting the printed wiring board connector 30 in one direction with respect to one pair of printed wiring boards that are used in common, i.e., the first printed wiring board 10 and the second printed wiring board 20, or by employing the printed wiring board connector 30a.

[0066] FIG. 9 is a view for illustrating Example 6 of the wiring conversion adapter according to the first embodiment of the present invention.

Specifically, arrangement of the through-holes and the pins of FIG. 9 corresponds to a shifted one of the above-mentioned arrangement in Example 1 of FIGS. 3. In this case, the printed wiring board connector 30 is shifted in two directions, i.e., in vertical and horizontal directions. In other words, four wiring patterns in total can be switched by shifting the printed wiring board connector 30 not only in the horizontal direction, but also by one line in the vertical direction and further in the horizontal direction.

[0067] According to Example 6, four types of wiring patterns corresponding to the silk-screen print outline portions 101, 102, 105, and 106 can be switched by shifting one type of printed wiring board connector 30 vertically or horizontally.

[0068] FIG. 10 is a view for illustrating Example 7 of the wiring conversion adapter according to the first embodiment of the present invention. Specifically, arrangement of through-holes and pins of FIG. 10 corresponds to a modified one of the above-mentioned arrangement in Example 1 of FIGS. 3. In this case, the printed wiring board connector 30 is rotated by 90 degrees so as to adapt to wiring patterns in two directions.

[0069] According to Example 7, two types of wiring patterns corresponding to the silk-screen print outline portions 107 and 108 can be switched by one type of printed wiring board connector 30 being used horizontally and being rotated by 90 degrees and changed in orientation from the horizontal direction to the vertical direction.

[0070] According to Example 6 and Example 7 above, the number of through-holes specific to different wiring patterns can be increased especially when the number of common wirings is small. This configuration enables a certain degree of design freedom.

[0071] As described above, according to the first embodiment, there is provided a configuration in which the wiring patterns on the first printed wiring board and the second printed wiring board are designed separately for wiring portions common to the plurality of wiring patterns and individual wiring portions, and the mounting position of the printed wiring board connector can be changed such that the common wiring portions of the two printed wiring boards are connected together all the time, while the individual wiring portions of the two printed wiring boards are connected together in accordance with a switching pattern.

[0072] With this configuration, one pair of printed wiring boards used to switch the plurality of wiring patterns can be used in common without switching wirings on the printed wiring boards. As a result, there can be provided a wiring conversion adapter that can be adapted to a plurality of switching patterns as well as suppress increases in size of the printed wiring board and the number of components thereof in a limited wiring pattern area.

[0073] Second Embodiment

In the above-mentioned first embodiment, one pair of printed wiring boards both have a larger number of through-holes than the number of pins of the printed wiring board connector so as to enable common use of the pair of printed wiring boards. However, the present invention is not limited to this configuration.

[0074] The present invention may also employ a configuration in which only one of one pair of printed wiring boards includes a larger number of through-holes than the number of the pins of the printed wiring board connector for common use, whereas another printed wiring board of the one pair of printed

wiring boards includes the same number of through-holes as the number of pins of the printed wiring board connector, which are formed in a different arrangement (or shifted positions), so as to individually adapt to a desired wiring connection pattern.

[0075] FIGS. 11 are explanatory views for illustrating how to achieve two wiring switching patterns in accordance with a mounting position of the printed wiring board connector 30 in the wiring conversion adapter according to the second embodiment of the present invention. More specifically, part (a) of FIG. 11 is a view for illustrating an example of a mounting position of the printed wiring board connector 30, which enables a first wiring pattern. Part (b) of FIG. 11 is a view for illustrating an example of another mounting position of the printed wiring board connector 30, which enables a second wiring pattern. The printed wiring board connector 30 is implemented by the same component both at the mounting position that allows connection to the first wiring pattern, and at the another mounting position that allows connection to the second wiring pattern.

[0076] Further, in the illustrated example of FIGS. 11, for ease of illustration and description, the through-hole group 12a includes twelve through-holes arranged vertically in line and the through-hole group 22a includes ten through-holes arranged vertically in line.

[0077] The through-hole group 12a formed in the first printed wiring board 10 includes three types of through-holes, i.e., through-holes 12a1, through-holes 12a2, and through-holes 12a3. In part (a) of FIG. 11 and part (b) of FIG. 11, the through-holes 12a2 located at a central portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern common to the first

wiring pattern and the second wiring pattern.

[0078] Meanwhile, in part (a) of FIG. 11 and part (b) of FIG. 11, the through-holes 12a1 located at an upper end portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern specific to the first wiring pattern. Further, in part (a) of FIG. 11 and part (b) of FIG. 11, the through-holes 12a3 located at a lower end portion of the through-hole group 12a correspond to through-holes connected to a wiring pattern specific to the second wiring pattern.

[0079] Meanwhile, as illustrated in part (a) of FIG. 11, the through-hole group 22a formed in a second printed wiring board 20(1) includes two types of through-holes, i.e., through-holes 22a1 and through-holes 22a2. Further, as illustrated in part (b) of FIG. 11, the through-hole group 22a formed in a second printed wiring board 20(2) includes two types of through-holes, i.e., through-holes 22a2 and through-holes 22a3.

[0080] The through-holes 22a2 located in common in part (a) of FIG. 11 and part (b) of FIG. 11 correspond to through-holes connected to a wiring pattern common to the first wiring pattern and the second wiring pattern.

[0081] In contrast, in part (a) of FIG. 11, the through-holes 22a1 located at an upper end portion of the through-hole group 22a correspond to through-holes connected to a wiring pattern specific to the first wiring pattern. Further, in part (a) of FIG. 11, an available wiring area 23(1) is formed at a lower end portion of the through-hole group 22a. The available wiring area 23(1) is an area in which no through-hole is formed and a wiring pattern can be designed. That is, the second printed wiring board 20(1) that enables the first wiring pattern has the available wiring area 23(1) in place of the through-holes 22a3.

[0082] Meanwhile, in part (b) of FIG. 11, the through-holes 22a3 located at the lower end portion of the through-hole group 22a correspond to through-holes connected to a wiring pattern specific to the second wiring pattern. Further, in part (b) of FIG. 11, an available wiring area 23(2) is formed at the upper end portion of the through-hole group 22a. The available wiring area 23(2) is an area in which no through-hole is formed and a wiring pattern can be designed. That is, the second printed wiring board 20(2) that enables the second wiring pattern has the available wiring area 23(2) in place of the through-holes 22a1.

[0083] In part (a) of FIG. 11, the printed wiring board connector 30 is connected at a position at which the through-holes 12a2 and the through-holes 22a2 that are common portions are connected, and the through-holes 12a1 and the through-holes 22a1 specific to the first wiring pattern are connected, whereas the through-holes 12a3 specific to the second wiring pattern are not connected. With the connection configuration of part (a) of FIG. 11, the wirings can be switchingly connected in accordance with the first wiring pattern.

[0084] Meanwhile, in part (b) of FIG. 11, the printed wiring board connector 30 is connected at a position at which the through-holes 12a2 and the through-holes 22a2 that are common portions are connected, and the through-holes 12a3 and the through-holes 22a3 specific to the second wiring pattern are connected, whereas the through-holes 12a1 specific to the first wiring pattern are not connected. With the connection configuration of part (b) of FIG. 11, the wirings can be switchingly connected in accordance with the second wiring pattern.

[0085] In other words, in the configuration of FIGS. 11, one type of first printed wiring board is provided for common use, and the second printed wiring board

having the available wiring area is provided for specific use. With this configuration, the first wiring pattern and the second wiring pattern can be easily switched by changing the connection position of the printed wiring board connector 30 without providing a circuit switching component such as a rotary switch or a jumper pin on the printed wiring board. Therefore, the same effects as those of the first embodiment can be achieved.

[0086] Further, the available wiring area is formed instead of using the second printed wiring board in common, to thereby improve the degree of design freedom upon producing the second printed wiring board in accordance with separate wiring patterns.

[0087] Next, a description is given of a case of switching wiring patterns with use of a configuration different from those of the second printed wiring boards 20(1) and 20(2) of FIGS. 11. FIGS. 12 are explanatory views for illustrating how to achieve two wiring switching patterns in accordance with a mounting position of the printed wiring board connector 30 with use of the configuration different from that of FIGS. 11, in the wiring conversion adapter according to the second embodiment of the present invention.

[0088] The configuration of FIGS. 12 differs from the above-mentioned configuration of FIGS. 11 in the following two points.

A second printed wiring board 20(3) used to form the first wiring pattern has no available wiring area 23(1), and accordingly has a smaller size in a vertical direction than that of the second printed wiring board 20(1).

A second printed wiring board 20(4) used to form the second wiring pattern has no available wiring area 23(2), and accordingly has a smaller size in a vertical direction than that of the second printed wiring board 20(2).

[0089] With the configuration of FIGS. 12, the printed wiring board can be made more compact, and a production cost thereof can be saved although the available wiring area is not provided.

[0090] To summarize the configurations of FIGS. 11 and FIGS. 12, in the second embodiment, one type of first printed wiring board is provided for common use, and the second printed wiring board having the available wiring area or the smaller size is provided for specific use in accordance with different wiring patterns. Under this state, the connection position of the printed wiring board connector 30 is changed.

[0091] This configuration also enables a wiring conversion adapter that can be adapted to a plurality of switching patterns as well as suppress increases in size of each printed wiring board and the number of components thereof in a limited wiring pattern area by inserting the printed wiring board connector in accordance with positions of through-holes of the another printed wiring board. Further, the another printed wiring board of the one pair of printed wiring boards can be designed with higher degree of freedom in accordance with different wiring patterns.

[0092] Further, in the configuration described in the first embodiment, and the configuration of FIGS. 11 as described in the second embodiment, the one pair of printed wiring boards have the same maximum sizes on the long side and the short side, whereas in the configuration of FIGS. 12 as described in the second embodiment, the first printed wiring board and the second printed wiring board have different shapes.

[0093] When the printed wiring boards forming the one pair of printed wiring boards have the same size, the boards can be efficiently incorporated in the same

housing. In addition, with the configuration described in the first embodiment, the second printed wiring board can be used in common. In this regard, however, the paired printed wiring boards are not required to have the same maximum sizes on the long side and the short side as described with reference to FIGS. 12.

[0094] The effect of the present invention, which enables "a wiring conversion adapter that can be adapted to a plurality of switching patterns as well as suppress increases in size of each printed wiring board and the number of components thereof in a limited wiring pattern area" can be also achieved by a configuration in which the second printed wiring board is made more compact than the first printed wiring board.

[0095] Further, in the illustrated examples of FIGS. 11 and FIGS. 12, the configuration of the first printed wiring board 10 and the configuration of the second printed wiring board 20 can be interchanged. Also in this case, the same effect can be achieved.

[0096] Further, a wiring pattern can be designed so as not to short-circuit pins having no printed wiring board connector 30 or 30a mounted thereon within the first printed wiring board 10, by suitably designing a pattern for the individual wiring portion. That is, a wiring pattern can be designed such that a wiring that may connect two pins is not formed on the first printed wiring board 10, whereas on the second printed wiring board 20 side, the number of through-holes for the individual wiring portion is increased so as to short-circuit the pins.

[0097] With this configuration, unless the first printed wiring board 10 and the second printed wiring board 20 are connected to each other by the printed wiring

board connectors 30 and 30a, the two pins are not short-circuited. On the other hand, when the first printed wiring board 10 and the second printed wiring board 20 are connected to each other by the printed wiring board connectors 30 and 30a, the two pins can be short-circuited on the second printed wiring board 20 side. Therefore, short-circuit can be prevented from occurring when the printed wiring board connector is not mounted.

Reference Signs List

[0098] 10 first printed wiring board; 11 first connector; 12 first through-hole region; 12a first through-hole group; 12a1, 12a2, 12a3, 12a4 through-hole; 12b free region; 20 second printed wiring board; 21 second connector; 22 second through-hole region; 22a second through-hole group; 22a1, 22a2, 22a3, 22a4 through-hole; 30, 30a printed wiring board connector; 31 extended-shape portion; 32 free region; 101 to 108 silk-screen print outline portion; 111, 112 silk-screen print portion

Claims

[Claim 1] A wiring conversion adapter, comprising:

- a first printed wiring board;

- a second printed wiring board; and

- a printed wiring board connector configured to electrically connect the first printed wiring board and the second printed wiring board to each other,

the wiring conversion adapter being configured to allow, when an first device is replaced with a second device, a wiring group used in the first device to be connected to the second device,

- the first printed wiring board including:

- a first connector connectable to the wiring group of the first device; and

- a first through-hole group to which pins of the printed wiring board connector, which are to be inserted into the first printed wiring board, are to be inserted,

- the second printed wiring board including:

- a second connector connectable to a connector of the second device; and

- a second through-hole group to which pins of the printed wiring board connector, which are to be inserted into the second printed wiring board, are to be inserted,

- the first through-hole group including a larger number of through-holes than the number of pins of the printed wiring board connector so as to allow the printed wiring board connector to be mounted thereto at a plurality of different positions,

- the first through-hole group further including a first common through-hole group that is used in common even when the printed wiring board connector is mounted at any one of the plurality of different positions,

- the second through-hole group including a larger number of through-holes than the number of pins of the printed wiring board connector so as to allow the printed wiring board connector to be mounted thereto at a plurality of different

positions,

the second through-hole group further including a second common through-hole group that is used in common even when the printed wiring board connector is mounted at any one of the plurality of different positions,

the wiring conversion adapter being configured such that a position at which the pins of the printed wiring board connector are mounted to each of the first through-hole group and the second through-hole group is changed when the first printed wiring board and the second printed wiring board are connected to each other by the printed wiring board connector, to thereby enable switching of a wiring connection pattern between the first connector and the second connector.

[Claim 2] The wiring conversion adapter according to claim 1,

wherein the wiring connection pattern to be switched includes two types of wiring connection patterns that are a first wiring connection pattern and a second wiring connection pattern,

wherein the first through-hole group has the through-holes arranged in line, and includes the first common through-hole group formed at a central portion of the line, a through-hole group for the first wiring connection pattern, which is formed on one end side of the first common through-hole group, and a through-hole group for the second wiring connection pattern, which is formed on another end side of the first common through-hole group,

wherein the second through-hole group has the through-holes arranged in line, and includes the second common through-hole group formed at a central portion of the line, a through-hole group for the first wiring connection pattern, which is formed on one end side of the second common through-hole group, and a through-hole group for the second wiring connection pattern, which is formed on another end side of the second common through-hole group, and

wherein the first printed wiring board and the second

printed wiring board are connected to each other at a position at which the printed wiring board connector being shifted in a horizontal direction is mounted, to thereby enable switching between the first wiring connection pattern and the second wiring connection pattern.

[Claim 3] The wiring conversion adapter according to claim 2, wherein the first through-hole group has a first free area having no through-hole in each of an area between the first common through-hole group and the through-hole group for the first wiring connection pattern, and an area between the first common through-hole group and the through-hole group for the second wiring connection pattern,

wherein the second through-hole group has a second free area having no through-hole in each of an area between the second common through-hole group and the through-hole group for the first wiring connection pattern, and an area between the second common through-hole group and the through-hole group for the second wiring connection pattern,

wherein the printed wiring board connector has a third free area having no pin at each of a position opposing the first free area when the printed wiring board connector is mounted at a first mounting position that enables the first wiring connection pattern, and a position opposing the second free area when the printed wiring board connector is mounted at a second mounting position that enables the second wiring connection pattern, so that the printed wiring board connector enables connection between the first printed wiring board and the second printed wiring board only at the first mounting position and the second mounting position.

[Claim 4] The wiring conversion adapter according to claim 2, wherein the first through-hole group further includes a through-hole group for a third wiring connection pattern, which is formed on an opposite side to a side on which the through-hole group for the second wiring connection pattern and the first

common through-hole group are adjacent to each other, via a first free area having no through-hole,

wherein the second through-hole group further includes a through-hole group for the third wiring connection pattern, which is formed on an opposite side to a side on which the through-hole group for the second wiring connection pattern and the second common through-hole group are adjacent to each other, via the first free area having no through-hole,

wherein the printed wiring board connector comprises one of:

a second printed wiring board connector having a third free area having no pin at a position opposing the first free area when the second printed wiring board connector is mounted at a third mounting position that enables the third wiring connection pattern; and

a first printed wiring board connector not having the third free area, the first printed wiring board connector being mountable at a first mounting position that enables the first wiring connection pattern, and at a second mounting position that enables the second wiring connection pattern,

wherein, when the first printed wiring board connector is used, the first printed wiring board and the second printed wiring board are connected to each other at a position at which the first printed wiring board connector being shifted in the horizontal direction is mounted, so as to enable switching between the first wiring connection pattern and the second wiring connection pattern, and

wherein, when the second printed wiring board connector is used, the second printed wiring board connector is mounted at the third mounting position to connect the first printed wiring board and the second printed wiring board to each other, so as to enable switching to the third wiring connection pattern.

[Claim 5] The wiring conversion adapter according to claim 2, wherein the wiring connection pattern to be switched

further includes two types of wiring connection patterns that are a third wiring connection pattern and a fourth wiring connection pattern,

wherein the through-holes of the first through-hole group and the second through-hole group are formed so that the printed wiring board connector is mountable under a vertically-shifted state in which the printed wiring board connector is shifted by one line in a vertical direction orthogonal to the horizontal direction,

wherein the first through-hole group further includes, under the vertically-shifted state, a through-hole group for the third wiring connection pattern on one end side of the first common through-hole group, and a through-hole group for the fourth wiring connection pattern on another end side of the first common through-hole group,

wherein the second through-hole group further includes, under the vertically-shifted state, a through-hole group for the third wiring connection pattern on one end side of the second common through-hole group, and a through-hole group for the fourth wiring connection pattern on another end side of the second common through-hole group, and

wherein, under the vertically-shifted state, the first printed wiring board and the second printed wiring board are connected to each other at a position at which the printed wiring board connector shifted in the horizontal direction is mounted, to thereby further enable switching between the third wiring connection pattern and the fourth wiring connection pattern.

[Claim 6] The wiring conversion adapter according to claim 1,

wherein the wiring connection pattern to be switched includes two types of wiring connection patterns that are a first wiring connection pattern and a second wiring connection pattern,

wherein the first through-hole group has the through-holes arranged in a cross shape in a vertical direction and a horizontal direction, and includes the first common

through-hole group formed at a central portion of the cross shape, a through-hole group for the first wiring connection pattern, which is formed at each of ends of the first common through-hole group in the horizontal direction, and a through-hole group for the second wiring connection pattern, which is formed at each of ends of the first common through-hole group in the vertical direction,

wherein the second through-hole group has the through-holes arranged in a cross shape in the vertical direction and the horizontal direction, and includes the second common through-hole group formed at a central portion of the cross shape, a through-hole group for the first wiring connection pattern, which is formed at each of ends of the second common through-hole group in the horizontal direction, and a through-hole group for the second wiring connection pattern, which is formed at each of ends of the second common through-hole group in the vertical direction, and

wherein the first printed wiring board and the second printed wiring board are connected to each other by the printed wiring board connector at a position at which the printed wiring board connector is mounted while being oriented in any one of the vertical direction and the horizontal direction, to thereby enable switching between the first wiring connection pattern and the second wiring connection pattern.

[Claim 7] The wiring conversion adapter according to any one of claims 1 to 6, wherein the printed wiring board connector includes an extended-shape portion having no pin, the extended-shape portion being extended to cover a predetermined silk-screen print portion on each of the first printed wiring board and the second printed wiring board when the printed wiring board connector is mounted thereto.

[Claim 8] A wiring conversion adapter, comprising:
a first printed wiring board;
a second printed wiring board; and

a printed wiring board connector configured to electrically connect the first printed wiring board and the second printed wiring board to each other,

the wiring conversion adapter being configured to allow, when an first device is replaced with a second device, a wiring group used in the first device to be connected to the second device,

the first printed wiring board including:

a first connector connectable to the wiring group of the first device; and

a first through-hole group to which pins of the printed wiring board connector, which are to be inserted into the first printed wiring board, are to be inserted,

the first printed wiring board being used in common to wiring connection patterns to be switched,

the second printed wiring board including:

a second connector connectable to a connector of the second device; and

a second through-hole group to which pins of the printed wiring board connector, which are to be inserted into the second printed wiring board, are to be inserted,

the second printed wiring board being used individually to each of the wiring connection patterns,

the first through-hole group including a larger number of through-holes than the number of pins of the printed wiring board connector, to thereby allow the printed wiring board connector to be mounted thereto at a plurality of different positions,

the first through-hole group further including a first common through-hole group that is used in common even when the printed wiring board connector is mounted at any one of the plurality of different positions,

the second through-hole group including the same number of through-holes as the number of pins of the printed wiring board connector,

the second through-hole group further including a second

common through-hole group that is used in common to the wiring connection patterns,

the wiring conversion adapter being configured such that a position at which the pins of the printed wiring board connector are mounted to the first through-hole group is changed when the first printed wiring board and the second printed wiring board are connected to each other by the printed wiring board connector, to thereby enable switching of a wiring connection pattern between the first connector and the second connector.

[Claim 9] A wiring conversion adapter, comprising:

a first printed wiring board;

a second printed wiring board; and

a printed wiring board connector configured to electrically connect the first printed wiring board and the second printed wiring board to each other,

the wiring conversion adapter being configured to allow, when an first device is replaced with a second device, a wiring group used in the first device to be connected to the second device,

the first printed wiring board including:

a first connector connectable to the wiring group of the second device; and

a first through-hole group to which pins of the printed wiring board connector, which are to be inserted into the first printed wiring board, are to be inserted,

the first printed wiring board being used in common to wiring connection patterns to be switched,

the second printed wiring board including:

a second connector connectable to a connector of the first device; and

a second through-hole group to which pins of the printed wiring board connector, which are to be inserted into the second printed wiring board, are to be inserted,

the second printed wiring board being used individually

to each of the wiring connection patterns,

the first through-hole group including a larger number of through-holes than the number of pins of the printed wiring board connector, to thereby allow the printed wiring board connector to be mounted thereto at a plurality of different positions,

the first through-hole group further including a first common through-hole group that is used in common even when the printed wiring board connector is mounted is at any one of the plurality of different positions,

the second through-hole group including the same number of through-holes as the number of pins of the printed wiring board connector,

the second through-hole group further including a second common through-hole group that is used in common to the wiring connection patterns,

the wiring conversion adapter being configured such that a position at which the pins of the printed wiring board connector are mounted to the first through-hole group is changed when the first printed wiring board and the second printed wiring board are connected to each other by the printed wiring board connector, to thereby enable switching of a wiring connection pattern between the first connector and the second connector.

[Claim 10] The wiring conversion adapter according to claim 8 or 9, wherein the second printed wiring board is smaller in size than the first printed wiring board.