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Lanni

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(54) **KEY CODED POWER ADAPTER CONNECTORS**

(75) Inventor: **Thomas W. Lanni**, Laguna Niguel, CA (US)

(73) Assignee: **Comarco Wireless Technologies, Inc.**, Lake Forest, CA (US)

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(51) **Int. Cl.**
H01R 3/00 (2006.01)

(52) **U.S. Cl.** **439/488**; 439/491; 439/680

(58) **Field of Classification Search** 439/680, 439/488, 489, 491, 222

See application file for complete search history.

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Primary Examiner—Hae Moon Hyeon

(74) *Attorney, Agent, or Firm*—Pillsbury Winthrop Shaw Pittman LLP

(57) **ABSTRACT**

A key coded power connector and a system and method for making key coded power connections are disclosed. A power connector such as a power adapter connector is configured with either a visual keying system, a physical keying system, or both. The physical keying system prevents a user from connecting a host device to a connector of the power source which does not support that host device. The visual keying system provides the user with an early indication that the particular device is not supported by a power source. The user can visually compare a marking key on the host device with the making key on the power connector and determine whether or not the power source is capable of outputting sufficient power to operate the device. The visual and physical keying systems prevents a user from improperly connecting a host device to a power source which does not support that device.

11 Claims, 6 Drawing Sheets

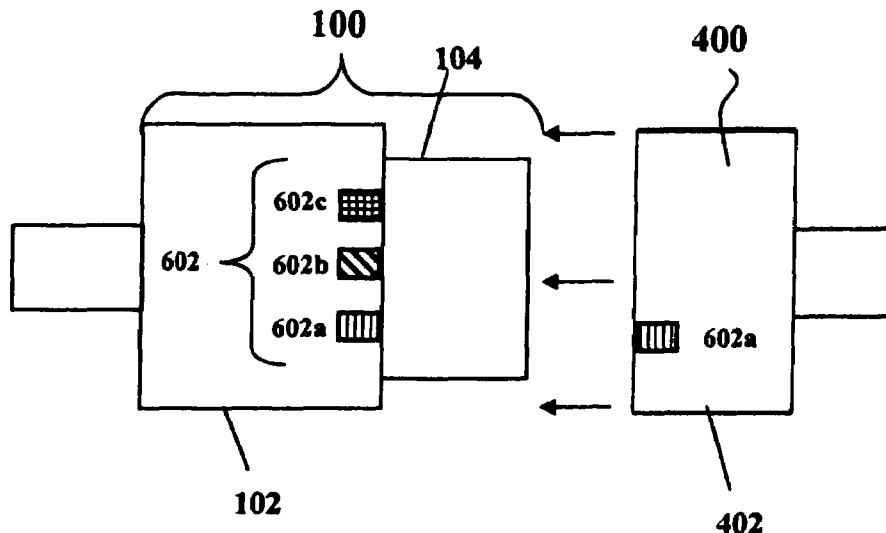


FIG. 1

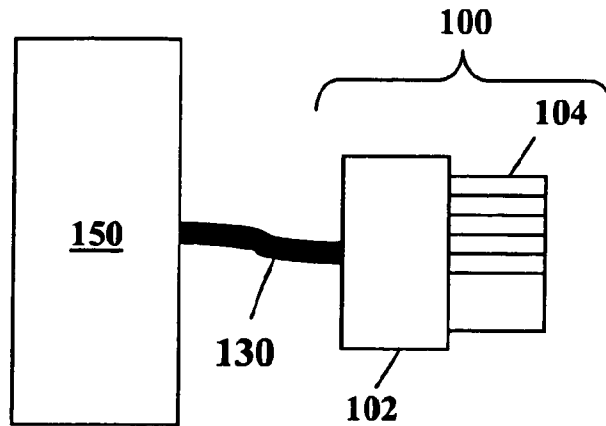


FIG. 2

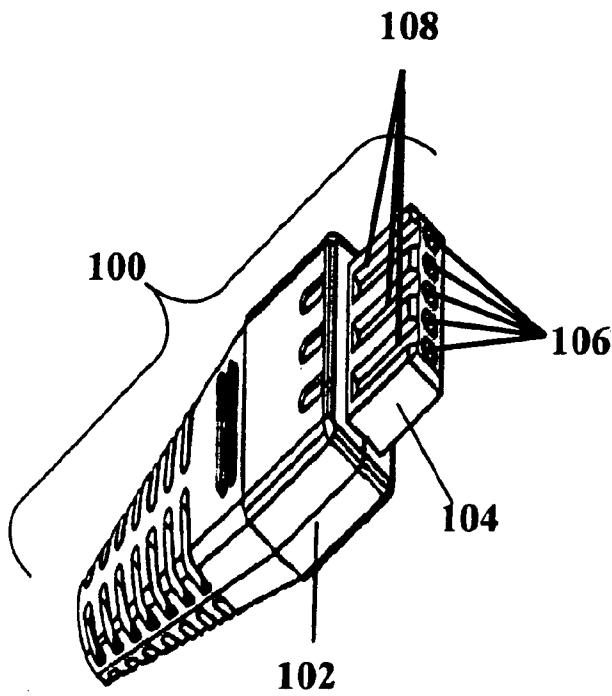


FIG. 3

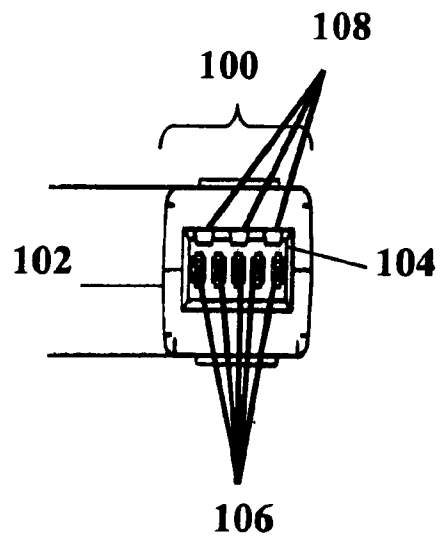


FIG. 4A

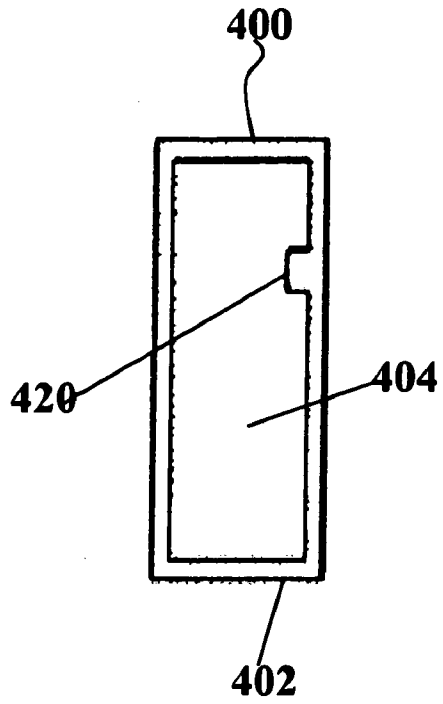


FIG. 4B

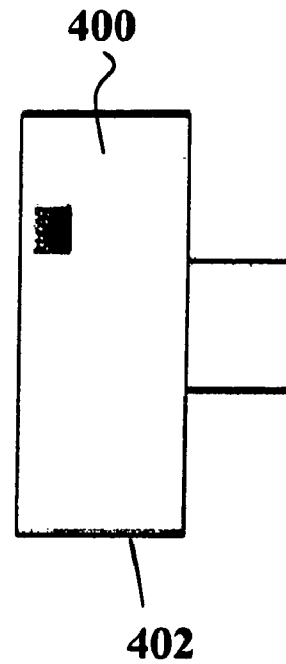


FIG. 4C

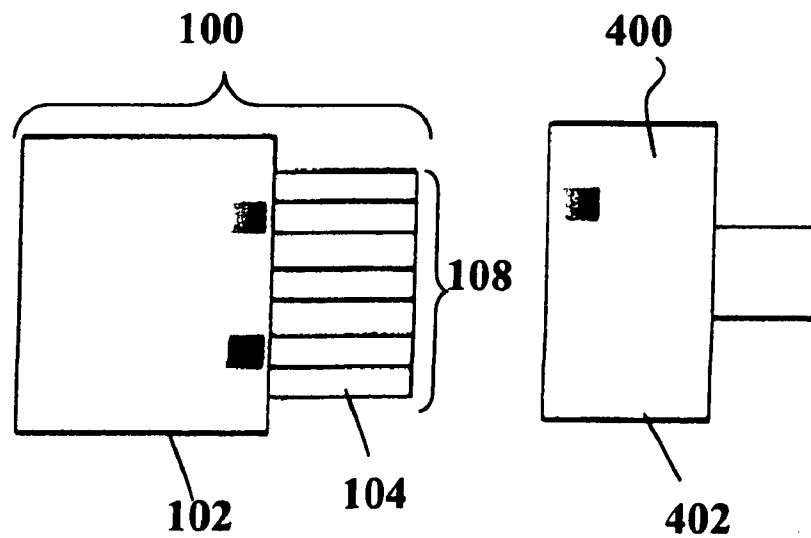


FIG. 5A

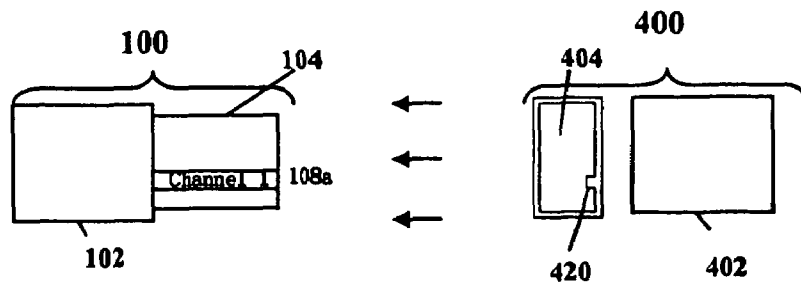


FIG. 5B

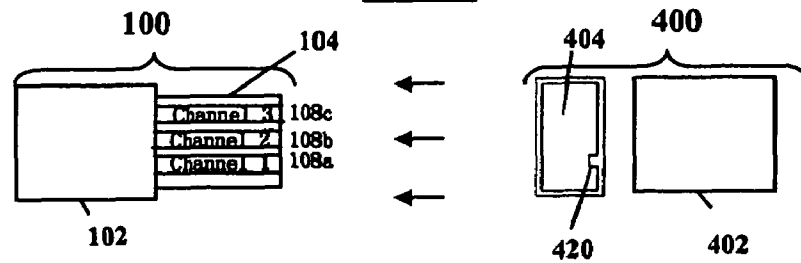


FIG. 5C

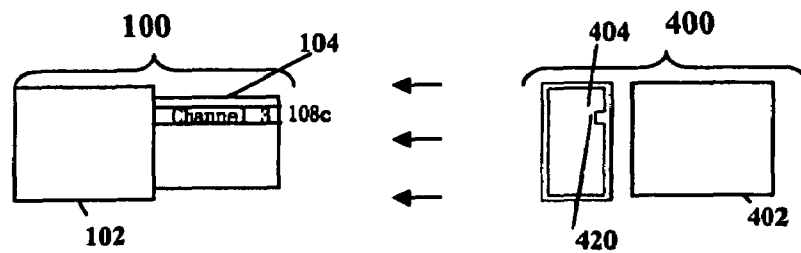


FIG. 5D

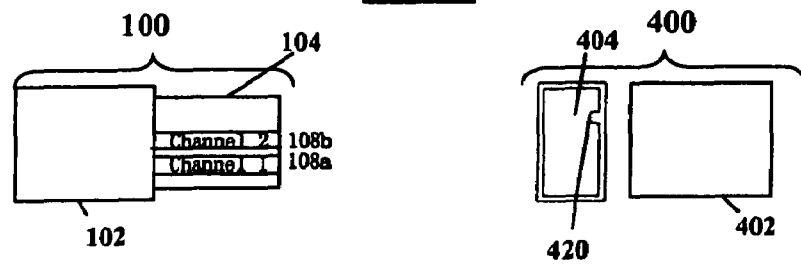


FIG. 5E

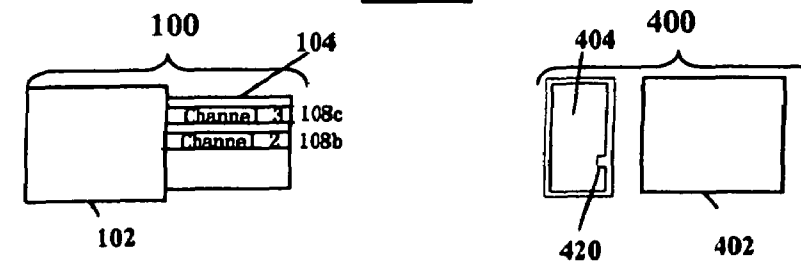


FIG. 6A

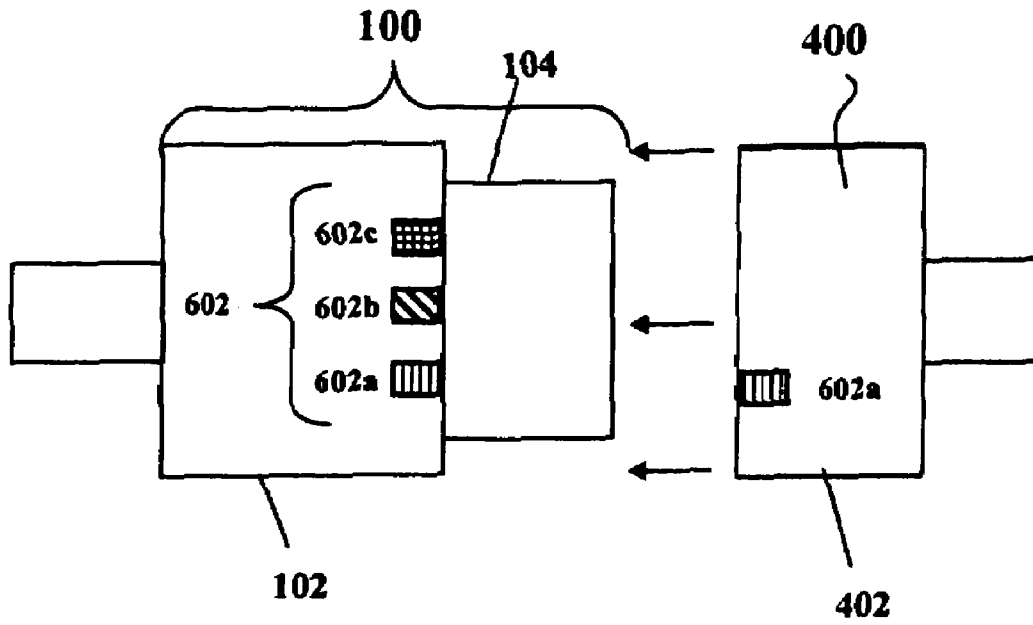


FIG. 6B

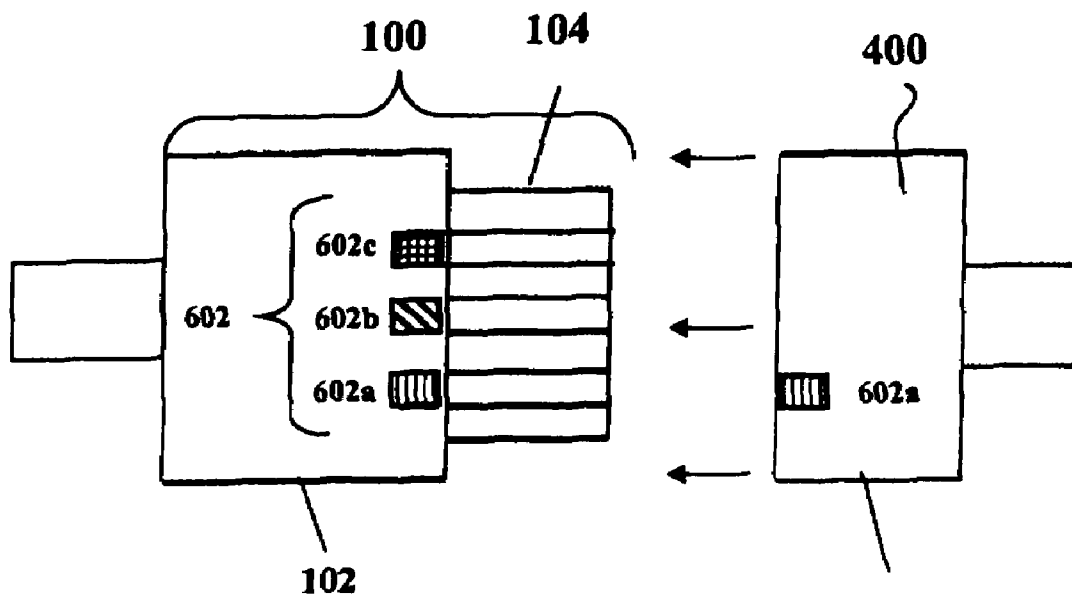
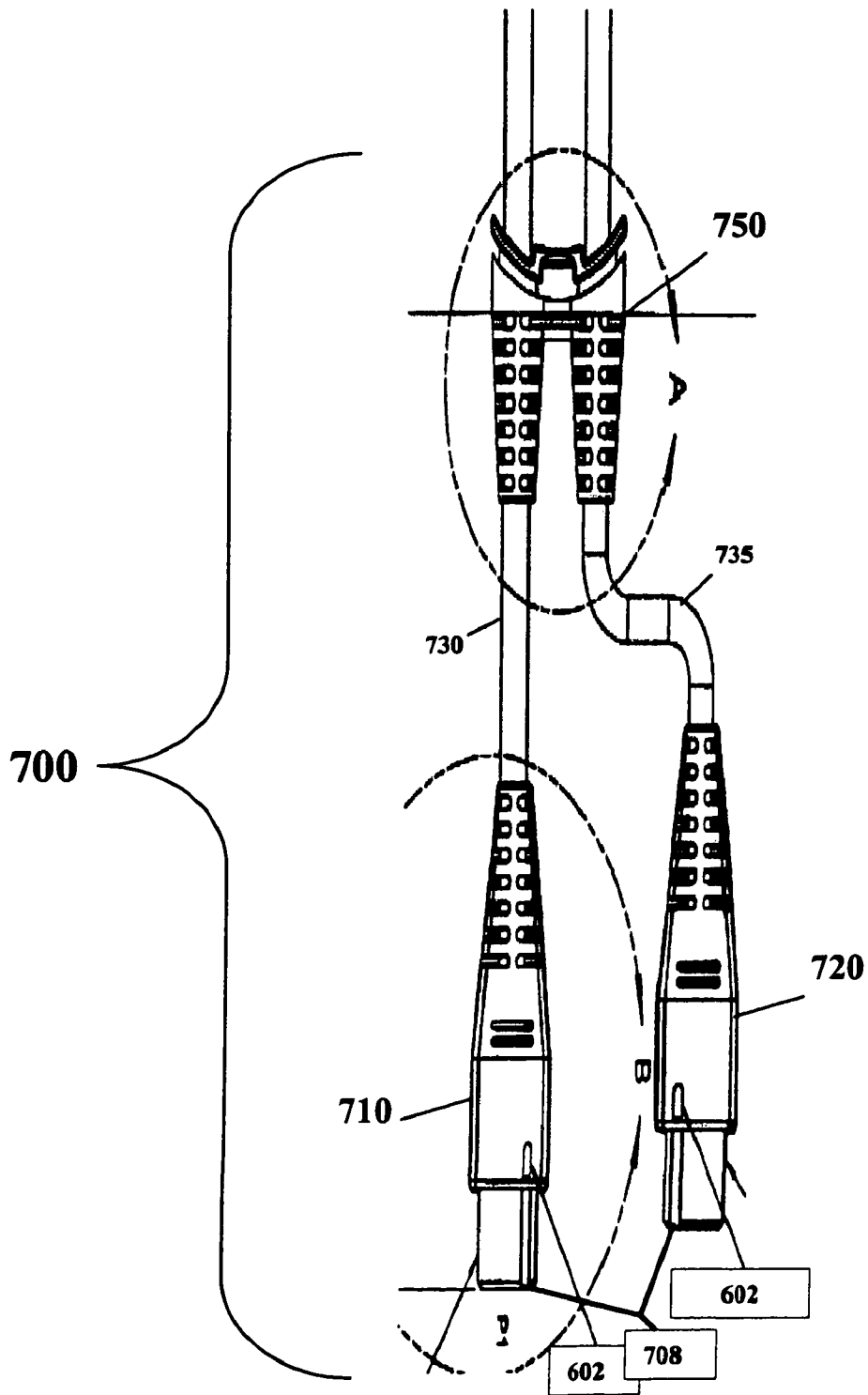
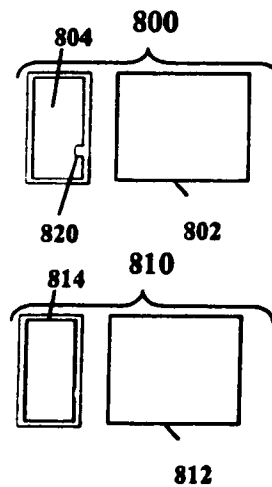
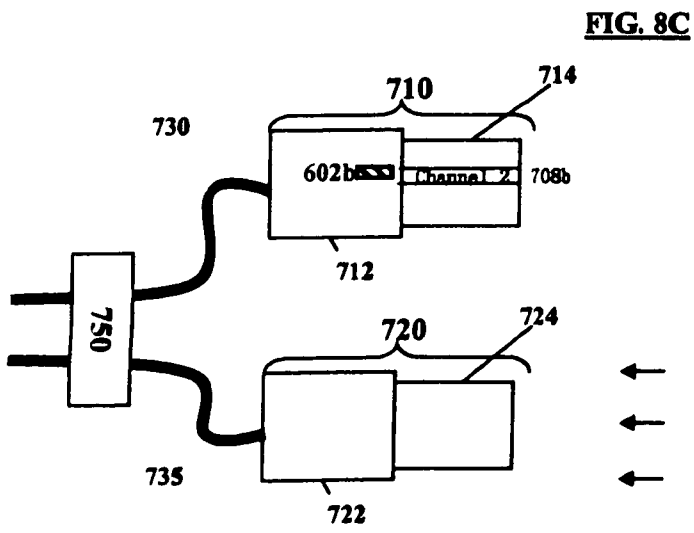
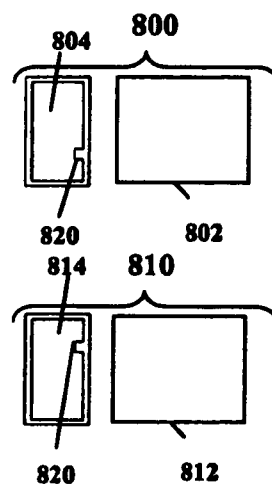
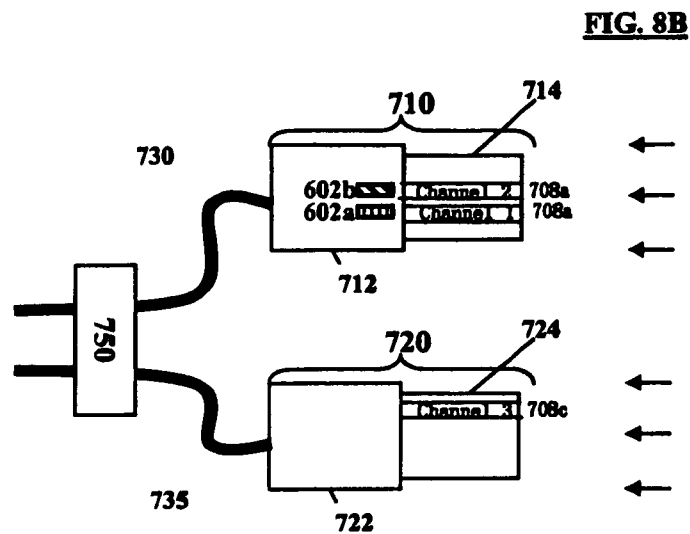
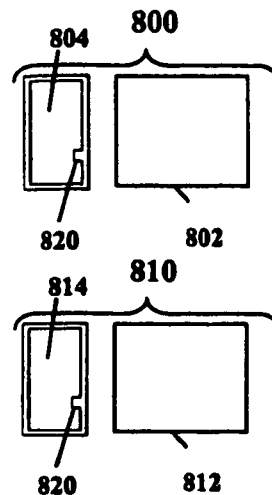
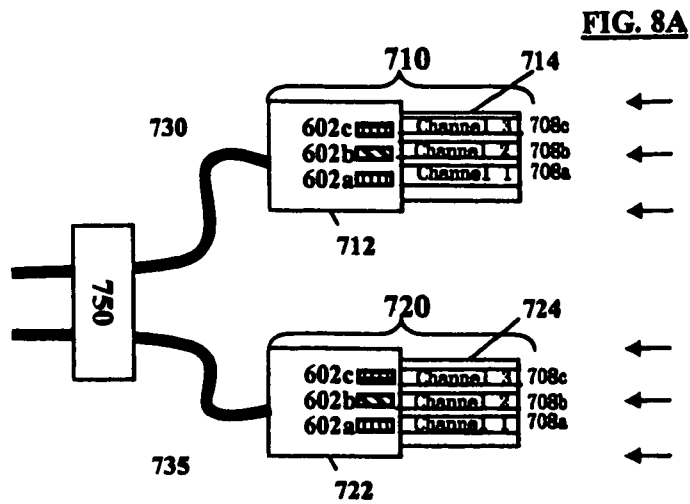


FIG. 7





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KEY CODED POWER ADAPTER CONNECTORS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. patent application Ser. No. 11/399,968 filed Apr. 7, 2006, now abandoned, which is a continuation application of U.S. patent application Ser. No. 10/987,361, filed Nov. 12, 2004, now U.S. Pat. No. 7,056,149.

FIELD OF INVENTION

Embodiments of the present invention relate to interconnectable power connectors including power adapter connectors and power cable assemblies providing key coded power connectors.

BACKGROUND OF THE INVENTION

With the continued growth and availability of consumer electronic devices on the market, consumers have accumulated a variety of such devices many of which require power adapters or connectors to a power source. These devices include laptop computers, handheld devices such as personal digital assistants (PDA), cellular telephones, digital cameras, audio recorders, Compact Disc (CD) players, MP3 players and portable digital video disc (DVD) players. Each device may be of varying form factor and power consumption requirements. As such, there are designated power adapters which may be used to properly supply power to each device. However, often the respective power adapters are very similar in appearance. Because many electronic devices are used by consumers who are unaware of the power consumption requirements for the particular device they seek to operate, the ability to physically connect a device to an incompatible power source may be problematic and have undesirable consequences. For example, if a consumer connects a device to a source that is incapable of delivering sufficient power to the device, the device will not work leaving the user to question the integrity of the device and/or the power source.

SUMMARY OF THE INVENTION

This present invention is directed to key coded power adapter connectors for providing consumer friendly connection between power adapters and host devices. It is an object of the invention to prevent consumers from connecting electronic devices to inappropriate power sources. A keying system is used to provide either a physical indication, a visual indication, or both a visual and physical indication of an inappropriate connection.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 illustrates a block diagram of a power connector system according to an embodiment of the present invention.

FIG. 2 illustrates a perspective view of a power connector according to an embodiment of the present invention.

FIG. 3 illustrates a front view of a power connector according to an embodiment of the present invention.

FIG. 4A illustrates a front view of a mating power connector according to an embodiment of the present invention.

FIG. 4B illustrates a top view of a mating power connector according to an embodiment of the present invention.

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FIG. 4C illustrates a top view of a typical system according to an embodiment of the invention.

FIGS. 5A-E illustrate typical systems implementing a physical keying system according to an embodiment of the present invention.

FIGS. 6A and 6B illustrate typical systems implementing a visual keying system according to an embodiment of the present invention.

FIG. 7 illustrates at top view of a multi-connection power connector according to an embodiment of the present invention.

FIGS. 8A-C illustrate typical systems including a multi-connection power connector according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 illustrates a block diagram of a power connector system according to an embodiment of the invention. Power connector **100** is provided and may be coupled to a power source **150** by cable connector **130**. The power source **150**, which may be an AC source or a DC source, is capable supplying a designated measure of power to a connected electronic device. For example, the power source may be an electrical outlet, a power supply coupled to an electrical outlet, a power generator, a power adapter, a programmable power supply, or a battery.

Power connector **100** has an outer housing **102** and an inner housing **104** both of which may be substantially rectangular in shape. Both the inner housing **104** and the outer housing **102** may be formed in any shape including, but not limited to a circle, a square, a triangle and a star. Further, the inner housing **104** may be configured to have a different shape than that of the outer housing **102**.

Outer housing **102** may be constructed of a durable insulating material, including but not limited to plastic, which may be used to shield power connector **100** from environmental conditions which may compromise the integrity of power connector **100** such as electromagnetic interference, physical force or other conditions.

As shown in FIGS. 2 and 3, inner housing **104** may be symmetrically disposed within and protrude from an interior of outer housing **102**. Inner housing **104** includes a plurality of channels **108** along an external surface and a circuit interface having a plurality of electrical contacts **106** disposed at predetermined positions within the cavity formed by inner housing **104**. Power connector **100** may be configured to receive a mating circuit interface having mating electrical contacts to couple to the plurality of electrical contacts **106** such that power connector **100** may deliver a power signal to an electronic device.

FIGS. 4A and 4B illustrate a mating power connector **400** of an electronic device. Mating power connector **400** includes a housing **402** that may be substantially rectangular in shape and a keying element **420** disposed on an inner surface of the housing **402**. The sides of housing **402** form a cavity **404** which is of a sufficient size and shape to accommodate or couple to the inner housing **104** of power connector **100**.

Mating power connector **400** includes a plurality of mating electrical contacts (not shown) which are exposed within cavity **404** at predetermined locations corresponding to the positions of the plurality of electrical contacts **106** of power connector **100**. For example, electrical contacts **106** and mating electrical contacts (not shown) may constitute a male/female pair. Of course, the mating connection could alternatively be any such mating system as is known in the art.

FIG. 4C illustrates a system according to an embodiment of the present invention. As shown in FIG. 4C, mating power connector 400 may be coupled to power connector 100. Inner housing 104 may act as a guide element to facilitate coupling of the connectors 100, 400. By aligning keying element 420 (not shown) with a corresponding channel of the plurality of channels 108, a user may insert the inner housing 104 of power connector 100 into cavity 404 of mating power connector 400. By coupling the mating power connector 400 and power connector 100 together, the plurality of mating electrical contacts (not shown) of mating power connector 400 may be coupled with the plurality of electrical contacts 106 of power connector 100. Coupling the power connector 100 with mating power connector 400 allows the power source 150 to deliver a power signal to an electronic device, thereby allowing the device to operate.

An embodiment of the present invention may further include a physical keying system. The physical keying system prevents a user from connecting a host device to a power source if the device is not supported by the power source.

FIGS. 5A-5E illustrate implementations of the physical keying system according to an embodiment of the present invention. As shown in FIG. 5A, power connector 100 may be configured with a channel 108a provided at a predetermined location along an external face of inner housing 104 (e.g. a top face, a bottom face or a side face). Channel 108a may correspond to a predetermined range of power which power source 150 may supply. For example the presence of channel 108a may indicate that the power source is capable of supplying up to 10 W of power.

Alternatively, as shown in FIG. 5B, power connector 100 may be configured with a plurality of channels 108 arranged at predetermined locations along an external face of inner housing 104. The plurality of channels 108 may also be provided along any face of the power connector 100 (e.g. a top face, a bottom face or a side face). Each channel (108a, 108b, and 108c) of the plurality of channels 108 corresponds to a predetermined range of power which the power source can supply. Although in FIG. 5B only three channels (108a, 108b, and 108c) are provided on power connector 100, any number of channels may be provided subject to space limitations.

Each channel (108a, 108b, and 108c) is provided in a predetermined location to permit the electrical coupling of mating power connector 400 to the power connector 100, when the power consumption of the electronic device attached to mating power connector 400 falls within a predetermined range of power that power source 150 can supply. For example, if power source 150 is capable of outputting 100 W of power, power connector 100 of FIG. 5B having 3 channels may be configured such that, channel 108a is provided to permit electrical coupling of electronic devices with power consumption less than 10 W, while channel 108b permits electrical coupling of electronic devices with power consumption in the range greater than 10 W but less than or equal to 40 W and channel 108c permits electrical coupling of electronic devices with power consumption in the range greater than 40 W. The ranges of power are not limited to those provided in the example and each channel may represent any predetermined range. Further, the power ranges represented need not cover the entire range of power output for the power source 150. Rather, any portion of the power output capacity of power source 150 may be represented.

In addition, the number of power ranges represented and the ordering of the ranges on power connector 100 are not limited to those provided in the example. Rather, any number power ranges may be represented and the ranges may be represented in any order and in any combination. Referring to FIGS. 5A-E, the power connector 100 may include any one channel of 108a, 108b, and 108c or any combination thereof.

FIG. 5B also shows that each electronic device may be configured with a mating power connector 400 having a keying element 420. The keying element 420 may have a shape and location defined according to the power consumption of the electronic device attached. As such, keying element 420 prevents a user from coupling the electronic device to a power source that cannot supply sufficient power to operate the device. In other words, the mating power connector 400 may mate with the power connector 100 when the location and shape of the key element 420 corresponds to the location and shape of at least one channel (108a, 108b, 108c) of the plurality of channels 108. Accordingly, the keying element 420 of mating power connector 400 may be aligned with the corresponding channel of the plurality of channels 108 of power connector 100. Inner housing 104 of power connector 100 may then be inserted into cavity 404 of mating power connector 400 thereby permitting the coupling of the plurality of electrical contacts 106 of power connector 100 with the corresponding plurality of mating electrical contacts (not shown) of the mating power connector 400. Thus, power source 150 may deliver a power signal to an electronic device allowing the device to operate.

Power connector 100 may also be used to restrict the coupling of an electronic device to power source 150. As shown in FIGS. 5D and 5E, keying element 420 of mating power connector 400 is provided in a location for which there is no corresponding channel on power connector 100. The lack of a corresponding channel 108 on power connector 100 indicates that the electronic device is not supported by the power source 150. Thus, when the user attempts to insert the inner housing 104 of power connector 100 into cavity 404 of mating power connector 400, the keying element 420 will encounter inner housing 104 and prevent the connectors (100, 400) from being coupling together.

The physical keying system may be implemented in various other ways. For example, the channels 108 and keying element 420 may be provided on different faces of the respective connector (100, 400). Also, the configuration of the connectors (100, 400) may be reversed such that a plurality of channels 108 is provided on a mating power connector 400 and a keying element 420 is provided on the power connector 100.

Further, a combination of channels 108 may also be used on power connector 100 to indicate a power range. For example, the combination of channel 108a and 108c may permit electrical coupling of electronic devices with power consumption in the range greater than 70 W. Accordingly, mating power connector 400 may be similarly configured with multiple keying elements 420 to represent the power consumption of an electronic device.

An embodiment of the present invention may further include a visual keying system. The visual keying system provides the user with an indication of whether a power source is capable of outputting power sufficient to operate an electronic device prior to physical connection.

FIGS. 6A and 6B depict a connection system implementing a visual keying system according to an embodiment of the present invention. The visual keying system may use a variety of visual keys including, but not limited to, color-coded keys, numerical keys or symbolic keys. Power connector 100 is provided with a plurality of visual keys 602 on an external surface of power connector 100.

Each visual key 602a, 602b, 602c of the plurality of visual keys 602 indicates a predetermined power range which may be set according to the requirements of a designated class of electronic devices. Alternatively, the predetermined power range may be arbitrarily set. Based upon the power consump-

tion of an electronic device, the mating power connector **400** of each device may be classified and assigned a visual key. For example, visual key **602a** may correspond to the power range of 10 W or less and visual key **602b** corresponds to 11-40 W, while visual key **602c** corresponds to 41-69 W. Accordingly, when mating power connector **400** is coupled to a portable radio which requires 3 W of power to operate the power connector **400** may be labeled with visual key **602a**. However, where mating power connector **400** is coupled to a laptop computer which requires 55 W of power to operate, the power connector may be labeled with visual key **602c**.

Similarly, a power connector **100** coupled to a given power source **150** may be marked with a plurality of visual keys **602** to indicate each range of power that the power source **150** is capable of outputting. For example, using the visual keying system provided above, when power source **150** is capable of outputting 40 W, power connector **100** may be labeled with visual key **602a** (≤ 10 W), visual key **602b** (11-40 W) or both. As shown in FIG. 6A, a user is visually alerted, prior to connection, that power connector **100** is coupled to a power source **150** that is capable of supplying sufficient power to devices that consume less than 10 W of power, as well as, devices that consume power in the 11-40 W range and the 41-69 W range. In addition, a user having an electronic device with a mating power connector **400** which is labeled with visual key **602a** will know prior to attempting a connection that the power source **150** coupled to connector **100** is capable of outputting power sufficient to operate the electronic device.

Each visual key may be placed at a predetermined position on both the power connector **100** and the mating power connector **400**. As such the visual keys **602** may also serve as a guide device for proper connection. As shown in FIG. 6A, the visual key **602a** is positioned in a corresponding vertical location on both power connector **100** and mating power connector **400**. The visual keys **602** are visible both before and after coupling the electrical contact to the mating electrical contact. Thus, when seeking to connect mating power connector **400** to power connector **100**, the user need only align the matching visual keys **602a** to ensure successful mating of the connectors (**100**, **400**).

In a preferred embodiment, the visual keying system may be employed in conjunction with a physical keying system. This combination keying system provides a user with an added layer of protection which may prevent the user from connecting an electronic device to a power source that does not output sufficient power to support the operation of the device. As shown in FIG. 6B, power connector **100** includes a plurality of channels **108** and visual keys **602**. When a user does not recognize the presence of the visual key **602**, such as when the user's hand is covering the visual keys **602**, the physical keying element **420** will nevertheless prevent the user from connecting power connector **100** and mating power connector **400**. Alternatively, where a user is not aware of the physical keying element **420**, the visual keys **602** will alert the user prior to connection whether the power connector **100** and the mating power connector **400** are suitably configured to permit electrical coupling of the plurality of electrical contacts **106** of power connector **100** with the plurality of mating electrical contacts (not shown) of mating power connector **400**. Thus, the combination keying system provides a user-friendly connection system which may prevent a user from forcibly attempting to connect power connector **100** and mating power connector **400** and damaging electrical contacts of either connector or causing damage to the power source **150** or the electronic device.

FIG. 7 illustrates a multi-connection power connector according to an embodiment of the present invention. Multiple power connectors may be provided to furnish additional connections to a given power source such that a user may connect multiple electronic devices to the same power source. In FIG. 7, multi-connection power connector **700** is provided having a first power connector **710** and a second power connector **720**. The multi-connection power connector **700** may include more than two power connectors.

The first power connector **710** and the second power connector **720** may be structurally equivalent to the power connector **100** described above. The first power connector **710** and the second power connector **720** are held together in a chamfered harness **750** and may each be coupled to a power source **150** via cable connectors **730** and **735**, respectively. The first power connector **710** and the second power connector **720** need not be coupled together and may instead be wholly separate.

In addition, the first power connector **710** and the second power connector **720** may each be configured with a visual keying system, a physical key system, or a combination thereof, as described above.

As shown in FIG. 8A, the first power connector **710** and the second power connector **720** may be identically configured with channels **708a**, **708b** and **708c** and visual keys **602a**, **602b** and **602c** such that the multi-connection power connector **700** may provide an additional power connector for a power source **150** which may output power in accordance with the power ranges represented. Alternatively, the second power connector **720** may be configured to provide support for additional power ranges. For example, where the multi-connection power connector **700** is coupled to a power source **150** capable of outputting 200 W, the first power connector **710** may be configured with channels **708a**, **708b** and **708c** to permit electrical coupling of an electronic device with power consumption in the ranges less than 10 W, 11-20 W and 21-40 W, respectively. The second power connector **720** may be configured with three distinct channels to permit electrical coupling of an electronic device with power consumption in the range 41-60 W, 61-80 W, and 81-100 W, respectively. Accordingly, a user could connect a portable radio requiring 3 W of power using the first power connector **710** and a laptop computer requiring 55 W using the second power connector **720** such that power source **150** could be used to simultaneously operate both electronic devices.

Additionally, the first power connector **710** and the second power connector **720** may be further independent in configuration. For example, as shown in FIG. 8C, the first power connector **710** may be configured with both channel **708b** and visual key **602b**, while the second power connector **720** includes neither a physical key or a visual key. Either of the power connectors **710**, **720** may be configured with the aforementioned complement and permutations of physical key elements and visual keys.

Any number of power ranges may be represented on each power connector (**710** and **720**) of the multi-connection power connector **700**. As shown in FIG. 8B, the first power connector **710** is configured with channel **708a** and **708b** while the second power connector **720** is configured with only channel **708c**.

Further, the power ranges represented on each of the power connectors (**710**, **720**) need not cover the entire range of power output for the power source **150**. Rather, any portion of the power output capacity of power source **150** may be represented. For example, where power source is capable of outputting 100 W, the first power connector **710** may include channels **708a** and **708b** to permit coupling electrical cou-

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pling of electronic devices requiring less than 10 W and 11-20 W of power, respectively, but not devices requiring greater than 20 W. The second power connector **720** includes only channel **708c** to permit coupling electrical coupling of electronic devices requiring 21-40 W, but does not support devices requiring 20 W or less or electronic devices 41-100 W.

The order of the power ranges represented on each power connector may also be arbitrarily determined. Referring to FIG. **8B**, channel **708b** may be used to permit electrical coupling of an electronic device coupled to a first mating power connector **800** requiring less than 10 W while channel **708a** may be used to support to a device coupled to a second mating power connector **810** requiring 11-20 W.

The multi-connection power connector **700** may be used to restrict the coupling of electronic devices to a power source. In FIG. **8C**, an electronic device coupled to a first mating power connector **800** will be prevented from being coupled to the first power connector **710** of the multi-connection power connector **700** since the keying element **820** of the first mating power connector **800** does not correspond to the location and shape of channel **708b** of the first power connector **710**. However, an electronic device coupled to second mating power connector **810**, which has no physical keying element will be allowed to couple to the second power connector **720** which utilizes neither a physical keying element or a visual keying element. Thus the power source **150** coupled to the second power connector **720** may deliver sufficient power to operate the device coupled to the second mating power connector **812**.

While the description above refers to particular embodiments of the present invention, it will be understood that many alternatives, modifications and variations may be made without departing from the spirit thereof. The accompanying claims are intended to embrace such alternatives, modifications and variations as would fall within the true scope and spirit of the present invention. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the claims, rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A power connector comprising:
 - an electrical contact to receive a mating electrical contact; and
 - a visual key element disposed at a predetermined position on the power connector, the predetermined position visually indicating ranges of powers which a power source coupled to the power connector is configured to output and visually indicating alignment and orientation for properly coupling the electrical contact to the mating electrical contact, the visual key element being visible both before and after coupling the electrical contact to the mating electrical contact.
2. The power connector of claim 1, further configured to transmit a power signal from the power source to the mating electrical contact through the electrical contact.
3. The power connector of claim 1, wherein the visual key element is color-coded.
4. A power connection system comprising:
 - a first power connector having an electrical contact to receive a mating electrical contact, wherein the first power connector is coupled to a power source and is configured with a visual key element, the visual key

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element disposed at a predetermined position on the first power connector, the predetermined position visually indicating ranges of power which the power source is configured to output; and

- a second power connector having the mating electrical contact, the second power connector being configured with a mating visual key element, the mating visual key element disposed at a predetermined position on the second power connector, the predetermined position of the mating visual key element indicating a power range assigned to the second connector, wherein when the first power connector and second power connector are positioned for connection and the power range assigned to second connector is met by the range of power which the power source is configured to output, the mating visual key element is aligned with the visual key element and wherein the visual key element and the mating visual key element are visible both before and after coupling the electrical contact to the mating electrical contact.
5. The power connection system of claim 4, wherein the power source is selected from the group consisting of a power supply and a battery.
6. The power connection system of claim 4, wherein the second power connector is coupled to an electronic device, and the mating visual key element visually indicates a power requirement of the electronic device.
7. The power connection system of claim 4, wherein the visual key element and the mating visual key element are color-coded.
8. The power connection system of claim 4, wherein the first power connector transmits a power signal from the power source to the second power connector through the electrical contact.
9. A method for preventing an improper power connection comprising:
 - configuring a first power connector with a visual key element, the first power connector being coupled to a power source capable of generating a power signal and including an electrical contact to receive a mating electrical contact;
 - configuring a second power connector with a mating visual key element, the second power connector having the mating electrical contact; and
 - providing a visual indication of whether the first power connector and the second power connector are properly connectable based on a positional comparison of the visual key element and the mating visual key element, wherein the visual key element and the mating visual key element are visible both before and after coupling the electrical contact to the mating electrical contact and visually indicate respectively ranges of powers that the power source coupled to the first power connector is configured to output as the power signal and a power range assigned to the second power connector.
10. The method of claim 9, further comprising:
 - connecting the first power connector to the second power connector when the first power connector is properly connectable to the second power connector; and
 - transmitting the power signal from the first power connector to the second power connector through the electrical contact.
11. The method of claim 9, wherein the second power connector is coupled to an electronic device, and the mating visual key element visually indicates a power requirement of the electronic device.