

ROTATABLE MAGNETIC ELECTRICAL CONNECTOR

5 FIELD OF THE INVENTION

The invention relates to electrical connectors, and in particular to connectors held together by magnetic force.

BACKGROUND OF THE INVENTION

10 Electrical connectors in two-part (male-female) format are well-known in the art. For example, a light bulb connected threadably to a standard AC light fixture is a two-part connector. A contact at the base of the light fixture provides power to the light bulb which illuminates when powered.

15 However, such traditional connectors can be awkward and cumbersome to install or replace in certain locations (in ceilings, in or under furniture, cabinets, or display cases), or in limited space environments (such as offices, vehicles, boats, or RV's). It would be beneficial to provide an electrical connector that is simple to install and maintain. In particular, it would be beneficial if such installation and maintenance could be done
20 manually, without tools.

Traditional connectors may also be difficult to secure. Many appliances are powered using a cord which plugs into an electrical socket. The cord provides a well-known tripping hazard. Inadvertent removal of the cord, physical injury and/or damage to the
25 appliance may result. It would be beneficial to provide an electrical connector that reduces such hazards, and in particular reduces or eliminates the need for cord

connection to a power source. It would also be beneficial to provide stability for appliances by preventing tipping from the socket.

To move an electrical appliance to face a different direction, it is frequently necessary to
5 unplug and reposition the appliance before plugging the cord back in. This may be
necessary to avoid cord hazards mentioned above. In some cases, the appliance and
its cord location (and the location of the power outlet) may not permit the desired
repositioning. It would be beneficial to provide a low-footprint power connector that
enables an appliance to be repositioned within a single connector (by rotation), or
10 positioned to engage another nearby connector simply and without cords.

Lighted display panels using multiple threaded light bulbs or other illuminated panels are
known. However, it would be beneficial to provide a display panel that allows quick-
release light bulbs to be installed and dismounted, to permit modular and changeable
15 displays to be erected.

SUMMARY OF THE INVENTION

The invention provides a rotatable magnetic electrical connector.

20 According to a first aspect of the invention, a rotatable quick disconnect electrical
connector assembly is provided. The assembly includes:

- a male component having a first electrical contact at a distal end thereof; and
- a female component having a mating fit with the male component.

The female component has a second electrical contact in its interior, which is situated so
25 as to meet and contact the first electrical contact when the male and female components
are mated together.

One of either the male component or the female component comprises a magnet mounted thereon, and the other of the male component or the female component comprises a magnet-sensitive material, so that the male and female components are attracted together by magnetic force.

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Each of the male and female components has a generally circular cross-section, and at least one of said male component and said female component is rotatable with respect to the other component through unlimited degrees in clockwise and counterclockwise directions.

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According to a second aspect of the invention, a male component is provided in accordance with the construction and features set out above.

According to a third aspect of the invention, a female component is provided in accordance with the construction and features set out above.

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According to a fourth aspect of the invention, a system of electrical connectors is provided with a panel comprising a plurality of female components in accordance with the construction and features set out above. Each of the female components are adapted to receive at least one male component, all in accordance with the construction and features set out above.

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BRIEF DESCRIPTION OF THE FIGURES

The preferred embodiments will now be described having reference to attached drawings, in which Figs. 1A-3 show a rotatable magnetic electrical connector. In particular:

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FIG. 1A shows a cross-sectional view of a female component of the electrical connector.

FIG. 1B shows the cross-sectional view along lines A-A of Fig. 1A.

FIG. 1C shows the isometric view from lines B-B of Fig. 1A.

FIG. 2A shows a cross-sectional view of a male component of the connector.

5 FIG. 2B shows the cross-sectional view along lines C-C of Fig. 2A.

FIG. 2C shows the isometric view of the male component.

FIG. 3 shows an exploded (assembly) view of an assembled connector.

DETAILED DESCRIPTION

10 Figs. 1A-3 show a rotatable magnetic electrical connector **10**. The connector is a low voltage electrical connector in two parts. The connection is maintained by magnetic force and separated by pull force. Preferably, the disconnection is easily achieved by hand (without tools). In engaged state, the connector provides constant electrical connection in place, as well as through unlimited rotation of the male component **12** or
15 the female component **14** in either clockwise or counterclockwise direction.

Beginning with Fig. 3, an assembly view is shown of the rotatable magnetic electrical connector **10**, having two main components: a male component **12** and a female component **14**. The female component is shown in more detail in Figs. 1A-1C. The
20 male component is shown in more detail in Figs. 2A-2C.

The male component **12** is sized and shaped to snugly fit inside an interior cavity **44** of the female component **14**. As shown, the male component **12** may be fully or partially tapered in shape, the female component **14** having an interior cavity **44** of the same
25 tapered shape. The fit is intended to provide a close tolerance mating of the two components, which in turn provides sufficient friction to prevent slipping of one

component relative to the other. Although various mating shapes of components may be used, it is preferred that the cross-sections of the male component and female component be generally circular. Preferably, the components are capable of secure mating relation without the need for other locating means or alignment means.

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In comparison with a straight fit between the male and female components, the tapered shape is considered preferable for several reasons. The tapered shape is considered beneficial for closer tolerance between the components (approaching zero tolerance). Thus, the components can be made to have a very secure, "locked together" mating, even apart from their magnetic bond. In assembled state, the components resist side-to-side or pivotal movement relative to the center axis of the female component (i.e. the components do not rattle or slide relative to each other). However, by contrast to a straight fit manufactured to the same tolerance, the tapered fit does permit the frictional bond to be broken relatively easily by hand.

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Functionally, the male component and female component are adapted for magnetic interconnection. As shown in the Figures, at least a portion of the male component **12** may be comprised of a magnet-sensitive metallic material, such as the housing **16**, which is attracted by one or more magnets **30** in the female component **14**. One type of magnet-sensitive material is stainless steel. The magnets may be rare earth magnets, such as neodymium, or any suitable magnetic material. Preferably, the magnets are ring-shaped and mounted proximate to the interior cavity of the female component.

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Although having a magnetic interaction, the male and female components are not necessarily entirely metal. In particular, for various reasons, it may be desirable to manufacture the connector having sub-components made of plastic or another material.

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Most critical is that the electrical leads and contacts be made of a material that is functional to conduct electricity, and that the magnetic and magnet-sensitive portions of the male and female components co-operate to form a magnetic bond to retain the components together.

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The electrical function of the connector is provided by wires (leads) **18, 36** and electrical contacts **24, 34**, which may be physically brought into connection when the male and female components are mated together magnetically. In a preferred embodiment, one or both of the electrical contacts **24, 34** may be spring-biased, to facilitate secure connection. As shown in Fig. 3, the male component may include a steel coil spring **22** to bias the contact **24** (such as Tellurium) into abutment with the corresponding contact **34** in the female component (such as Tellurium). A black (negative) lead is also provided **40**. Current is carried through the connector to a light bulb or appliance via lead **18**.

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In the male component, the electrical wires and contacts are provided to be housed within a housing **16** (e.g. stainless steel). To secure the electrical components in place, one or more washers may be provided **20**. As shown in Fig. 3, the component may be packed with a pressure-fit retainer, such as a Nylatron retainer **26**.

20

In the female component, the electrical wires and contacts are provided to be housed within a housing **28** (e.g. stainless steel). The magnet rings **30** preferably are mounted within the housing below the cavity **44**. The interior parts are preferably secured using one or more washers **32**. Suitable washers may be made of any insulating material, such as Delrin. As shown in Fig. 3, the component may be packed with a pressure-fit

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retainer, such as a Nylatron retainer **38** to guard against relative movement and wear within the female component.

For installation, the female component may also be provided with a nut **42** which
5 engages a threaded exterior portion on the steel housing **28**.

Preferably, the female component is adapted to fit into new and existing millwork (platforms, showcases, cabinets, tables, etc.), as well as wall board and paneling. The male component could be used as an attachment to LED and halogen light fixtures as
10 well as, any low voltage AC DC appliance that conforms to accepted electrical standards (such as CSA, UL or European standards).

It is an advantage of the connector that its versatility allows for installation in horizontal, vertical and overhead positions, as well as providing 360-degree rotation, such as for
15 light fixtures. The magnetic connection, as well as the snug fit of the components, provides the overall assembly with a high level of stability (against tipping, and lateral pull and "shearing" forces). This is achieved with a relatively small "footprint" of the female component. To illustrate, the female component (in use as a fixture/base for a table lamp) can have a footprint as small as about 1.25" in diameter. By contrast, a table
20 lamp having a standard AC base can have a footprint between 4" and 10" in diameter or more.

Because the connector can be installed into existing millwork, multiple female components can be installed in handy locations, to permit male-component equipped
25 appliances and light bulbs to be swapped in and out as desired. The small footprint and smooth top surface (which can be recessed to lie flush with the surface in which it is

installed) allow the connector to be used in place of standard AC outlets in many locations. Reach from an outlet to an appliance is therefore less of a concern, and the connector can be used in place of a standard electrical cord, thereby providing a safer, and less-obtrusive connection.

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To illustrate, the connectors may be used in multiple locations throughout the architecture of a boat or RV to provide quick release and installation of all fixtures (lights, radio, navigational tools, etc.) preferably without the use of tools. The fixtures will not tip over or come undone due to rough seas or roads, and all fixtures may be easily installed and uninstalled for versatility and ease of stowage.

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In a possible display application, a plurality of connectors would be useful mounted in any type of grid pattern on one or more panels. Male components (such as lights) could be swapped in and out to provide a modular lighting display.

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The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact processes, components and applications shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention and the appended claims and their equivalents. For example, while specific materials are described in the foregoing disclosure, it is not intended to limit the scope to such materials, but materials having similar properties (e.g. magnet-sensitive, magnetic, insulating, etc.) may be substituted without limitation.

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CLAIMS

What is claimed is:

1. A rotatable quick disconnect electrical connector assembly, comprising:
 - a male component having a first electrical contact at a distal end thereof;
 - 5 a female component having a mating fit with the male component and having a second electrical contact in the interior thereof, the second electrical contact being situated so as to meet and contact the first electrical contact when the male and female components are mated together;
 - wherein one of either the male component or the female component comprises a magnet mounted thereon, and the other of the male component or the female component comprises a magnet-sensitive material, so that the male and female components are attracted together by magnetic force;
 - and wherein each of the male and female components has a generally circular cross-section, and at least one of said male component and said female component is rotatable with respect to the other component through unlimited degrees in clockwise and counterclockwise directions.
2. A male component adapted for inclusion in the assembly according to claim 1.
- 20 3. A female component adapted for inclusion in the assembly according to claim 1.
4. A system of electrical connectors, comprising:
 - at least one male component having a first electrical contact at a distal end thereof;
 - 25 a panel comprising a plurality of female components, each female component:
 - capable of a mating fit with one of the at least one male component, and

having a second electrical contact in the interior thereof, the second electrical contact being situated so as to meet and contact the first electrical contact when the male and female components are mated together;

5 wherein one of either the male component or the female component comprises a magnet, and the other of the male component or the female component comprises a magnet-sensitive material, so that a pair of male and female components is attracted together by magnetic force;

10 and wherein each of the male and female components has a generally circular cross-section, and at least one of said male component and said female component is rotatable with respect to the other component through unlimited degrees in clockwise and counterclockwise directions.

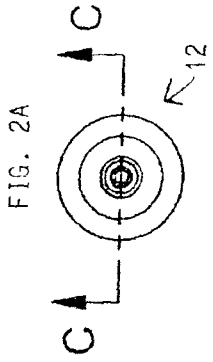


FIG. 2A

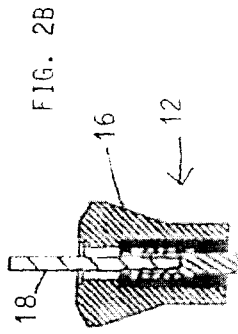


FIG. 2B

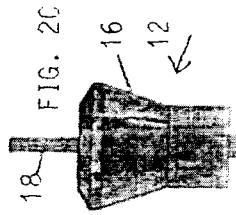


FIG. 2C

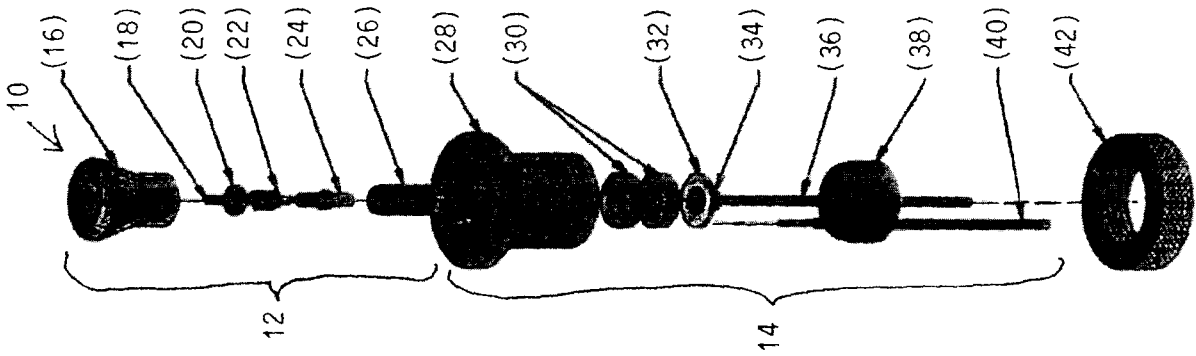


FIG. 3

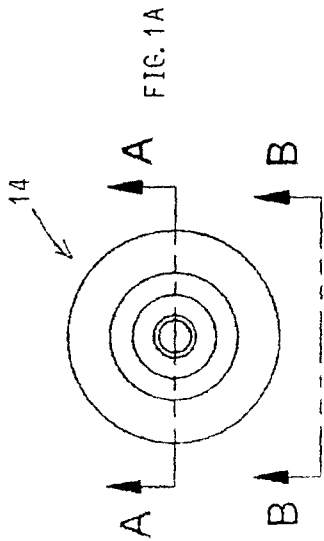


FIG. 1A

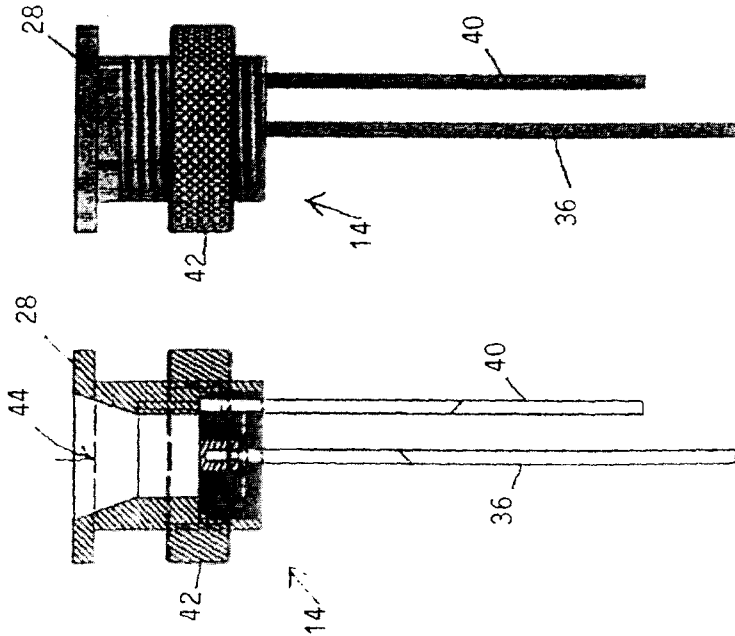


FIG. 1C

FIG. 1B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2006/001047

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC: H01R 35/00 (2006.01) , H01R 13/62 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC</p>														
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(2006.01): H01R all</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used) Databases: CPD, Delphion, Questel-Orbit, USPTO Keywords: Magnet, Electrical, Rotatable, Swivel, Revolve, Safety, Quick-Connect/Disconnect, Connector, Coupler, Plug</p>														
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:10%;">Category*</th> <th style="width:60%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width:30%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td align="center">X</td> <td>US 3,521,216 A (TOLEGIAN) 21 JULY 1970 (21-07-1970) * entire disclosure</td> <td align="center">1, 4</td> </tr> <tr> <td align="center">X</td> <td>US 3,808,577 A (MATHAUSER) 30 APRIL 1974 (30-04-1974) * entire disclosure</td> <td align="center">1, 4</td> </tr> <tr> <td align="center">X</td> <td>US 3,810,258 A (MATHAUSER) 07 MAY 1974 (07-05-1974) * entire disclosure</td> <td align="center">1, 4</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 3,521,216 A (TOLEGIAN) 21 JULY 1970 (21-07-1970) * entire disclosure	1, 4	X	US 3,808,577 A (MATHAUSER) 30 APRIL 1974 (30-04-1974) * entire disclosure	1, 4	X	US 3,810,258 A (MATHAUSER) 07 MAY 1974 (07-05-1974) * entire disclosure	1, 4
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X	US 3,810,258 A (MATHAUSER) 07 MAY 1974 (07-05-1974) * entire disclosure	1, 4												
<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.</p>														
<table border="0" style="width:100%;"> <tr> <td style="width:50%; vertical-align: top;"> <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width:50%; vertical-align: top;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p> </td> </tr> </table>			<p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>										
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<p>Date of the actual completion of the international search</p> <p>11 September 2006 (11-09-2006)</p>		<p>Date of mailing of the international search report</p> <p>20 October 2006 (20-10-2006)</p>												
<p>Name and mailing address of the ISA/CA</p> <p>Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001(819)953-2476</p>		<p>Authorized officer</p> <p>Craig MacMillan (819) 934-3422</p>												

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2006/001047

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons :

1. Claim Nos. :
because they relate to subject matter not required to be searched by this Authority, namely :

2. Claim Nos. : 2 and 3
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically :

Present claims 2 and 3 relate to an extremely large number of possible products. In the present case, meaningful search over the whole of the claimed scope is impossible as these claims are directed to the desired result of being "adapted for inclusion". These claims cover all products having this characteristic, whereas the application provides support within the meaning of PCT Article 6 and/or description within the meaning of PCT Article 5 for only a very limited number of such products.

3. Claim Nos. :
because they are dependant claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows :

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos. :
4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos. :

- Remark on Protest** The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2006/001047

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US3521216	21-07-1970	none	
US3808577	30-04-1974	none	
US3810258	07-05-1974	none	