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PTO/SB/122 (01-06)

Approved for use through 12/31/2008. OMB 0651-0035

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Application Number	61/001/587
Filing Date	11/02/2007
First Named Inventor	EARL G POWELL
Art Unit	N/A
Examiner Name	N/A
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Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).
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Typed or Printed
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Date 01/28/2008

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NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
61/001,587	11/02/2007		105			

TIGO ENERGY INC
10337 TULA LANE
CUPERTINO, CA 95014

CONFIRMATION NO. 1343

FILING RECEIPT



OC00000027372441

Date Mailed: 12/20/2007

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Earl G. Powell, Sunnyvale, CA;
Ron Hadar, Cupertino, CA;
Dan Kikinis, Saratoga, CA;

Power of Attorney: None

If Required, Foreign Filing License Granted: 12/19/2007

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 61/001,587**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

Photovoltaic safety switch

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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110207

17581 U.S. PTO

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61/001587
11/02/2007

PTO/SB/16 (10-07)

Approved for use through 06/30/2010. OMB 0651-0032

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET - Page 1 of 2

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EB 668948576 US

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
EARL G.	POWELL	SUNNYVALE, CALIFORNIA
RON	HADAR	CUPERTINO, CALIFORNIA
DAN	KIKINIS	SARATOGO, CALIFORNIA

Additional inventors are being named on the _____ separately numbered sheets attached hereto

TITLE OF THE INVENTION (500 characters max):

PHOTOVOLTAIC SAFETY SWITCH

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☐ The address corresponding to Customer Number:

OR

☒ Firm or Individual Name **TIGO ENERGY INC**

Address **10337 TULA LANE**

City CUPERTINO	State CALIFORNIA	Zip 95014
Country USA	Telephone 408 366-2379	Email ron.hadar@tigoenergy.com

ENCLOSED APPLICATION PARTS (check all that apply)

☐ Application Data Sheet. See 37 CFR 1.76

☒ Drawing(s) Number of Sheets 7

☒ Specification (e.g. description of the invention) Number of Pages 4

☐ CD(s), Number of CDs _____

☐ Other (specify) _____

Fees Due: Filing Fee of \$210 (\$105 for small entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is \$260 (\$130 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

METHOD OF PAYMENT OF THE FILING FEE AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT

☒ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fee and application size fee (if applicable).

☒ Payment by credit card. Form PTO-2038 is attached

☐ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: _____ A duplicative copy of this form is enclosed for fee processing.

\$105.00

TOTAL FEE AMOUNT (\$)

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PTO/SB/16 (10-07)

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.



No.



Yes, the name of the U.S. Government agency and the Government contract number are: _____

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SIGNATURE _____

Date November 2, 2007

TYPED or PRINTED NAME RON HADAR

REGISTRATION NO. _____
(if appropriate)

TELEPHONE 408 835-5810

Docket Number: _____

Photovoltaic Safety Switch

Inventors Earl Powell, Ron Hadar, and Dan Kikinis

Background

When a photovoltaic panel or laminate is exposed to direct or diffuse light, a lethal voltage potential may be present. In the United States the possible voltage could be as high as 600 volts, while in Europe and the rest of the world this voltage could approach a kilovolt. Because of this potential danger from electrical shock, solar panel manufacturers and code and standards development organizations have made some recommendations to minimize or eliminate this danger. One suggestion has been to cover the photovoltaic panel with an opaque material such as a tarpaulin. However, this approach proposes its own safety risk from having the wind catch the tarpaulin and pull installation personnel off the roof as they try to control the unstable sheet material against the wind. Another recommendation is to install and/or service the photovoltaic panels at night when there is minimal risk of the panels being energized. This approach presents the potential safety risks associated from working in a poorly lighted environment. In addition to the potential personnel safety issues there are also significant risks to equipment and hardware. Connecting or disconnecting energized plugs can cause arcing and damage to these connectors, junction boxes, and other electrical components.

What is clearly needed is a method and system to reduce the safety risks during the shipment, installation and/or maintenance of photovoltaic systems inherent in covering them with an opaque material or working on them at night.

Description of the Embodiment

This invention provides this protection by the inclusion of a normally closed switch integral to the panel junction box or integral to the panel module when AC or DC modules are used.

Figures 1- 7 shows a representative switch that would be integrated into either the panel junction box 308 or panel modules (not shown). Figures 1 through 4 show an

exemplary implementation in which the switch consists of two contactors 102 and 103 made of a conductive metal or plated hybrid. The contactors 102 and 103 are normally made of a spring alloy metal or have an integral spring plunger design (not shown). The contactors 102 and 103 are positioned or fixed in such a way that the two contacts 102 and 103 are spring loaded toward each other so that electrical continuity is maintained between the two contactors 102 and 103. In this configuration the switch is normally closed (NC) and not in safe mode. The safe mode is achieved when the blade 104 is inserted between the two contacts 102 and 103. The blade 104 is manufactured from a dielectric material and when inserted between the two contactors 102 and 103 there is no electrical continuity. The blade 104 may also have a flag 105 attached, which flag could be red or some other highly visible color, to provide a visual indicator of the state of the panel. The panels and/or panel with integral modules would come shipped from the factory with the blade 104 and flag 105 inserted between the two contactors. The panels would be installed and integrated with the blade 104 present and flag 105 visible. The installer would mount, secure, and plug in all of the connections in the system, including the grounding. As shown in Figure 2, once the installation is completed the installer would remove the blades 104 at all those places indicated by the flags 105. If additional work or troubleshooting were needed, the blade(s) 104 and flag(s) 105 could be reinserted aided by the tapered section 207 of the blade 104, thereby breaking the electrical continuity of the contactors 102 and 103 at point 206.

While symmetry is implied in contactors 102 and 103, these contactors need not be identical or even similar. They simply need to be made of electrically conductive material and be configured to be in physical contact with each so that an electrically conductive path 206 is maintained. Furthermore, as long as this electrical conductive path 206 can be maintained, then disrupted by the blade 104, and then reestablished by the reinsertions of a dielectric device such as the blade 104, the design intent of this invention is met.

In addition to the visual indication of the modes of the panels provided by the flag(s) 105, said flags could also provide information in the form of text, such as, for example, "Remove before operation" or a warning of potentially lethal voltage.

Other embodiments of this invention would use a reed switch, as shown in figures 5 and 6. Figure 5 shows a reed switch 510 integrated into the photovoltaic junction box 308. Figure 6 shows how to make the reed switch 510 normally closed in some cases by integrating a stationary biasing magnet into the junction box 308 in close proximity to the reed switch, so that the switch 510 is closed. Another magnet 512 is inserted into the junction box well 509 so that the reversed polarity cancels the magnetic lines of force and the reed switch opens 510. The magnet 512 is installed at the factory and a flag 105 is attached (not shown). In other cases, normally closed (NC) reed contacts can be used, avoiding the necessity of the additional stationary magnet. Once the installation and integrations are complete the magnet 512 is removed and discarded. The power leads of the junction box are now energized via the semiconductor switch or relay (not shown).

In some cases, a semiconductor switch (not shown) can be used. A watchdog circuit within a controller unit that could be integrated into the panel junction box 308 or inverter (not shown) sends a signal every time interval t to maintain the connection of the panel outputs to the string. When this signal is timed-out or is absent, the panel outputs of the panel are disconnected via a semiconductor switch device (not shown).

Figure 7 shows an alternative optical sensor unit 700 with an optical sensor 701 mounted on a PCB. Additionally, springs 702 a, b hold a separator 703 in place that can be removed in direction of arrow 704 using a pull-tab similar to the tab discussed earlier. Not shown is the exterior enclosure that would contain the mechanical elements such as the cable connections and the guide elements for guiding separator 703 in and out of the unit. Also, additional circuitry will be on the side of the PCB, such as a control circuit to affect an on/off switching either in some cases by FET transistors or using, in other cases,

a relay, such as a bi-stable relay or another suitable circuit. The operational power may be drawn from the solar system itself, or it may be brought up by auxiliary wiring. In yet some other cases, a relay can be simply remote controlled by an auxiliary wire to close or open the circuit. The advantage of this approach is that no pull-tabs can be forgotten on the roof.

Yet another implementation would be to have a mechanism and or circuitry in the panel that would identify the load from the inverter and connect the panel to the panel outputs. When no load is present the panel outputs would be disconnected. This functionality would also be implemented using a semiconductor switch device or other suitable device (such as a relay), and some sensor circuitry, allowing an automatic reconnect when the loop appears to be closed and a load connected.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novel art of this disclosure. These modifications and variations do not depart from the broader spirit and scope of the invention, and the examples cited here are to be regarded in an illustrative rather than a restrictive sense.

1/7

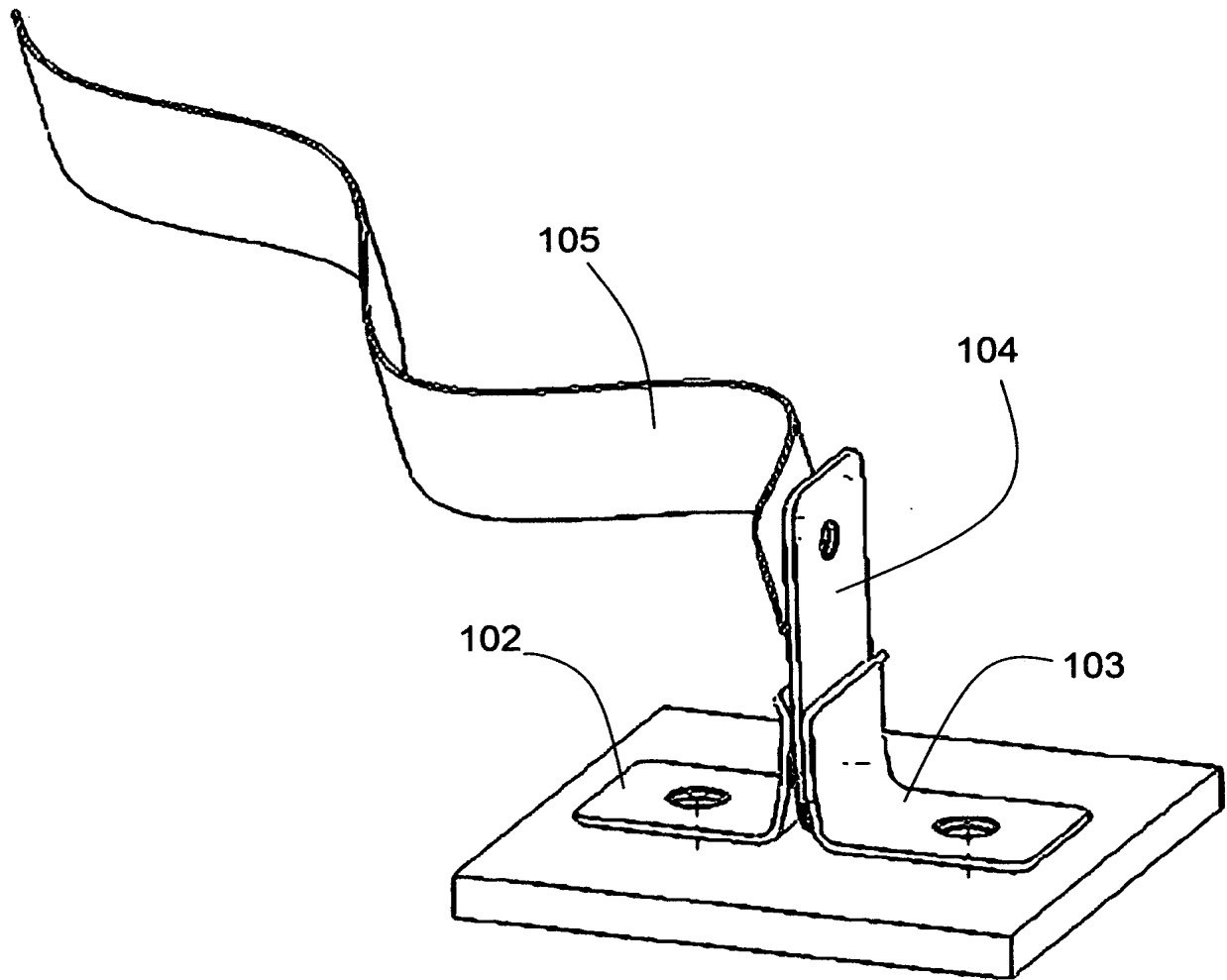


Fig. 1

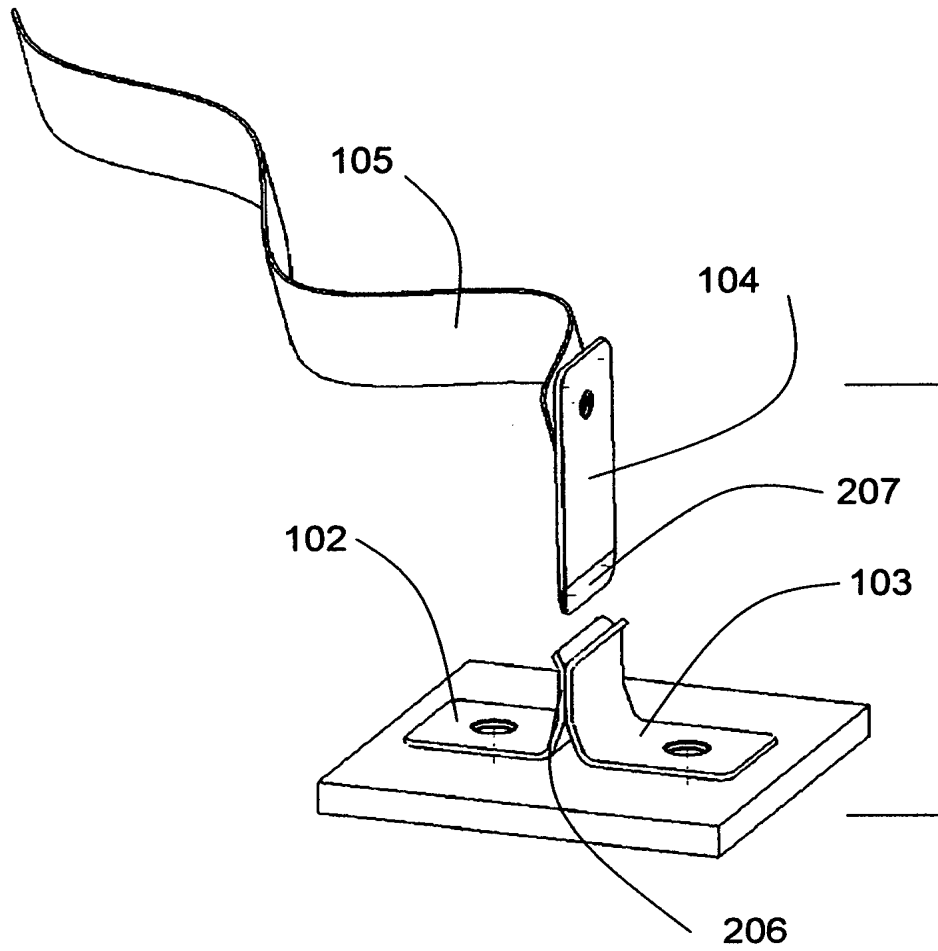


Fig. 2

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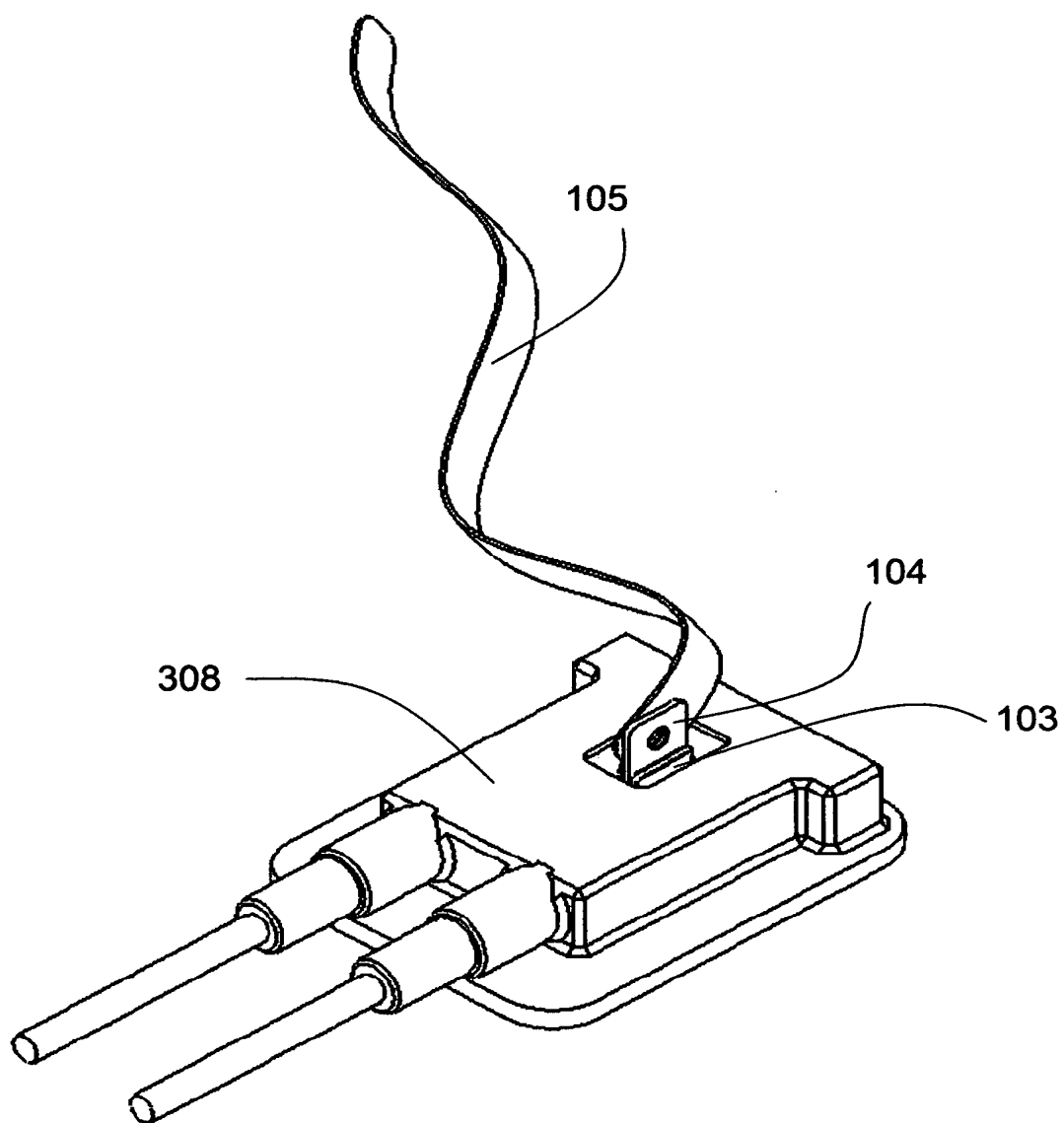


Fig. 3

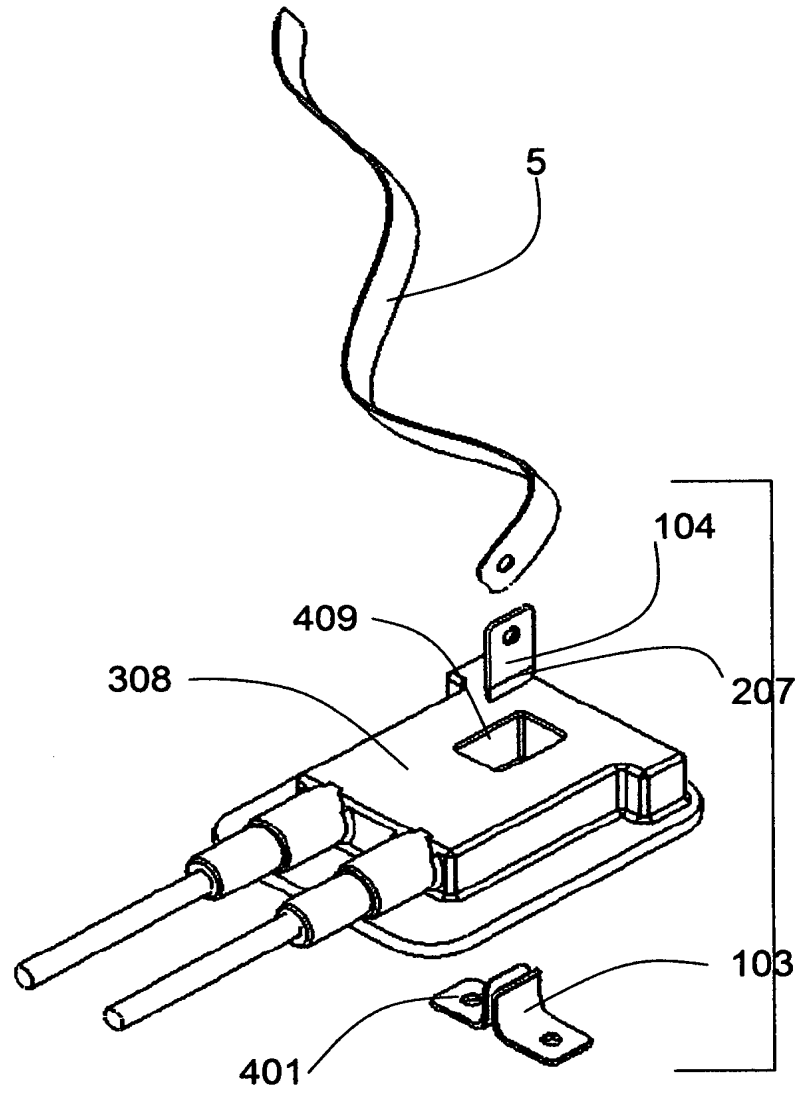


Fig. 4

5/7

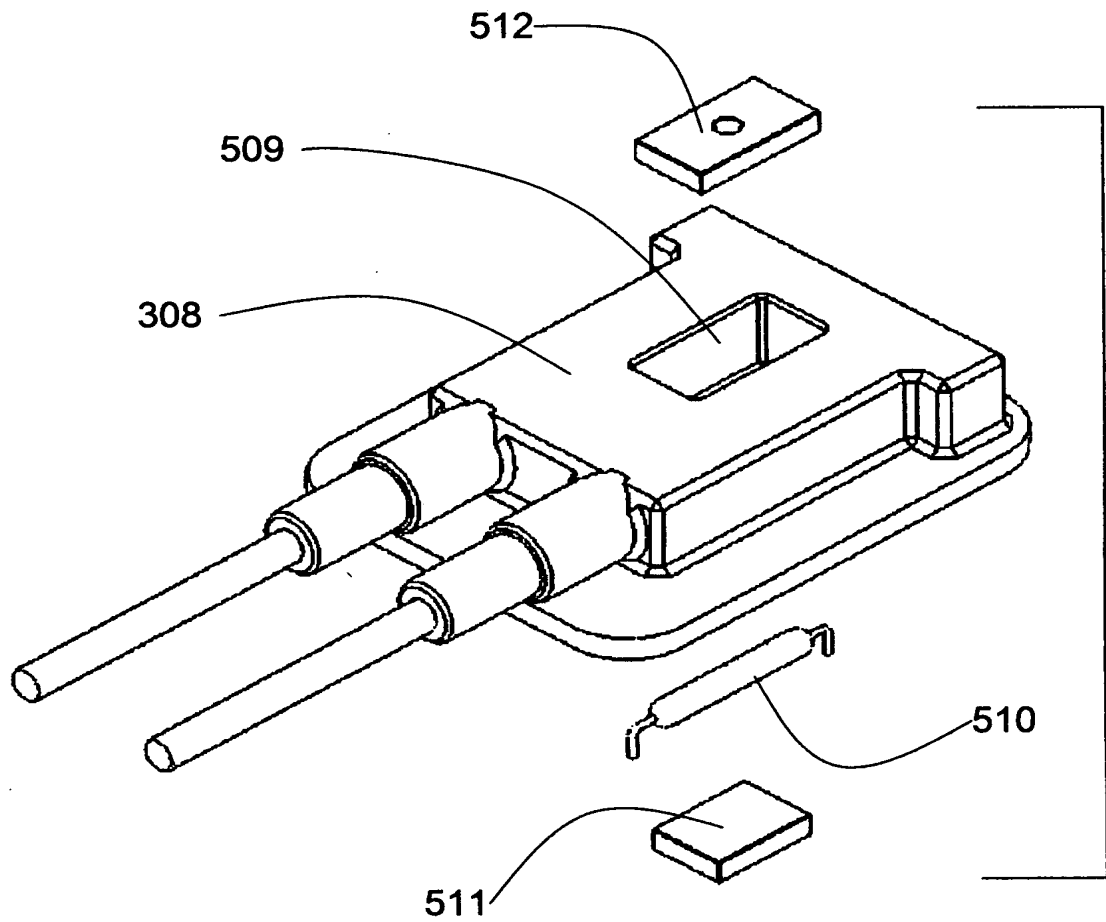


Fig. 5

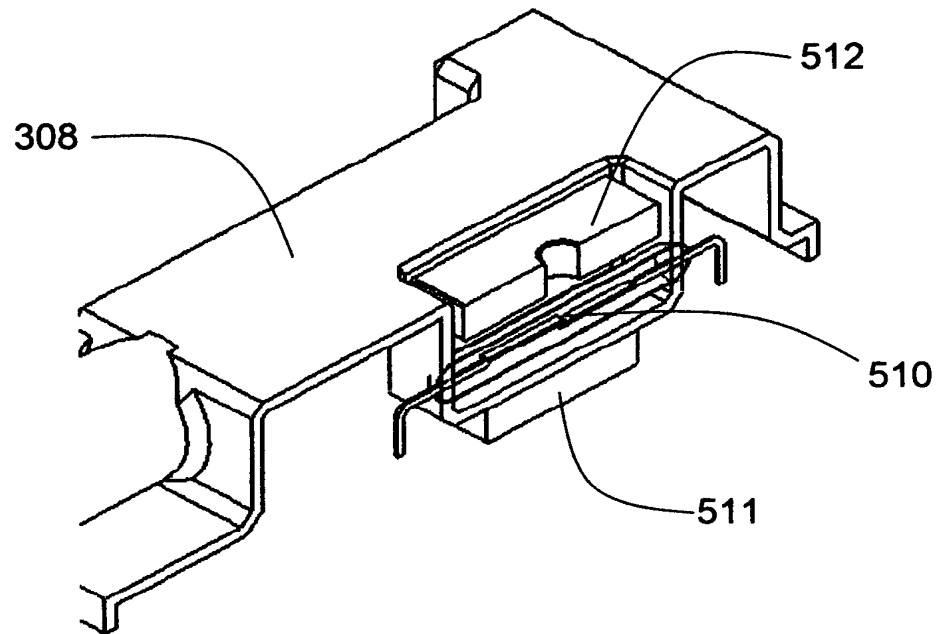


Fig. 6

7/7

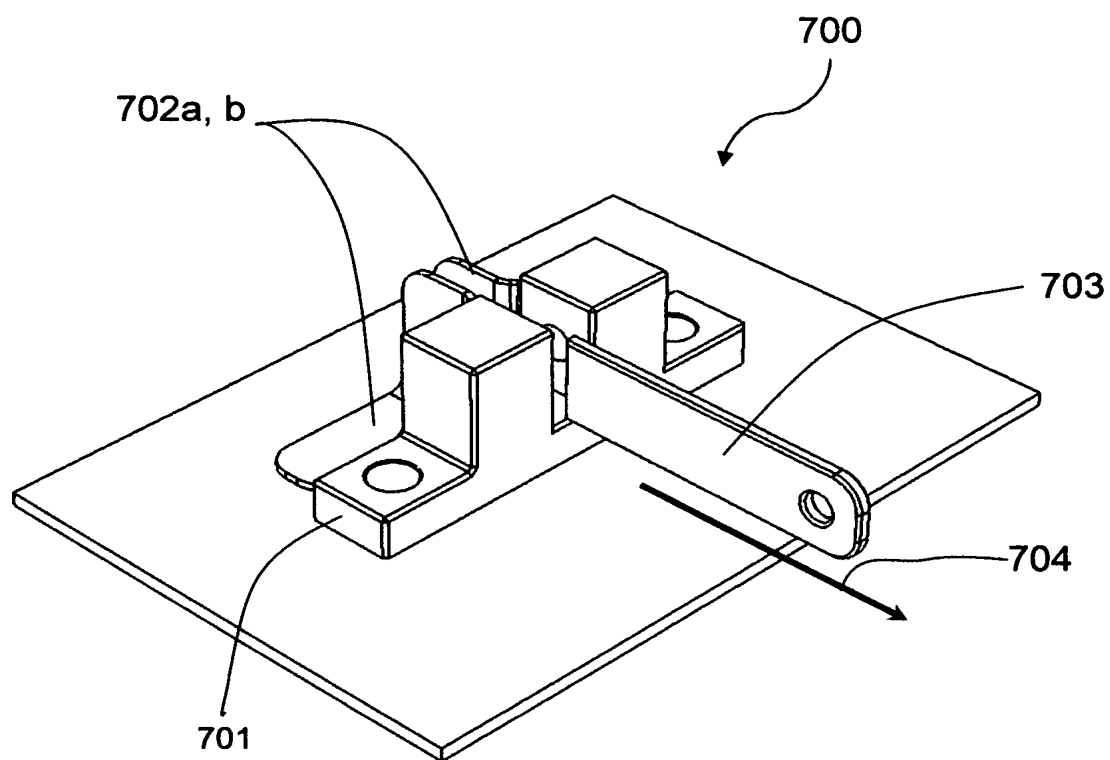


Fig 7

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(5/87)**