

Modular Socket Panel and Layer Module for Modular Socket Panel

FIELD OF THE INVENTION

The present invention relates to an electrical connector, and in particular to a device mounted in indoor environments such as residential buildings or office buildings, and configured to supply power to electrical appliances.

BACKGROUND OF THE INVENTION

Socket panels are commonly seen on walls of residential rooms or office rooms, and they are used to supply 110V or 220V mains power to various industrial or domestic electrical appliances via standard sockets. Usually, the surface of socket panels are in white color, so that the socket panels are in tune with surrounding white wall face, and would not violate the room's interior decoration tone. In addition, a socket panel usually consists of two parts: an embedded case (also referred to as bottom case) embedded in the wall and a panel snap-fitted to the embedded case. These two parts are connected by screws.

As technology (especially various communication and electronic devices) advances rapidly, conventional socket panels that only provide AC power supply turn to be not meeting user's demands any more. Besides the basic functions, it is desirable that socket panels can provide other functions, such as network connection and USB interface, etc. In addition, many conventional domestic socket panels keep being worn gradually and have to be replaced, or should be renovated to be in tune with the interior decoration that has been improved rapidly. However, it is still not easy nowadays for ordinary people to replace socket panels, because not only it is a bit dangerous to replace the socket panel (as there is bare electrical wiring), but also the replacement requires tools to accomplish. Conventional designs of socket panels make the replacement difficult and render limitations in their functionality.

SUMMARY OF THE INVENTION

Therefore, the present invention in one aspect discloses a modular socket panel, which contains a bottom layer and a surface layer. The bottom layer is adapted to be fixed to an embedded case in a wall and is adapted to electrically connect to a power supply provided by the embedded case. The surface layer is adapted to be directly or indirectly connected to the bottom layer in a non-fastening manner. The surface layer provides a power socket, which is electrically connected to the bottom

layer.

Preferably, the modular socket panel further contains a middle layer disposed between the bottom layer and the surface layer. The middle layer is adapted to connect to the bottom layer in a pull and plug manner. The surface layer is adapted to connect to the middle layer in a pull and plug manner. The middle layer is electrically connected to the bottom layer and the surface layer respectively.

Preferably, the middle layer is provided with at least one of the following components: an environmental sensor, a network adapter, and a controller.

In an exemplary embodiment, the environmental sensor is one of the following sensors: a temperature sensor, a humidity sensor, a human body sensor, an infrared sensor, and a light sensor. The network adapter is a powerline adapter, an Ethernet adapter, and a wireless access point. The controller is adapted to connect with switches disposed on the surface layer, and receive inputs generated by operation on the switches, therefore controls operation of electrical appliances external to the modular socket panel.

In a variation of the embodiments, the bottom layer of the modular socket panel has a plurality of bottom layer jacks, all of which are connected to the power supply provided by the embedded case. The middle layer has a plurality of middle layer pins that are respectively corresponding to and electrically connected to the bottom layer jacks, and a plurality of middle layer jacks connected to the middle layer pins. The surface layer has a plurality of surface layer pins that are respectively corresponding to and electrically connected to the middle layer jacks.

In another variation, the bottom layer of the modular socket panel is directly connected to the surface layer. The bottom layer has a plurality of bottom layer jacks, all of which are connected to the power supply provided by the embedded case. The surface layer has a plurality of middle pins that are respectively corresponding to and electrically connected to the bottom layer jacks.

In one implementation, the power socket of the modular socket panel is a USB socket, which is connected to the bottom layer via an AC to DC converter.

In another implementation, the bottom layer is adapted to be fixed to the embedded case in the wall

by screws.

In one variation, the surface of the surface layer is colorful.

In another variation, the front side of the surface layer is in polygonal, round, or irregular shape.

In a further variation, the non-fastening manner by which the middle layer and surface layer are mounted onto the bottom layer includes sliding, pull and plug, or snap-fitting.

In another aspect of the present invention, a layer module for a modular socket panel is disclosed. The layer module is adapted to be mounted in a pull and plug manner onto a bottom layer fixed to an embedded case in a wall. The layer module provides power sockets, which are electrically connected to the bottom layer.

Preferably, the layer module is the outermost surface layer of the modular socket panel.

More preferably, the layer module is a middle layer, which is provided with at least one of the following components: an environmental sensor, a network adapter and a controller.

More preferably, the middle layer is configured to accept a surface layer mounted onto it in a pull and plug manner, and the surface layer is adapted to be electrically connected to the middle layer.

In one variation, the non-fastening manner includes sliding, pull and plug, or snap-fitting.

The modular socket panel provided in the present invention has many advantages. With the detachable design in a pull and plug manner, the user can mount the middle layer and the surface layer onto the bottom layer or remove the middle layer and the surface layer from the bottom layer without using any tool. During the interior decoration, the bottom layer can be pre-mounted on the embedded case in the wall by screws and at the same time the electric wires led out from the embedded case is connected to the bottom layer. Of course, the embedded case can be removed and replaced when necessary at a later time. However, the user usually does not need to consider the installation of the bottom layer, but only has to mount the middle layer and/or the bottom layer in snap-fitting, pull and plug, or sliding manner. Thus, the middle layer or the surface layer can be

easily replaced when it is damaged. In addition, the user can easily replace the surface layer with another one with the user's favorable color.

Moreover, a great advantage provided by the present invention is that the middle layer can be easily removed and replaced by the user without any tool or professional electrician's skill. The user can mount different middle layers in the modular socket panel as required to implement different functions, and the manufacturer can provide new middle layers for the users to choose as the market is developing. Thus, the functions of the modular socket panel can be expanded continuously, for example adding more intelligent functions, without replacing the entire modular socket panel.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention can be understood further by reading the following description with reference to the accompanying drawings. Among the accompanying drawings, the same component is denoted by the same reference mark. In some cases, a sub-mark is appended to a reference mark by a hyphen to represent a specific one among similar components. A reference mark which is not appended by any specific sub-mark refers to all the similar components.

Fig. 1 is a diagram illustrating assembly relationship of the modular socket panel according to an embodiment of the present invention.

Fig. 2a is a front view of the bottom layer in the modular socket panel shown in Fig. 1.

Fig. 2b is a rear view of the bottom layer in the modular socket panel shown in Fig. 1.

Fig. 2c is a diagram illustrating the wiring of the bottom layer in the modular socket panel shown in Fig. 1, showing the front view and bottom view of the bottom layer.

Fig. 3a is the front view of the middle layer in the modular socket panel shown in Fig. 1.

Fig. 3b is the rear view of the middle layer in the modular socket panel shown in Fig. 1.

Fig. 3c is a diagram illustrating the wiring of the middle layer in the modular socket panel shown in Fig. 1, showing the front view and bottom view of the middle layer.

Fig. 4a is the front view of the surface layer in the modular socket panel shown in Fig. 1.

Fig. 4b is the rear view of the surface layer in the modular socket panel shown in Fig. 1.

Fig. 4c is a diagram illustrating the wiring of the surface layer in the modular socket panel shown in Fig. 1.

Fig. 5 is a diagram illustrating the assembly relationship of the modular socket panel according to an embodiment of the present invention, where the surface layer is directly coupled to the bottom layer.

Fig. 6 is a diagram illustrating the assembly relationship of the modular socket panel according to an embodiment of the present invention, where the surface layer is coupled to the middle layer in a different direction.

Fig. 7 is a diagram illustrating the assembly of the modular socket panel according to an embodiment of the present invention, where a separate connector base is mounted on the bottom layer jacks of the bottom layer.

DETAILED DESCRIPTION

In embodiments of the present invention, there is provided a socket panel structure that can be assembled and disassembled flexibly. Thus, the socket panel is easy to be replaced and maintained, and the function expandability of the socket panel is greatly improved. As a result, the socket panel is able to meet the requirements for intelligent home and intelligent furniture in the future. Other benefits and advantages provided by embodiments of the present invention can be understood easily through reading the following description.

Firstly, the modular socket panel according to one embodiment of the present invention is shown in Fig. 1. The modular socket panel contains three parts: a bottom layer **20**, a middle layer **22** and a surface layer **24**. The bottom layer **20**, the middle layer **22**, and the surface layer **24** are stacked and mounted together into an assembly in a top-to-bottom sequence by a pull and plug manner. The bottom layer **20**, the middle layer **22**, and the surface layer **24** are adapted to be detached manually without using any tool as well. The pull and plug way of assembling is accomplished by coupling a

plurality of jacks and/or pins of each part accordingly. This will be described in details later hereunder.

The bottom layer **20** is adapted to be fixed to an embedded case (not shown) in the wall. Here, the embedded case includes a conventional bottom case/embedded case mounted in the wall, for example. It is well known to the person skilled in the art that such an embedded case is usually in a rectangular shape, and with an opening on the side facing outward. Electric wires led out from the wall can be connected to the bottom layer **20** outside of the embedded case via the opening, so that the bottom layer **20** is electrically connected to the electric wires (also referred to as power supply herein) in the embedded case. See Fig. 1, Fig. 2a and Fig. 2b, the bottom layer **20** is a substantially protruding part including a protrusion **26** and a cavity **32** defined in the protrusion **26**. The cavity **32** is configured to receive a protrusion **34** of the middle layer **22** as shown in Fig. 1. An outer rim **28** is arranged on the periphery of the protrusion **26**, i.e. on the front side of the bottom layer **20**. The cross-sectional area defined by the outer rim **28** is greater than the cross-sectional area of the protrusion **26**. The outer rim **28** is configured to match the bottom layer **20** with the shape of the embedded case (not shown) and align bottom layer **20** to the embedded case. In addition, in a preferred embodiment, the outer rim **28** has screw holes (not shown), so that the bottom layer **20** can be easily mounted on the embedded case with long screws.

Moreover, a plurality of bottom layer jacks **30**, **30a** are arranged on the front side of the lower part of the bottom layer **20** (here, the lower part refers to the portion which is lower on the modular socket panel when the modular socket panel is mounted on a vertical wall face). In this embodiment, there are seven bottom layer jacks **30**, **30a** aligned along a straight line and spaced evenly. The difference between the bottom layer jacks **30a** and the bottom layer jacks **30** is that there are three bottom layer jacks **30** and four bottom layer jacks **30a**. The bottom layer jacks **30** are electrically connected to the mains power supply led out from the embedded case. In particular, the three bottom layer jacks **30** are connected to the live wire, neutral wire, and earth wire of mains power supply respectively. In addition, the four bottom layer jacks **30a** are not configured to directly connect to the mains power supply. Instead, the bottom layer jacks **30a** are configured to connect other electrical appliances (not shown), such as electric lamps, speakers, air conditioners and the like in the room. In other words, the bottom layer jacks **30a** are configured to control other electrical appliances. Moreover, as shown in Fig. 2c, each bottom layer jack **30** is connected to a bottom wiring terminal **48** uniquely corresponding to it, while each bottom layer jack **30a** is connected to a bottom layer jack **48a**

uniquely corresponding to it. It should be noted that the wirings between the bottom layer jacks **30** and the bottom wiring terminals **48** shown in Fig. 2c are provided only to illustrate the connections there between, but are not real fly lines. The bottom layer jacks **30** and the bottom wiring terminals **48** are in fact connected together through internal wirings which are not exposed to the outside of the bottom layer **20** in consideration of aesthetic appearance and safety. As shown in Fig. 2b, a row of back wiring terminals **50**, **50a** are arranged along the lower edge of the protrusion **26** on the back side of the bottom layer **20**, and these back wiring terminals **50**, **50a** are connected to the bottom wiring terminals **48**, **48a**. Fig. 2b also shows the opening **46** on the back side of the bottom layer **20**. The opening **46** allows cables other than the mains power wiring from the embedded case, such as network cable, telephone wire, TV cable, CD-ROM drive cable, speaker wire and the like to be connected to the middle layer **22** through it.

Now, look at the structure of the middle layer **22**. Referring to Fig. 1, Fig. 3a, and Fig. 3b, similar to the bottom layer **20**, the middle layer **22** is also a substantially protruding part with a protrusion **34**. But what is different from the bottom layer **20** is that the middle layer **22** has no open cavity. A casing **21** is arranged on the periphery of the protrusion **34**, i.e., on the front side of the middle layer **22**. The cross-sectional area defined by the casing **21** is greater than the cross-sectional area of the protrusion **34**. The casing **21** is configured to match the shape of the middle layer **22** with that of the bottom layer **20**, and align the middle layer **22** to the bottom layer **20**, so that the protrusion **34** of the middle layer **22** is received in the cavity **32** of the bottom layer **20** and the back side periphery of the casing **21** fits closely to the outer rim **28** when the middle layer **22** and the bottom layer **20** are coupled together. In addition, a plurality of middle layer jacks **38**, **38a** are arranged on the front side of the lower part of the middle layer **22**. Similar to the configuration of the surface layer, there are seven middle layer jacks **38**, **38a** aligned in a line and spaced at the same interval in this embodiment. The three middle layer jacks **38** of the middle layer **22** are respectively connected to three middle layer pins **36** on the back side of the middle layer **22**, while the four middle layer jacks **38a** are respectively connected to four middle layer pins **36a** on the back side of the middle layer **22**. Here, the concept of the middle layer jacks **38**, **38a** and middle layer pins **36**, **36a** is similar to that of the bottom layer jacks **30**, **30a**. The middle layer jacks **38** and the middle layer pins **36** are respectively corresponding to the live wire, earth wire, and neutral wire of the mains power supply, so that the middle layer **22** obtains power supply and can supply power to the surface layer **24** via the middle layer jacks **38**. The middle layer jacks **38a** and middle layer pins **36a** are control wirings configured to control other electrical appliances. In addition, a power socket **52** is arranged on the

front side of the middle layer **22**. Here, the power socket **52** shown in the figure has three jacks arranged in a triangle shape as in British 220V standard.

Fig. 3c shows the internal wiring in the middle layer **22**. The power socket **52**, middle layer jacks **38** and **38a**, and a plurality of switches **58** disposed at the two sides of the power socket **52**, are connected together through wirings. There are eight switches **58** shown in Fig. 3c. In this embodiment, three switches out of the eight switches **58** are connected to three USB ports **56**. Besides those three switches, another switch **58** is connected to the power socket **52**, and the remaining four switches of the eight switches **58** are connected to the four middle layer jacks **38a** respectively. It should be noted that the wirings shown in Fig. 3c are provided only to illustrate the connections between the middle layer jacks **38**, **38a**, the power socket **52**, and the switches **58**, but are not real fly lines. The above components are in fact connected together through internal wirings which are not exposed to the outside of the middle layer **22** in consideration of aesthetic appearance and safety.

The switches **58** are elements configured to switch on/off different electrical appliances or interfaces. For example, the switch **58** connected to the power socket **52** is adapted to control the power supply from the power socket **52**, i.e., the switch is a power switch for the electrical appliance connected to the power socket **52**. The switches **58** connected to the four middle layer jacks **38a** are power switches for other electrical appliances. The control wirings of these electrical appliances can be arranged by exposed wirings or concealed wirings in the room and then connected to the modular socket panel via the bottom layer pins **30a** and the back wiring terminals **50a**, etc. The switches **58** connected to the USB ports **56** may be used to control the power supply (e.g., Vcc pin) to these USB ports **56**. These switches **58** are not directly controlled by human hands. Instead, they can be controlled by other micro-electronic devices, for example relays.

Besides the switches **58**, the middle layer **22** may further contain other functional components besides the power supply. For example, the middle layer may contain an environmental sensor, a network adapter, or a controller. These components can be connected via the opening **46** of the bottom layer **20** to different cables in the wall, such as network cable, telephone wire, TV cable, and speaker wire, etc. In Fig. 3b, a RJ45 network port **35** is shown. The RJ45 network port **35** can be connected to a network cable in the wall, so that the middle layer **22** can be used for connecting to a network or communicate with other network devices. The environmental sensor can be an infrared

sensor, a human body sensor, an optical inductor, a temperature sensor or a humidity sensor, so that the modular socket panel can detect if there is any human activities in the room. Or the modular socket panel can acquire indoor environmental parameters, including luminance, humidity, temperature and the like, and send the parameters to a remote computer or other devices, to present the environmental information in the room to the user. The network adapter can be a powerline adapter that provides a network connection through electric wires, or an Ethernet access point or wireless access point, such as a Wi-Fi, Bluetooth, or NFC wireless access point. In case a wireless access point is provided, the middle layer **22** can further has an antenna for wireless signal transmission/receiving, such as a built-in antenna, or external rotatable or foldable antenna. The controller is adapted to receive the inputs generated by the switch operation of the modular socket panel therefore to control the operation of electrical appliances outside of the modular socket panel, for example, the controller can send RF control signals to other electrical appliances in the room so as to control the electrical appliances remotely. The environmental sensor, network adapter, or controller can be connected to the switches **58** so as to control the operation of the switches **58** and thereby accomplish the control of intelligent household electrical appliances.

Among the USB ports **56**, two USB ports are on the bottom of the middle layer **22**, and another USB port is on the surface of the middle layer **22**. These USB ports **56** output DC power via an AC to DC converter (not shown) in the middle layer **22**, such as a rectifier chipset, so as to charge a variety of handheld electronic devices connected to the USB ports **56**. Additionally, these USB ports **56** can be connected to other components in the middle layer **22** to provide data connection function. Specifically, these USB ports **56** can be configured to connect the surface layer of the modular socket panel or other USB devices.

Now, look at the structure of the surface layer **24**. Referring to Fig. 1, Fig. 4a and Fig. 4b, the surface layer **24** is a generally planar part including a plurality of surface layer pins **44**, **44a** arranged on the back side of the lower part of the surface layer **24**. The surface layer pins **44** are respectively corresponding to the middle layer jacks **38** on the middle layer **22** or the bottom layer jacks **30** on the bottom layer **20**. The surface layer pins **44a** are respectively corresponding to the middle layer jacks **38a** on the middle layer **22** or the bottom layer jacks **30a** on the bottom layer **20**. Here, the concept of the surface layer pins **44**, **44a** is similar to the concept of the bottom layer jacks **30**, **30a**. The surface layer pins **44** are respectively corresponding to the live wire, earth wire, and neutral wire of the mains power supply, so that the surface layer **24** obtains power supply and the power socket **42**

obtains power supply. The surface layer pins **44a** are control wirings configured to control other electrical appliances. In this embodiment, there are seven surface layer pins **44**, **44a** aligned in a line and spaced evenly. A plurality of switches **40** that can be operated by the user and a power socket **42** are arranged on the surface of the surface layer **24**. As shown in the figures, there are five switches **40** designed to be controlled directly by human hands. For example, the switches **40** can be conventional mechanical switches, or they can be touch switches, e.g., the switches implement the control of inputs by means of capacitive or resistive induction. Thus, the user can control other electrical appliances in the room through the wiring among the surface layer **24**, middle layer **22**, and bottom layer **20** by controlling the switches **40** on the panel. The connections among the switches **40**, power socket **42**, and the surface layer pins **44**, **44a** are shown exemplarily in Fig. 4c. It should be noted that the wirings among the switches **40**, power socket **42**, and surface layer pins **44** shown in Fig. 4c are provided only to illustrate the connections among them, but are not real fly lines. The switches **40**, power socket **42**, and surface layer pins **44** are in fact connected through internal wires which are not exposed to the outside of the surface layer **24** in consideration of esthetic appearance and safety.

In addition, since the surface layer **24** is the outermost part of the modular socket panel and is directly placed in the residential environment, the surface layer **24** can be in color other than white, or have patterns, so as to be in tune with the interior decoration. For example, the surface layer **24** can have a colorful surface. The surface layer **24** can be in other diversified designs. For example, the dimension of the surface layer **24** (and the dimension of the middle layer) can be approximately 86mm*86mm when it is used with a common Type 86 embedded case. However, the surface layer **24** can be in other dimensions. For example, the surface layer **24** may have larger dimension, so that large decorative patterns can be printed on the surface layer **24**. The surface layer **24** may have various shapes, such as round shape, diamond shape, triangular shape or the like, but not limited to the square shape of a conventional modular socket panel. The above said variant appearances of the surface layer do not affect the connection and mounting to the middle layer or the bottom layer, so the person skilled in the art can make variations to the appearance of the surface layer as required.

Next, the installation and operation of the modular socket panel in the above embodiment of the present invention will be described. Though the modular socket panel comprises three parts (a bottom layer, a middle layer, and a surface layer), the user can install all of the three parts or only install the bottom layer and surface layer where necessary. As shown in Fig. 1, in the case that all of

the three parts are to be installed, the user firstly mounts the bottom layer **20** to an embedded case in the wall by connecting means, such as screws. As described above, such an embedded case can be an embedded case that is used together with a conventional socket panel in the art. In addition, the user must connect the electric wires led out from the embedded case to the bottom layer jacks **30** on the bottom layer **20**. The control wirings for controlling other electrical appliances in the room should be connected to the bottom layer jacks **30a**. In addition, other signal cables, such as network cable, telephone wire, TV cable, speaker wire and the like should be led in through the opening **46** of the bottom layer **20**, so that the control wirings can be ready for connecting to the middle layer **22**. After the bottom layer **20** is installed, the user only has to align the middle layer **22** to the bottom layer **20** in the above-mentioned pull and plug manner, in which the protrusion **34** is aligned to the cavity **32** and each middle layer pin **36** is aligned respectively to the corresponding bottom layer jack **30**, and then plug the middle layer **22** onto the bottom layer **20**. Then, the signal cables (e.g., network cable) can be directly inserted into the corresponding ports of the middle layer **22**. Finally, the user only need to align the surface layer **24** to the middle layer **22**, in which each surface layer pin **44** is aligned respectively to the corresponding middle layer jack **38**, and then plug the middle layer **22** onto the surface layer **38** in a similar way. Therefore, the assembling of the modular socket panel is completed. Next, the user can plug the power plugs of the electrical appliances into the power socket **42**, so that the electrical appliance can be used in a way similar to that in the case of a conventional socket panel in the prior art.

In addition, since the bottom layer, surface layer and middle layer of the modular socket panel disclosed in the present invention are electrically connected together via the bottom layer jacks, middle layer pins, middle layer jacks, surface layer pins and the like, any other elements in the middle layer would immediately obtain power and enter into an operating state after the middle layer is installed. For example, a Wi-Fi access point in the middle layer would start to transmit network signals, or temperature and humidity sensors in the middle layer would start their operations. At that time, the user can control the ON/OFF of the household electrical appliances by pressing or touching the switches on the surface layer. One of the benefits provided by the present invention is that the middle layer can be removed or replaced by the user without using any tool or requiring professional electrician's skills. The user can mount different middle layers in the modular socket panel as required to implement different functions, and the manufacturer can provide new middle layers for the users to choose as the market is developing. Thus, the functions of the modular socket panel can be expanded without replacing the entire modular socket panel, for example, adding more intelligent

functions.

When the user wants to control the ON/OFF of other electrical appliance in the room during use, the user only has to manipulate the corresponding switches **40** on the control panel. Thus, the electrical appliances in the room will be controlled through the wiring among the surface layer **24**, the middle layer **22**, and the bottom layer **20**. Moreover, the user can connect different electronic devices via the USB ports into the modular socket panel, so as to charge the electronic devices or carry out other data operations.

In another embodiment, the user can choose not to install the middle layer. That is to say, the modular socket panel only includes the bottom layer and surface layer. Such an exemplary configuration is shown in Fig. 5. In the assembly process, the surface layer **24** is directly plugged onto the bottom layer **20** fixed to an embedded case in the wall, so that the surface layer pins are directly inserted into the bottom layer jacks. In this case, the modular socket panel doesn't have intelligent functions or communication functions originally provided by the middle layer; instead, the modular socket panel has become a simple power socket, just like a conventional socket panel. However, compared with socket panels in the art, the surface layer of the socket panel in the present invention can still be replaced freely, so as to create different types of decorative patterns on the surface or configure different types of power sockets. Since the middle layer and the surface layer can be plugged onto the bottom layer interchangeably in the present invention, and the surface layer can be stacked onto the middle layer and then plugged onto the bottom layer, the socket panel disclosed in the present invention is actually a modular design. Both the surface layer and the middle layer can be referred to as layer modules herein.

In another embodiment of the present invention shown in Fig. 6, the bottom layer **120** and middle layer **122** of the modular socket panel, and different surface layers **124** that can work with the bottom layer **120** and the middle layer **122** are shown. Here, the bottom layer **120** and the middle layer **122** are similar to the bottom layer and middle layer shown in Figs. 1~4c. But the surface layer **124** shown in Fig. 6 is different. In particular, the surface layer **124** is not mounted onto the middle layer **122** by directly plugging from the front side. Instead, the surface layer **124** is plugged into the middle layer **122** in a lateral direction. That is to say, the front side of the surface layer **124** and the front side of the middle layer **122** are parallel to each other and form a rectangular surface when the surface layer **124** is mounted. Here, the surface layer **124** is not connected to the middle layer jacks on the

middle layer via the surface layer pins; instead, the surface layer **124** is connected to the middle layer **122** only via the USB interfaces. Two different surface layers **124** are shown in Fig. 6. One surface layer **124** has a USB plug **155** protruding from the back side thereof, while the other surface layer **124** has a USB plug **155** protruding from a side thereof. The two surface layers **124** can be mounted on the corresponding USB port **153** of the middle layer **122** separately. If required, the two surface layers **124** can be mounted on the same middle layer **122** at the same time as shown in the figure, so as to provide a larger control panel for the user. However, the person skilled in the art should appreciate that any other number of panels can be mounted on the middle layer as required.

In Fig. 7, a part of another modular socket panel disclosed in the present invention is shown, wherein, the bottom layer jacks **230** on the bottom layer **220** don't receive the middle layer pins of the middle layer or the surface layer pins of the surface layer. Instead, a separate circuit board **290** is plugged via circuit board pins **236** to the bottom layer jacks **230**. At the other end of the circuit board **290**, a plurality of wirings **237** corresponding to the bottom layer pins **230** are led out respectively. Such wirings **237** are configured to connect the bottom layer **220** to other devices external to the modular socket panel, such as separate switches or controllers, so that the control to the electrical appliances in the room can be flexibly achieved through the wiring of the bottom layer **220**.

Hence, from the above description of some embodiments, those skilled in the art would realize that variations, substitute structures, and equivalences can be implemented without departing from the nature of the present invention. Accordingly, the above description should not be deemed as constituting any limitation to the scope of the present invention, which is only confined by the following claims.

For example, there are seven jacks/pins configured for inter-connection among the bottom layer, middle layer, and surface layer of the modular socket panel as described above, but the person skilled in the art should appreciate that the quantity is not the only possible configuration. The jacks/pins can be configured to be more or to be less as required. For example, more than seven jacks/pins can be configured to provide more electrical connections, or less than seven jacks/pins can be configured.

In addition, the components included in the middle layer in the above embodiments include, for example environmental sensor, network adapter, controller and the like, but the components are not limited to those examples. The person skilled in the art can deploy other components in the middle

layer as required, so as to implement control of various intelligent household electrical appliances or provide an electronic communication function, etc.

Moreover, the power socket provided on the modular socket panel in the above embodiments is a British standard three-jack socket, but it can be configured into a different type of power socket, such as a Chinese standard socket, American standard socket, or European standard socket, etc.

The surface layer, the middle layer and/or the bottom layer of the modular socket panel shown in Figs. 1-7 are inter-connected in a pull and plug manner. It should nonetheless be appreciated that other types of installation are also possible. For example, a protruding fixed base is arranged on one of these parts, and a snap is arranged on one another part, so that the two parts can be connected together in a snap-fitted manner. Or, a sliding channel is arranged on one of these parts, and a protruding sliding piece is arranged on one another part, so that the two parts can be fixed and connected in a slide manner. Both the snap-fitting means and the sliding means described above are only exemplary. The person skilled in the art should appreciate that other similar connecting structures are also possible, and all these connecting means have a common characteristic, i.e., all of them don't require any additional fastener such as screws, and don't require any special tool to fix two panels together. This is an important distinguishing characteristic of the present invention when compared with the prior art. The above installation means can be generally referred to as a non-fastening manner.

Finally, the surface layer and the middle layer of the modular socket panel shown in the above embodiments are preferably in 86mm*86mm dimension. However, the dimension of the surface layer and middle layer can be designed to other common standard dimension as required in other applications, such as 120mm*60mm or 120mm*120mm.

CLAIMS

1. A modular socket panel, comprising:
 - a bottom layer adapted to be fixed to an embedded case in a wall and adapted to electrically connect to a power supply provided by the embedded case; and
 - a surface layer adapted to be directly or indirectly connected to the bottom layer by a non-fastening manner;
 - wherein, the surface layer provides a power socket, which is electrically connected to the bottom layer.
2. The modular socket panel according to claim 1, further comprises a middle layer disposed between the bottom layer and the surface layer; the middle layer adapted to connect to the bottom layer in a pull and plug manner; the surface layer adapted to connected to the middle layer in a pull and plug manner; the middle layer electrically connected to the bottom layer and the surface layer respectively.
3. The modular socket panel according to claim 2, wherein the middle layer is provided with at least one of the following components: an environmental sensor, a network adapter and a controller.
4. The modular socket panel according to claim 3, wherein the environmental sensor is selected from one of the following sensors: a temperature sensor, a humidity sensor, an infrared sensor, a human body sensor, and a light sensor.
5. The modular socket panel according to claim 3, wherein the network adapter is a powerline adapter, an Ethernet adapter, or a wireless access point.
6. The modular socket panel according to claim 3, wherein the controller is adapted to connect with switches disposed on the surface layer, and receive the inputs generated by operations on the switches, therefore control the operation of electrical appliances external to the modular socket panel.
7. The modular socket panel according to claim 2, wherein the bottom layer has a plurality of bottom layer jacks, all of which are connected to the power supply provided by the embedded case; the middle layer having a plurality of middle layer pins that are respectively corresponding to and electrically connected to the bottom layer jacks, and a plurality of middle layer jacks connected to the middle layer pins; the surface layer having a plurality of surface layer pins that are respectively corresponding to and electrically connected to the middle layer jacks.
8. The modular socket panel according to claim 1, wherein, the bottom layer is directly connected to the surface layer. The bottom layer having a plurality of bottom layer jacks, all of which are

connected to the power supply provided by the embedded case; the surface layer having a plurality of middle pins that are respectively corresponding to and electrically connected to the bottom layer jacks.

9. The modular socket panel according to any one of claims 1-8, wherein the power socket is a USB socket, which is connected to the bottom layer via an AC to DC converter.
10. The modular socket panel according to any one of claims 1-8, wherein the bottom layer is adapted to be fixed to the embedded case in the wall by screws.
11. The modular socket panel according to any one of claims 1-8, wherein the surface of the surface layer is colored.
12. The modular socket panel according to any one of claims 1-8, wherein the front side of the surface layer is in a polygonal, round, or irregular shape.
13. The modular socket panel according to any one of claims 1-8, wherein the non-fastening manner includes sliding, pull and plug, or snap-fitting.
14. A layer module for a modular socket panel, characterized in that the layer module is adapted to be mounted by a non-fastening manner onto a bottom layer fixed to an embedded case in a wall; wherein the layer module provides power sockets, which are electrically connected to the bottom layer.
15. The layer module according to claim 14, wherein the layer module is the outermost surface layer of the modular socket panel.
16. The layer module according to claim 14, wherein the layer module is a middle layer, which is provided with at least one of the following components: an environmental sensor, a network adapter and a controller.
17. The layer module according to claim 16, wherein, the middle layer is configured to accept a surface layer mounted onto it in a pull and plug manner, and the surface layer is adapted to be electrically connected to the middle layer.
18. The layer module according to any of claims 14-17, wherein the non-fastening manner includes sliding, pull and plug, or snap-fitting.