

USB CONNECTOR AND USB DEVICE

FIELD OF THE INVENTION

The invention relates to the field of communications, in particular to a USB (Universal Serial Bus) connector and a USB device.

BACKGROUND OF THE INVENTION

With the rapid development of communication technology, USB products play a more and more important role in people's life and work. Conventional USB products generally use special USB connectors. A special USB connector is provided at a front end of the USB products, and the USB products connect with a USB port through the USB connector.

During the implementation of the present invention, the inventor has found that with regard to the USB products commonly available in the market, its USB port connects longitudinally with the USB body. Therefore, the length of the USB port adds to the length of the USB body which makes the USB products longer. As a result, such USB products are neither easy to carry nor up to people's standards for exquisiteness and compactness.

SUMMARY OF THE INVENTION

The present invention provides a USB connector and a USB device. The USB connector has a reduced thickness, thereby decreasing the thickness of the USB device.

The present invention provides a USB connector for connecting with a USB female comprising metal legs, a connecting line, a substrate and a rotating shaft assembly. One end of the metal legs connects with one end of the connecting line, the metal legs are fixed to a face of the substrate, the rotating shaft assembly is fixed to a surface of the substrate, the rotating shaft assembly comprises a rotating shaft and a rotating shaft sleeve, and the rotating shaft is disposed in the rotating shaft sleeve and capable of rotating relative to the rotating shaft sleeve.

The present invention also provides a USB device comprising a USB connector, a housing and a PCB (Printed Circuit Board) wherein:

the USB connector comprises metal legs, a connecting line and a substrate; one end of the metal legs connects with one end of the connecting line, the metal legs are formed on a face of the substrate, the USB device further comprises a rotating shaft assembly, the rotating shaft assembly is fixed to a surface of the substrate, the USB connector is installed at an end of the housing by the rotating shaft assembly, and the USB connector is able to rotate relative to the housing by means of the rotating shaft assembly.;

the PCB is disposed inside the cavity of the housing and an end of the PCB connects with another end of the connecting line; and

a receptacle for accommodating the USB connector is provided on a surface of the housing.

According to the USB connector and the USB device of the present invention, the metal legs are formed on the surface of the substrate so as to ensure the connecting strength of the metal legs. Since the size of the USB connector depends mainly on the substrate and as long as the thickness meets a requirement of inserting the USB connector into the USB female, the thickness of the USB connector and further, the thickness of the USB device are reduced without compromising the function of the USB connector. Compared with the conventional USB products, the thickness of the USB device according to the present invention is greatly reduced so that the USB device becomes smaller and easy to carry. It not only meets the people's requirement for exquisite and compact electronic products, but also improves the practicality and aesthetics of the USB device.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an exploded schematic view of a USB connector according to a first embodiment of the present invention;

Figure 2a is a first structural schematic view of the USB connector according to the first embodiment of the present invention;

Figure 2b is a second structural schematic of the USB connector according to the first embodiment of the present invention;

Figure 3 is an exploded schematic of a rotating shaft assembly shown in Figure 1;

Figure 4 is a structural schematic of the rotating shaft assembly shown in Figure 3;

Figure 5a is a first partially exploded schematic view of a USB device according to a second embodiment of the present invention;

5 Figure 5b is a second partially exploded schematic view of the USB device according to the second embodiment of the present invention;

Figure 6 is a first structural schematic view of the USB device according to the second embodiment of the present invention;

10 Figure 7 is a second structural schematic view of the USB device according to the second embodiment of the present invention; and

Figure 8 is a schematic view of the USB connector in use in the USB device according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is detailed as below.

15 In the first embodiment, as shown in Figure 1, a USB connector 51 for connecting with a USB female includes metal legs 11, a connecting line 12 and a substrate 13. One end of the metal legs 11 connects with one end of the connecting line 12. Another end of the connecting line 12 is used to connect with a PCB. The metal legs 11 are formed on a surface of the substrate 13. The connecting line 12 is fixed to the surface of the substrate 13. The
20 thickness of the USB connector depends mainly on the thickness of the substrate 13. As long as the thickness of the substrate 13 meets a requirement of inserting the USB connector into the USB female, the thickness of the USB connector and further, the thickness of the USB device are reduced without compromising the function of the USB connector. Compared with
25 the conventional USB products, the thickness of the USB device according to the present invention is greatly reduced, making the USB device smaller and easy to carry, which not only meets the people's requirement for exquisite and compact electronic products, but also improves the practicality and aesthetics of the USB device.

Furthermore, when the thickness of the substrate 13 is more than 2.45 mm, it may be difficult to insert the USB connector into the USB female. When the thickness of the substrate 13 is less than 2.2 mm, a gap between the USB connector and the USB female may be too large after insertion of the USB connector into the USB female. As a result, the stability of connection between the USB connector and the USB female is reduced. Therefore, the thickness of the substrate 13 is preferably in the range of 2.2 mm to 2.45 mm.

The metal legs 11 may be fixed to the surface of the substrate 13 by means of In Mold Decoration (IMD) molding or hot-inserting. Furthermore, in order to improve the connecting strength of the metal legs 11, slots may be set on the surface of the substrate 13 and the metal legs 11 are embedded in the surface of the substrate 13 so as to integrate with the substrate 13. Alternatively, the metal legs 11 may be formed on the surface of the substrate 13 by corrosion methods. For example, the metal legs 11 are formed by copper exposure on the surface of the substrate 13.

Further, in order to ensure the electrical connecting performance between the metal legs and the USB female, the surface of the metal legs 11 is not below the surface of the substrate 13. However, when the metal legs 11 exceed the surface of the substrate 13 by a height of more than 0.2 mm, it may be difficult to insert the USB connector into the USB female. So, the metal legs exceed the surface of the substrate 13 by the height of between 0 and 0.2 mm.

Further, in order to prolong the life of the USB connector, the surface of the metal legs 11 is plated with gold or silver to prevent the metal legs 11 from being oxidized by the contaminants in the air and prevent the metal legs 11 from being eroded when a user contacts them.

Further, in order to improve the Electrostatic Discharge (ESD) protection for the USB connector, the connecting line 12 also includes a ground terminal 121 for connecting with the ground wire of the PCB. A metal layer 14 is provided at other surface of the substrate 13 opposite to the metal legs 11. The metal layer 14 connects with the ground terminal 121 through a metal sheet 15 to realize the ESD protection. Further, the metal layer 14 may be a layer of stainless steel so as to improve its anticorrosion, thereby prolonging the life of the USB connector. Further, the metal sheet 15 extends through the substrate 13 so that one end of the metal sheet 15 connects with the ground terminal 121 of the connecting line 12 and the other end connects with the metal layer 14. Thus, the metal sheet 15 is invisible from the

outside of the assembled USB connector, thereby improving the aesthetics of the USB connector. The metal layer 14 may be fixed to the substrate 13 by means of ultrasonic welding, bonding or other methods so that a good contact between the metal layer 14 and the metal sheet 15 is ensured.

5 Further, in order to enhance the stability of the USB connector, a retainer 16 for the connecting line is provided to cover the connecting line 12. The retainer 16 for the connecting line fixes the connecting line 12 onto the substrate 13. The retainer 16 for the connecting line may be made of plastic or hot-melt rubber by means of injection molding. The heated plastic or hot-melt rubber is filled into the gap between the connecting line 12 and the substrate 13
10 and forms the retainer 16 for the connecting line after cooling.

Further, in order to improve the practicability of the USB connector, a fool-proof structure 17 is provided on the surface of the substrate 13 to prevent the USB connector from being inserted reversely. When the user inserts the USB connector 51 into the USB female, the surface with the fool-proof structure 17 is set upward so as to form a good contact
15 between the metal legs 11 and the USB female 1, thereby preventing the USB connector from being inserted reversely into the USB female and from causing a short circuit or no function by means of the fool-proof structure 17. Since a gap is formed between the surface of the substrate 13 and the inner wall of the USB female when the substrate 13 engages with the USB female, the fool-proof structure 17 may be accommodated into the gap. Thus, a
20 universal USB female may engage with the USB connector 51 according to this embodiment. In addition, the fool-proof structures 17 can be disposed symmetrically or asymmetrically on the surface of the substrate 13. Preferably, the fool-proof structures 17 are disposed symmetrically on the surface of the substrate 13 to improve the aesthetics of the USB connector and facilitate manufacturing. Alternatively, the fool-proof structures 17 may be the
25 projections disposed on one side of the surface of the substrate 13 or symmetrically on both sides of the surface of the substrate 13.

Further, in order to ensure flexibility when the USB connector is in use, as shown in Figure 2a, a rotating shaft assembly 18 is fixed to the surface of the substrate 13. The rotating shaft assembly 18 may be fixed to the surface of the substrate 13 by means of ultrasonic
30 welding, bonding and so on. See Figures 5a and 5b, when the USB connector 51 is installed to other components by the rotating shaft assembly 18 to form a USB device such as a U-disk or a wireless network adaptor, the USB connector 51 may rotate relative to other components by means of the rotating shaft assembly 18. Further, see Figures 3 and 4, the rotating shaft

assembly 18 may include a rotating shaft 181 and a rotating shaft sleeve 182. The rotating shaft sleeve 182 is fixed on the surface of the substrate 13 and the rotating shaft 181 may rotate in the rotating shaft sleeve 182. The rotating shaft 181 has a first positioning structure 1811 thereon, and the rotating shaft sleeve 182 has a second positioning structure 1821 therein. The first positioning structure 1811 works with the second positioning structure 1821 to realize the positioning function. The rotating shaft assembly 18 with the first positioning structure 1811 and the second positioning structure 1821 could realize positioning when the USB connector 51 is rotating. For example, the USB connector 51 may stop when rotating every 45° or every 90° . The first positioning structure 1811 and the second positioning structure 1821 may adopt the conventional positioning structure. For example, the first positioning structure 1811 is elastic projections, and the second positioning structure 1821 is positioning holes or positioning grooves distributed regularly within the rotating shaft sleeve 182 according to the positioning requirements when the USB connector 51 rotates. When the rotating shaft 181 rotates relative to the rotating shaft sleeve 182 and the first location structure 1811 meets the second location structure 1821, the elastic projections insert into the positioning holes or the positioning grooves, thereby stopping and positioning the USB connector 51. When a force for continuously rotating the USB connector 51 has effect on the USB connector 51, the elastic projections deform under extrusion of the inner wall of the positioning holes or the positioning grooves and disengage from the positioning holes, so that the USB connector may continue to rotate in an original direction or an opposite direction.

In order to facilitate mounting the USB connector 51 to other components to form the USB device, the rotating shaft assembly 18 may also includes a rotating shaft support 183. Unlike the way in which the rotating shaft sleeve 182 is fixed on the surface of the substrate 13, the rotating shaft assembly 18 with the rotating shaft support 183 is fixed on the surface of the substrate 13 by the rotating shaft support 183. As shown in figures 2a and 2b, the rotating shaft assemble provided with a rotating shaft support is fixed on the surface of the substrate in the following way: the rotating shaft support 183 is nested in the surface of the substrate 13, a portion of the rotating shaft support 183 which comes into contact with the surface of the substrate 13 is fixedly connected, a first support hole 1831 and a second support hole 1832 are provided at either side of the rotating shaft support 183 respectively, the other end of the connecting line 12 passes through the first support hole 1831 to connect with the PCB; the rotating shaft sleeve 182 passes through the second support hole 1832. As shown in figure 1, five wires are twisted together to form the connecting line 12, one end of the five wires connects with the metal legs 11 and the other end passes through the first support hole 1831.

As shown in figure 6, the USB connector has been installed to other components to form a USB device, the USB connector may rotate clockwise or anti-clockwise relative to other components by means of the rotating shaft assembly 18. During rotation, the connecting line 12 twists or untwists like a fried-dough-twist. Further, the rotating shaft sleeve 182 includes a first sleeve part 1822, a second sleeve part 1823 and an elastic part 1824. The first sleeve part 1822 has a through hole thereon. The second sleeve part 1823 has a cavity 18231 therein and a hole 18232 formed in the side wall of the second sleeve part 1823. The elastic part 1824 may be a spring and so on. The rotating shaft 181 includes an elastic square head 1811 and a trailing end 1812 which connects with the elastic square head. The trailing end 1812 passes through the first sleeve part and cooperates with the second sleeve part 1823 of the rotating shaft sleeve 182 to press the elastic part 1824. After the trailing end 1812 is fitted into the cavity 18231 of the second sleeve part, the elastic deformation of the elastic part 1824 resumes so that the elastic square head 1811 is ejected out of the hole 18232 of the side wall of the second sleeve part.

In the second embodiment, as shown in Figures 5a, 5b and 6, a USB device, such as a U-disk or a wireless network adaptor and so on, includes the USB connector 51 as described in the first embodiment, a housing 52 and a PCB. The same parts as those in the first embodiment are indicated by the same reference numerals as those in the first embodiment. The USB connector 51 includes metal legs 11, a connecting line 12, a substrate 13 and a rotating shaft assembly 18. One end of the metal legs 11 connects with one end of the connecting line 12. The metal legs 11 are formed on the surface of the substrate 13. The rotating shaft assembly 18 is fixed to the surface of the substrate 13. The USB connector is installed at the end of the housing 52 by the rotating shaft assembly 18. The PCB is disposed inside the cavity of the housing and the end of the PCB connects with other end of the connecting line 12. A receptacle 521 for accommodating the USB connector is provided in the surface of the housing.

In order to facilitate assembling, the housing generally includes a first housing 522 and a second housing 523. The first and the second housings join together to form a cavity in which the PCB is disposed. When assembled, each of both ends of the USB connector is fitted into one corresponding hole which is provided at either side of one end of the first housing. The USB connector is thus installed at one end of the first housing by the rotating shaft assembly 18; then the first housing is covered with the second housing to form the USB device. The USB connector may rotate with respect to the housing and ensures the continuity

of the connecting line 12. Mounting the USB connector at one end of the first housing by the rotating shaft assembly 18 may be implemented in the following ways: the rotating shaft assembly includes a rotating shaft sleeve and a rotating shaft, the rotating shaft may rotate in the shaft sleeve, the rotating shaft sleeve is fixed to the surface of the substrate, and each of
5 both ends of the rotating shaft is fitted into the corresponding hole of either side of the one end of the first housing; alternatively, as shown in figs. 5a and 5b, the rotating shaft assembly 18 includes a rotating shaft sleeve 182, a rotating shaft 181 and a rotating shaft support 183; the rotating shaft support 183 is fixed to the surface of the substrate 13; the rotating shaft sleeve 182 passes from inside through the second support hole 1832 at one side of the rotating
10 shaft support 183 and a hole 5221 formed at one side of the one end of the first housing; the rotating shaft 181 may rotate in the rotating shaft sleeve 182; a first supporting portion which is coaxial with the rotating shaft 181 is provided on the rotating shaft support 183, and a second supporting portion corresponding to the first supporting portion is provided at the first housing; the first supporting portion cooperates with the second supporting portion so as to
15 connect pivotably the USB connector with the first housing. The first supporting portion may be a projection 1831 protruding outward from the rotating shaft support 183, and the second supporting portion may be a hole 5222 formed at other side of the one end of the first housing, and the projection is nested into the hole. Alternatively, the first supporting portion may be a groove formed on the rotating shaft support 183, the second supporting portion may be a
20 projection protruding inward from other side of the one end of the first housing, and the projection is nested into the groove.

The receptacle 521 on the surface of the housing accommodates the USB connector in such a way that the metal legs face to the receptacle. Thus, when the USB device is unused, the USB connector is accommodated into the receptacle and the metal legs face to the
25 receptacle. Viewed from outside of the USB device, only the other surface of the substrate opposite to the metal legs exposes to the outside, thereby preventing the metal legs from being contaminated or damaged by the environment.

Further, as shown in Figure 7, from the perspective of aesthetics and psychology, there is a smooth transition between an outside surface of the USB connector and an outside
30 surface of the housing when the USB connector is accommodated in the receptacle. Thus, when the USB device is unused, the USB connector and the housing appear to have the same surface so that the appearance of the USB device is aesthetic, simple and smooth, thereby meeting the user's requirements for exquisite products.

As shown in Figure 8, in practice, the USB connector may rotate with respect to the housing in a direction or in an opposite direction so that it may rotate freely and is easy to store. The USB device according to the present invention eliminates the disadvantage of conventioanl USB device in which the USB connector is arranged in a line with the housing
5 and can not be bent.

The description above is merely a special embodiment of the present invention. It is noted that it is possible for a person skilled in the art to make various modifications and variations without departing from the principles of the present invention and those modifications and variations will fall within the scope of the present invention.

CLAIMS

1. A USB connector comprising:

a substrate;

5 metal legs positioned at a surface of the substrate;

a connecting line, one end of the connecting line electrically connected with one end of the metal legs; and

a rotating shaft assembly at least partially received within an aperture defined in the substrate, wherein the rotating shaft assembly comprise a rotating shaft and a rotating shaft sleeve, the rotating shaft being rotatable in the rotating shaft sleeve.

2. The USB connector according to claim 1, wherein the rotating shaft has a first positioning structure thereon and the rotating shaft sleeve has a second positioning structure therein, wherein the first positioning structure is engagable with the second positioning structure to realize relative movement.

15 3. The USB connector according to claim 2, wherein the rotating shaft assembly further comprises an elastic part, the rotating shaft with the first positioning structure extending through the second positioning structure, the first positioning structure engaging with the second positioning structure to compress the elastic part within the rotating shaft sleeve.

4. A USB device comprising:

20 a housing;

a USB connector positioned at an end of the housing, the USB connector comprising metal legs, a connecting line, and a substrate, the metal legs being positioned at a surface of the substrate, one end of the connecting line electrically connected with one end of the metal legs, the USB connector further comprising a rotating shaft assembly at least partially received within an aperture defined in the substrate, wherein the rotating shaft assembly comprise a rotating shaft and a rotating shaft sleeve, the rotating shaft being rotatable in the rotating shaft sleeve;

a printed circuit board disposed inside a cavity of the housing and electrically connected with another end of the connecting line; and

30 the housing defining a receptacle for receiving the USB connector.

5. The USB device according to claim 4, wherein the rotating shaft has a first positioning structure thereon and the rotating shaft sleeve has a second positioning structure therein, wherein the first positioning structure is engagable with the second positioning structure to realize relative movement.

5 6. The USB device according to claim 5, wherein the rotating shaft assembly further comprises an elastic part, the rotating shaft with the first positioning structure extending through the second positioning structure, the first positioning structure engaging with the second positioning structure to compress the elastic part within the rotating shaft sleeve.

7. The USB device according to claim 4, wherein the USB device is a wireless network
10 adaptor.

8. A USB device comprising:

a substrate;

a rotating shaft sleeve having a cavity defined by a first wall that is substantially parallel to a second wall and a third wall that is substantially parallel to a fourth wall;

15 a rotating shaft disposed in the cavity of the rotating shaft sleeve, the rotating shaft capable of rotating relative to the rotating shaft sleeve, wherein the rotating shaft has a first positioning structure thereon and the rotating shaft sleeve has a second positioning structure therein so that the first positioning structure is engagable with the second positioning structure to realize relative movement;

20 metal legs positioned at a surface of the substrate, wherein an axis of the rotating shaft is substantially parallel to the surface of the substrate where the metal legs are positioned and is substantially perpendicular to an extending direction of the metal legs;

a connecting line adjacent the surface of the substrate, wherein one end of the metal legs electrically connects with one end of the connecting line;

25 a printed circuit board electrically connected to the metal legs through the connecting line; and

a housing, wherein the printed circuit board is disposed inside a cavity of the housing and wherein the substrate is rotatably attached to an end of the housing so that the substrate can rotate around the axis of the rotating shaft.

30 9. The USB device according to claim 8, wherein the substrate is rotatably attached to an end of the housing so that the substrate can rotate 180 degrees around the axis of the rotating shaft.

10. The USB device according to claim 8, wherein the USB device further comprises an elastic part, the rotating shaft with the first positioning structure extending through the second positioning structure, the first positioning structure engaging with the second positioning structure to compress the elastic part within the rotating shaft sleeve.

5 11. The USB device according to claim 8, wherein the USB device is a wireless network adaptor.

12. A USB device comprising:

a housing;

10 a USB connector positioned at an end of the housing, the USB connector comprising metal legs, a connecting line, and a substrate, the metal legs being positioned at a surface of the substrate, one end of the connecting line electrically connected with one end of the metal legs, the USB connector further comprising a rotating shaft assembly at least partially received within an aperture defined in the substrate;

15 a printed circuit board is disposed inside a cavity of the housing and electrically connected to the metal legs through the connecting line;

the housing defining a receptacle for receiving the USB connector;

wherein the rotating shaft assembly comprise a rotating shaft and a rotating shaft sleeve, the rotating shaft sleeve having a cavity defined by a first wall that is substantially parallel to a second wall and a third wall that is substantially parallel to a fourth wall;

20 wherein the rotating shaft disposed in the cavity of the rotating shaft sleeve, the rotating shaft capable of rotating relative to the rotating shaft sleeve, wherein the rotating shaft has a first positioning structure thereon and the rotating shaft sleeve has a second positioning structure therein so that the first positioning structure is engagable with the second positioning structure to realize relative movement;

25 wherein an axis of the rotating shaft is substantially parallel to the surface of the substrate where the metal legs are positioned and is substantially perpendicular to an extending direction of the metal legs;

30 wherein the rotating shaft assembly further comprises an elastic part, the rotating shaft with the first positioning structure extending through the second positioning structure, the first positioning structure engaging with the second positioning structure to compress the elastic part within the rotating shaft sleeve;

wherein the USB connector further comprise a metal layer which cover the substrate, the metal layer being opposite to the metal legs, the metal layer has a U-shaped cross-section having two flanks extending away from an undersurface of the metal layer;

wherein the USB connector further comprises a fool-proof structure to prevent the USB connector from being inserted reversely, the fool-proof strunture includes at least one first projection; wherein:

5 the projection extends from at least one of the two flanks of the metal layer, the projection being higher than the substrate and at a longitudinal end of the metal layer which is near the metal legs.