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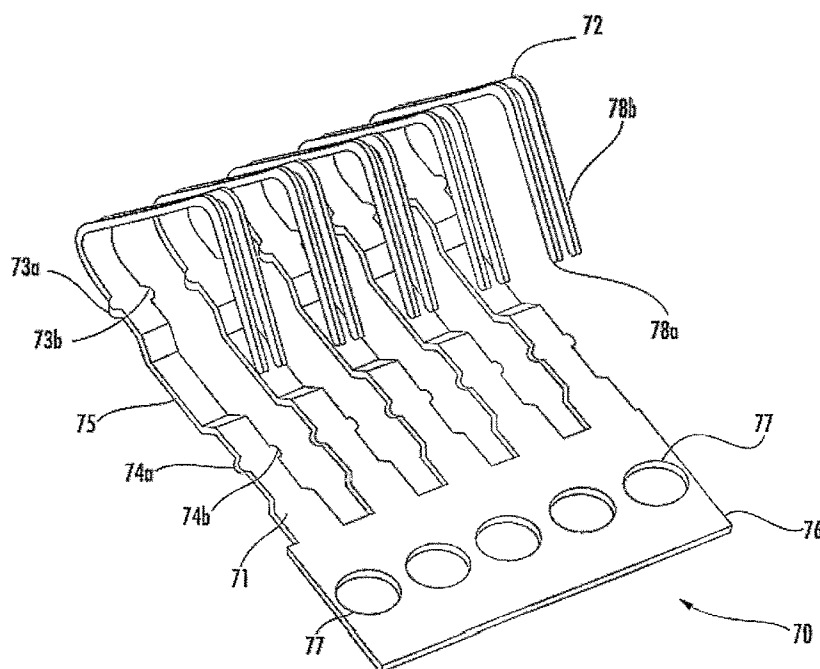
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(54) Title: CONNECTOR WITH BIFURCATED CONDUCTOR



(57) Abstract: A connector block (52) is provided with a plurality of channels (55). Separating the channels are ribs (59) and conductors (71) are mounted in the channels. The conductors each include a soldering region (75) for joining with a surface conductor and a contact region (72) for joining with conductors on a mating connector block. The contact region includes a conductor that is bifurcated. The rib positioned between adjacent channels acts as a shield and may extend below the soldering region of the conductors so as to prevent solder from adjacent conductors from inadvertently forming a short.

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## **CONNECTOR WITH BIFURCATED CONDUCTOR**

### **CROSS REFERENCE TO RELATED APPLICATIONS**

[001] This Non-Provisional Application claims benefit to a United States Provisional Application Serial No. 60/705,375 filed August 4, 2005; and to a United States Nonprovisional Application, Serial No. Pending filed July 28, 2006, titled "Connector With Bifurcated Conductor".

### **FIELD OF THE INVENTION**

[002] The present invention relates to the field of connectors and more particularly to the field of electrical connectors.

### **BACKGROUND OF THE INVENTION**

[003] A printed circuit board (PCB) is commonly used as a substrate for electrical circuitry. As is known, electrical components may be surface mounted on a PCB in a desired configuration and connected as desired with traces so as to provide the desired circuitry. The functionality of the circuitry can range from something relatively complex like a motherboard for a computer to a simple circuit that includes just one or two electrical components.

[004] In order to provide electrical communication between the circuitry on the PCB and other components not on the PCB, wires may be soldered to conductors provided on a surface of the PCB. However, another possible method of providing electrical communication with the circuitry on the PCB is to mount a connector on the PCB that is in electrical communication with the circuitry. Then, a mating connector can be attached to the mounted connector. This is helpful if multiple wires are to be attached to the circuitry on the PCB. For example, the mounted connector may include a number of conductors connected to circuitry on the PCB and these conductors may be coupled to other components (which may be external to the PCB) by simply installing the mating connector on the mounted connector. In other words, a number of conductors can be coupled together by performing one operation (joining two connectors together), and for example, the circuitry on two separate PCBs can be conveniently brought into electrical communication.

[005] While the use of mating connectors is known, certain problems can exist. When mounting a connector with a number of conductors on the PCB, the conductors in the

connector can be soldered to surface conductors on the PCB. If the conductors in the connector are soldered to the surface conductors on the PCB, it is possible that solder melted by the soldering action may inadvertently bridge two conductors that were not intended to be in electrical communication, potentially causing the circuitry or the connector (or both) to short out, possibly causing the entire circuitry to become waste. Furthermore, the respective conductors in the mating connector and mounted connector sometimes get damaged or have trouble forming a desirable electrical connection because one of the conductors in one of the connectors becomes contaminated by dirt or corrosion or other contaminants that prevent the conductors from the two connectors from forming the electrical connection. Furthermore, vibrations can cause the electrical connection between respective conductors in mating connectors to become intermittent, especially if one or both suffers from some degree of contamination. Therefore, improvements to known connectors would be beneficial.

#### **SUMMARY OF THE INVENTION**

[006] In an embodiment, a connector block is provided with a plurality of channels. Mounted in the channels are conductors. The conductors may each include a soldering region proximal a bottom of the connector block and a contact region proximal a top of the connector block. A rib positioned between adjacent channels acts as a shield and may extend below the soldering region of the conductors so as to prevent solder from adjacent conductors from inadvertently forming a short. An alignment feature may be used to align the connector block with a mounting surface.

[007] Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings in which like numerals are used to designate like features.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[008] Figure 1 is a schematic view of an embodiment of a mounted connector and a mating connector.

[009] Figure 2 is an isometric view of an embodiment of a connector.

[0010] Figure 3 is a plan view of an embodiment of a connector similar to the connector depicted in Figure 2.

[0011] Figure 4 is a front view of the connector of Figure 3, as viewed from line 4-4.

[0012] Figure 5 is a side view of the connector of Figure 3, as viewed from line 5-5.

[0013] Figure 6 is an isometric view of an embodiment of a set of stamped conductors mounted to a carrier strip.

[0014] Figure 7 is a cross section view of an embodiment of a stamped conductor.

#### **DETAILED DESCRIPTION OF THE EMBODIMENTS**

[0015] Printed circuit boards (PCB) are commonly used to package electrical circuitry and may be formed by a number of different processes. While other methods exist to provide circuitry and PCBs have certain developmental costs, PCBs have advantages with respect to reliability and piece cost and therefore are commonly used in conjunction with higher volume production. For example, a module, which provides some desired functionality, can be provided on a PCB and due to economics of scale, the module can be reproduced relatively inexpensively compared to other methods of providing the functionality of the module. As can be appreciated, the module can be sold as is or one or more modules may be mounted in a housing and sold as a product.

[0016] Sometimes a module may include a plurality of inputs and/or outputs. As can be appreciated, if a number of wires or conductors are needed in order to provide the needed input to and/or receive the desired output from the module, the cost of connecting each conductor can raise the price of the module substantially as well as reduce the overall reliability of the module; sometimes making the module less economically desirable. Therefore, a connector may be mounted to the module so as to provide a convenient method of coupling the module to other components. As the use of connectors on a module is a common design choice, an improved method of mounting a connector to a module may provide a substantial economic benefit. Furthermore, if it is desirable to automatically connect and disconnect to the circuitry provided by the module, it may be beneficial to have a single connector with a set of conductors so that a single operation can couple a set of conductors in a desired manner.

[0017] Looking at Figure 1, a schematic of a printed circuit assembly 10 is provided. As depicted, a connector 50 with a conductor set 60 is surface mounted to a PCB 20. The PCB 20, which is an example of a mounting surface, may be populated with one or more electrical components (not shown) such as resistors, capacitors, logic blocks and the like. The resultant circuitry can be as complex or as straightforward as is appropriate for the given purpose of the resultant module. In operation, a mating connector 90 can be coupled to the connector 50 so as to allow the module to receive the desired inputs and outputs.

[0018] It should be noted that in an embodiment where the connector 90 is automatically adjustable between an engaged position and a disengaged position, a signal passed through one or more of the conductors 60 of the connector 50 can cause the connector 90 to be moved to the disengaged position, as depicted in Figure 1. In such a system, an intermittent connection would be problematic because it is possible that the signal indicating the need for separation might not be delivered as intended.

[0019] Turning to Figures 2-5, various views are provided of embodiments of a connector that may be mounted to surface, such as the surface of a PCB. As depicted, the connector 50 includes the conductor set 60 mounted in a block 52. The block 52 includes a first side 53a, a second side 53b and a third side 53c. The third side 53a includes a plurality of channels 55 and is part of the perimeter 54. As can be appreciated, the perimeter 54 may be configured so that a corresponding shaped mating connector will only be able to engage the connector 50 in one orientation. To ease assembly of the mating connector, the corners of the perimeter 54 near the first side 53a may include a desired radius so as to improve ease of assembly.

[0020] Separating the channels 55 are ribs 59 that may be configured to act as shields. As depicted, a conductor 71 is positioned in each of the channels 55 and the conductors 71 extend above the first side 53a. In an embodiment the conductor 71 is shaped substantially as shown in Figure 7 and includes a contact region 72 and a soldering region 75. When the connector 50 is mounted to a surface, the soldering region 75 of the conductor 71 can be brought into contact with a solder pad on the surface and the conductor 71 may then be soldered in a known manner. In the embodiment, the soldering region 75 of the conductors 71 does not extend below the second side 53b and the ribs are substantially flush with the second side 53b. Thus, when the connector 50 is mounted to a surface, the ribs 59 are substantially flush with the surface. As can be appreciated, this allows the ribs 59 to act as shields when the soldering region 75 of the conductors 71 is soldered to a surface conductor, not shown, and helps prevent the melted solder from bridging adjacent conductors.

[0021] It should be noted that a conductor 71 need not be positioned in each channel 55. Furthermore, while the channels 55 are depicted as being substantially the same size, larger and smaller channels 55 (with respectively configured conductors 72) may also be used.

[0022] As seen in Figures 4 and 5, extending below the second side 53b is an alignment feature 56, which may be one or more pegs or some type of fastener that can extend through a hole in a PCB and helps ensure the connector 50 is properly aligned with the surface conductors and any associated soldering pads, if provided, on the mounting surface. It should be noted that if the alignment feature 56 is cylindrically shaped, two alignment features may be helpful to control the orientation of the connector 50. Alternatively, one non-symmetrical shaped alignment feature 56 may be sufficient to control the orientation of the connector 50. It should be noted that in an alternative embodiment, not shown, the alignment feature 56 may be a notch or recess in the block 52 that is configured to accept a member or mounting feature extending from the mounting surface.

[0023] As depicted in Figures 3-7, each conductor 71 includes a contact region 72 and each of the contact regions is bifurcated or split into a first conductor 78a and a second conductor 78b (Figure 4). For most common sized connectors 71, bifurcating the conductor 71 into two conductors 78a and 78b at the contact region 72 is sufficient. However, for larger or stiffer conductors 71 it may be desirable to split the conductor 71 into more than two conductors.

[0024] To hold the conductors 71 in the channels 55, a retaining feature such as ridges 73a-b and 74a-b may be provided (Figure 6). As depicted, the ridges 73a-b and 74a-b have rounded surfaces so that the conductors 71 are provided with an interference-fit with the channels 55 when installed but do not necessarily gouge or permanently disfigure the connector block 52. It should be noted that the interference fit may be as desired and may depend on the tolerances of the block 52, the channel 55 and the retaining features on the conductors 71, as well as the material properties of same.

[0025] Referring to Figure 6, while not required, to install the conductors 71, the set of conductors 60 may be formed of a single piece of material, which may be a metallic alloy such as steel or aluminum, though a known process such as stamping. The conductors 71 can be shaped through a stamping operation and can be transferred from station to station via a carrier strip 76 with one or more apertures 77 that can be used to help hold and align the carrier strip 76 (and the attached conductors). In an embodiment, the retaining features (such as ridges 73a-b which form a first retaining feature and ridges 74a-b which form a second retaining feature) may be situated in a linear manner with respect to the carrier strip 76 so that the carrier strip 76 and the retaining features form a plane. As can be appreciated, if the

retaining features are in line with the carrier strip 76, the carrier strip 76 may be secured and used to push the conductors 71 into the channels 55 with minimum bending forced exerted on the conductors 71. Therefore, it is possible to insert the conductors 71 into the channels 55 without significant deformation of the soldering region 75. It should be noted that as depicted, the soldering region 75 forms a plane substantially parallel to the plane defined by the carrier strip and the retaining features. This alignment, in combination with the rounded retaining features, also helps prevent deformation of the conductors while still provide the desired functionality of an interference fit that holds the conductors 71 in position.

[0026] Once the conductors are installed, the carrier strip 76 may be removed and the connector may be mounted to a surface. This can entail placing the soldering region 75 of the conductors 71 on solder pads (not shown) and providing heat energy to solder the soldering regions 75 of the conductors 71 to surface conductors provided on the surface.

[0027] Once a connector is mounted to the surface, a mating connector may then be installed on the mounted connector. In an embodiment, the contact region 72 of the conductors 71 of the mounted connector 50 may be somewhat deflected once a mating connector is installed. In an embodiment, the installation of a mating connector may cause the deflection of the conductors 71 to be elastic. As noted above, if the conductor 71 is bifurcated near the contact region 72, the split conductors 78a, 78b in the contact region 72 can provide additional security into the contact device. For example, vibration can potentially cause an intermittent connection between conductors. The use of the additional conductor (provided by the bifurcation of the conductor 71 near the contact region) preserves the strength of the conductor 71 while doubling the number of contact points and potentially reducing the likelihood of an intermittent connection.

[0028] Variations and modifications of the foregoing are within the scope of the present invention. It should be understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text and/or drawings. All of these different combinations constitute various alternative aspects of the present invention. The embodiments described herein explain the best modes known for practicing the invention and will enable others skilled in the art to utilize the invention. The claims are to be construed to include alternative embodiments to the extent permitted by the prior art.

[0029] Various features of the invention are set forth in the following claims.

## CLAIMS

### WHAT IS CLAIMED IS:

1. A connector for mounting to a surface, comprising:  
a block having a first side, a second side, a third side, a perimeter and a thickness;  
a plurality of channels extending into the third side of the block and spanning the thickness of the block between the first and second side, wherein each of the plurality of channels is separated from an adjacent channel by a rib; and  
a plurality of conductors positioned in the plurality of channels between the first and second sides, wherein each of the plurality of conductors includes a soldering region proximal the second side and a contact region that is closer to the first side than the soldering region, wherein the contact region is split into at least two separate conductors.
2. The connector of claim 1, further comprising an alignment feature for controlling, in operation, alignment of the block with the mounting surface.
3. The connector of claim 2, wherein the alignment feature comprises at least one peg extending from the second surface of the block.
4. The connector of claim 1, wherein the soldering region of the conductors is substantially linear and closer to the second side of the block than the remainder of the conductor.
5. The connector of claim 1, wherein the plurality of conductors each includes a first and second retaining feature configured to provide an interference fit between the conductors and an inner surface of the channel and the soldering region is positioned between first and second retaining feature.
6. The connector of claim 5, wherein the solder region is substantially linear and forms a first plane that is substantially parallel to a second plane formed by the first and second retaining feature.
7. The connector of claim 1, wherein the rib extends the thickness of the block and the soldering region of the conductors is positioned a distance from the second surface.

8. The connector of claim 1, wherein the plurality of channels is at least three channels and the plurality of conductors is at least three conductors and the contact region of each conductor is bifurcated into two separate conductors.

9. A method of providing a connector, comprising:

- (a) providing a block with at least two channels that open on a first, second and third side;
- (b) aligning a carrier strip that includes at least two stamped conductors with the at least two channels, each of the at least two stamped conductors including a soldering region between two retaining features and further including a bifurcated contact region;
- (c) inserting the at least two stamped conductors into the at least two channels, wherein the two retaining features are configured to provide an interference fit between the stamped conductors and the respective channels; and
- (d) removing the carrier strip.

10. The method of claim 9, wherein the providing the block in (a) further comprises:

- (i) shaping the at least two channels so that they extend a thickness of the block, whereby the channel opens to three sides of the block.

11. The method of claim 9, wherein the aligning in (b) comprises:

- (i) providing a plurality of locator holes in the carrier strip; and
- (ii) using the plurality of locator holes in the carrier strip to align the stamped conductors with the channels.

12. The method of claim 9, wherein the providing in (a) comprises:

- (i) providing an alignment feature on the block.

13. The method of claim 12, further comprising:

- (e) supporting the block on a mounting surface with at least two surface conductors; and

- (f) soldering the soldering region of the at least two conductors to the respective surface conductors.
14. The method of claim 13, wherein the soldering in (f) comprises:
- (i) aligning the soldering regions of the at least two conductors with respective solder pads provided on the mounting surface; and
  - (ii) heating the solder pads so as to cause the at least two soldering regions to form a bond with the respective at least two surface conductors, wherein a shield between two channels that are adjacent prevents the molten solder from adjacent bonding points from mixing.
15. The method of claim 13, wherein the supporting in (e) comprises:
- (i) using the alignment feature to fasten the block to the mounting surface.
16. A connector system, comprising:
- a mounting surface with two surface conductors;
  - a connector block having a first side and a second side, the first side supported by the mounting surface, the block including a first and second channel extending between the first and second side;
  - a first and second conductor positioned in the first and second channels, the first and second conductors each including a depression region soldered to the one of the two surface conductors and a bifurcated contact region extending from the second side of the block; and
  - a shield extending from the block and positioned between the soldered regions of the first and second conductors, wherein the shield is configured so that, during assembly, the shield prevents solder from the first conductor from mixing with solder from the second conductor during the soldering of the first and second conductors to the surface conductors.
17. The connector system of claim 16, wherein the connector block includes an alignment feature configured to orient the block with a corresponding alignment feature on the mounting surface.
18. The connector system of claim 16, wherein the mounting surface is a printed circuit board further comprising electrical components in communication with the surface conductors.

19. The connector system of claim 16, wherein connector block is configured to provide a shaped perimeter, whereby a mating connector can only be mounted to the connector block in one orientation.

20. The connector system of claim 16, wherein the mounting surface includes five surface connectors, the mounting block further includes a third, fourth and fifth channel and a third, fourth and fifth conductor are positioned in the respective channels, wherein each of the five conductors includes the features of the first and second conductor and a shield is provided between each adjacent channel.

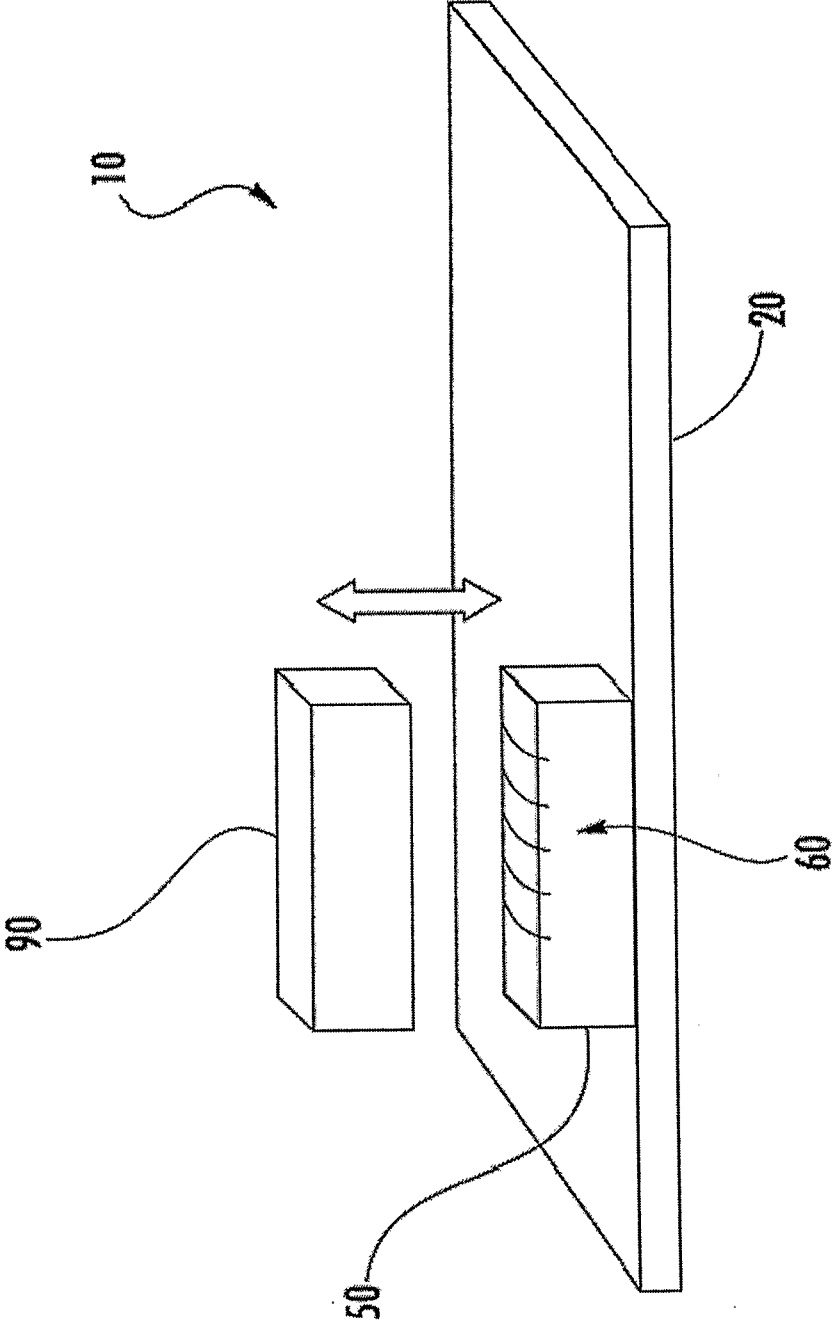


FIG. 1

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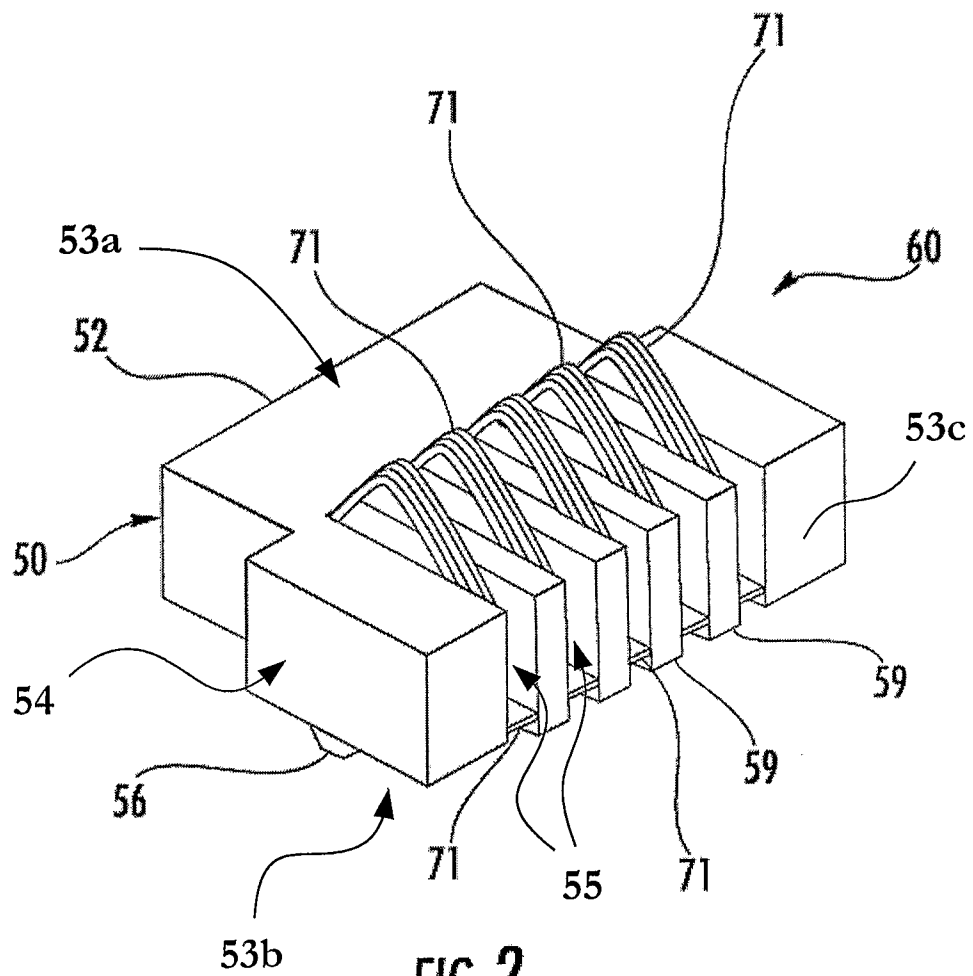
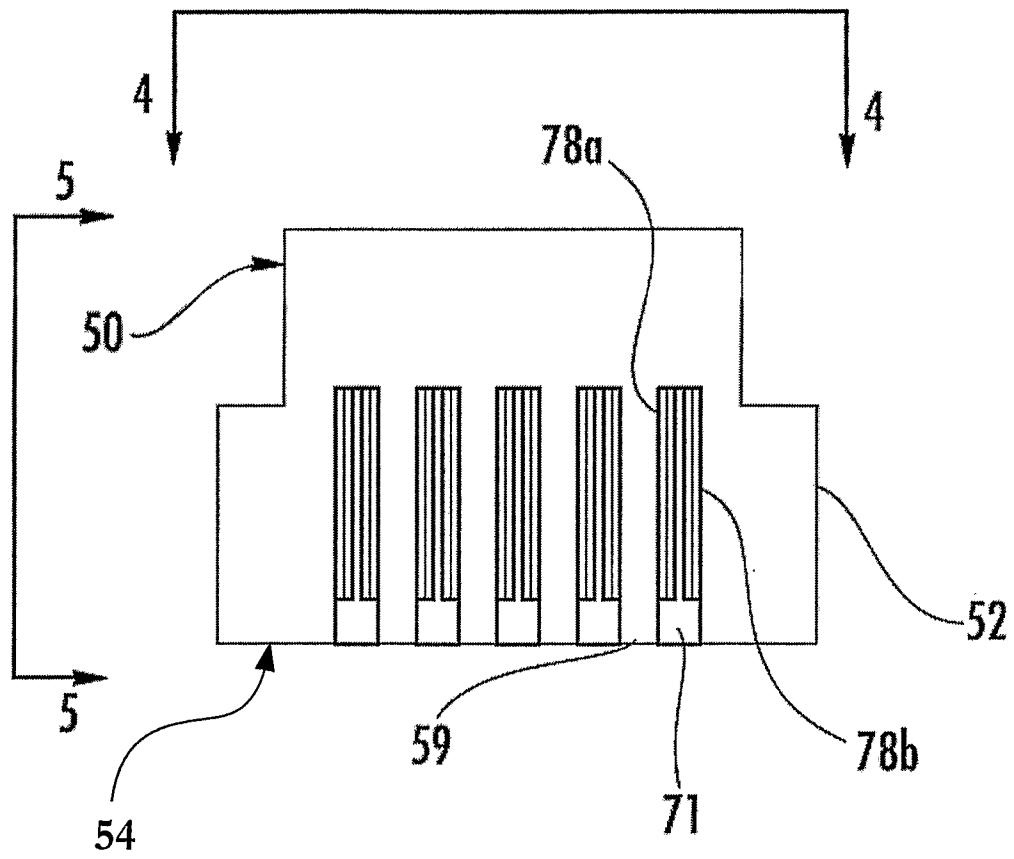


FIG. 2

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**FIG. 3**

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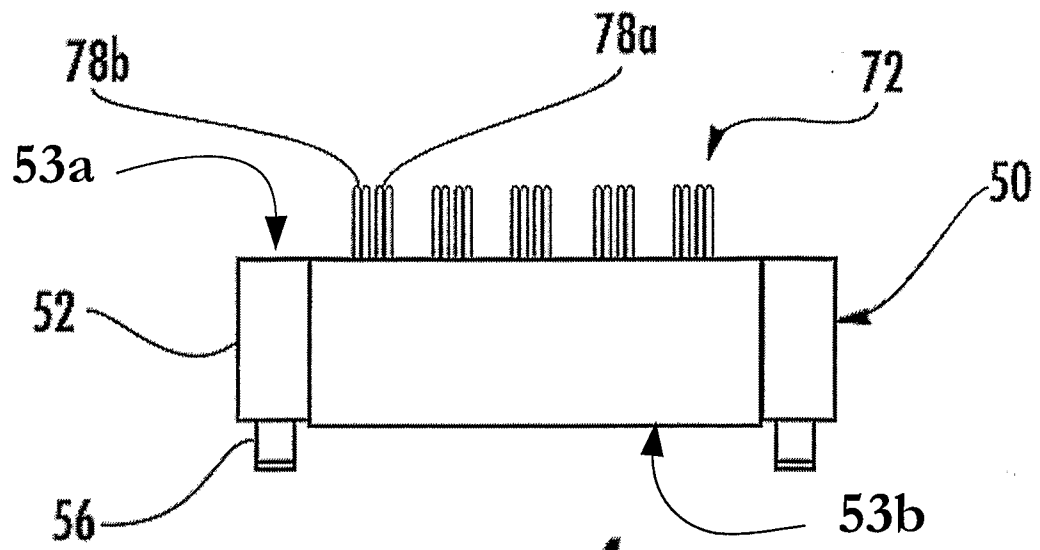


**FIG. 4**

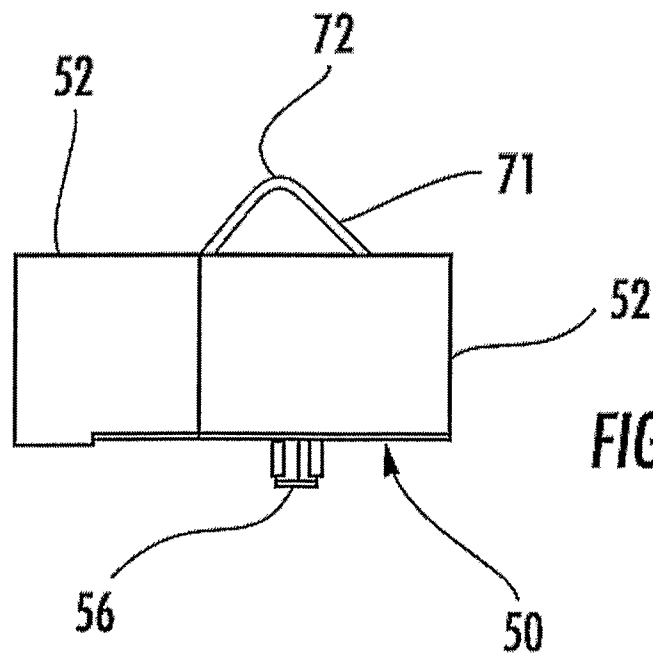
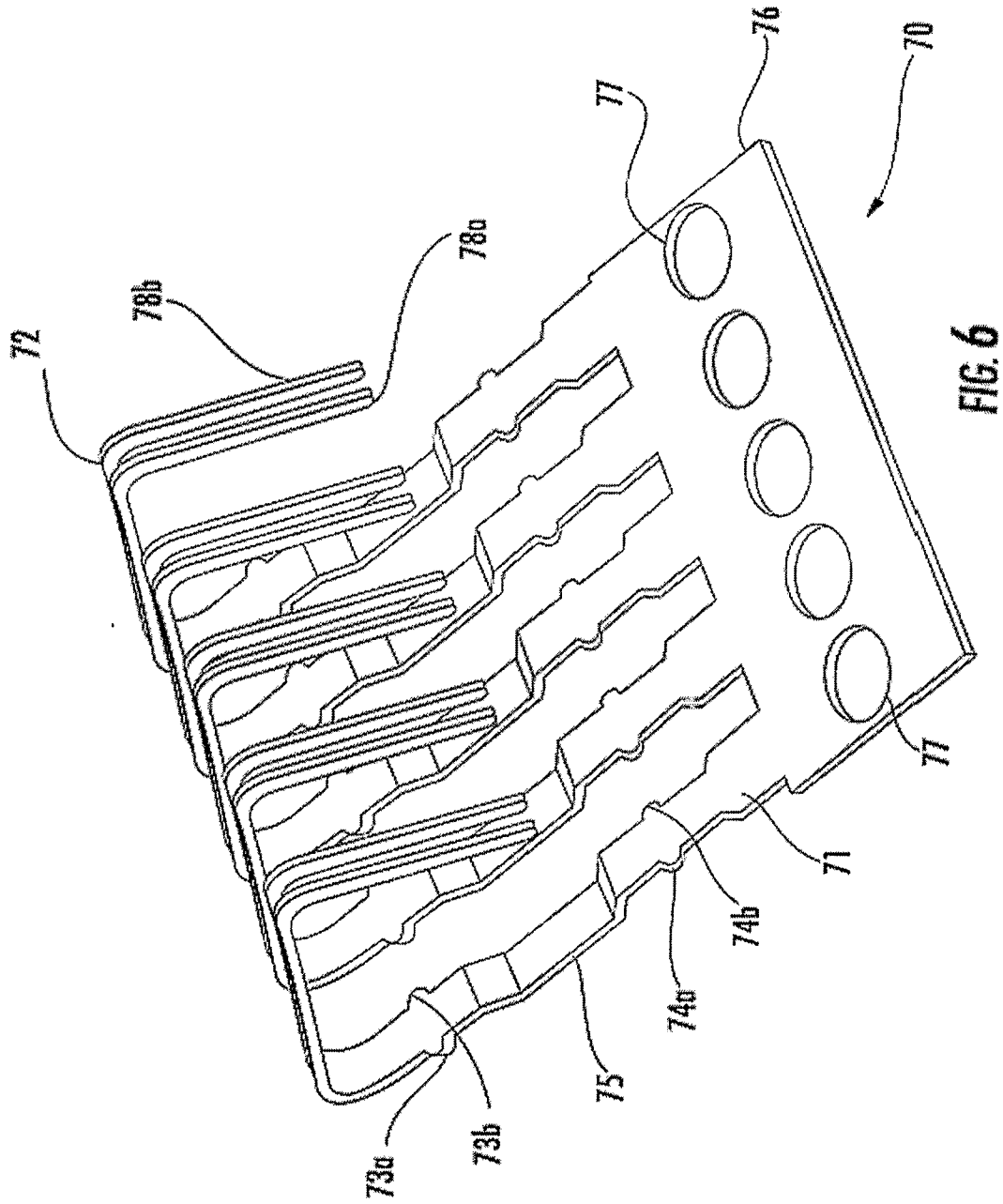


**FIG. 5**

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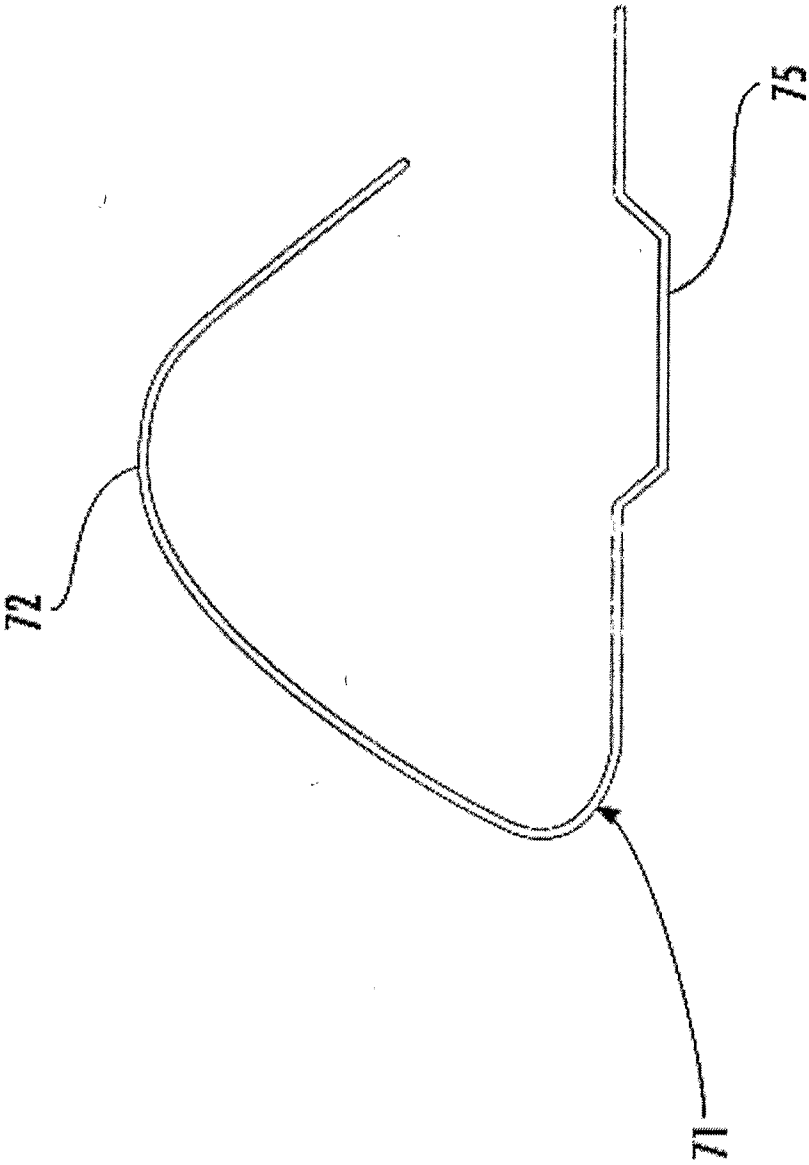


FIG. 7

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

|                                                      |                                                                                                  |                                                         |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Applicant's or agent's file reference<br>713-1442PCT | <b>FOR FURTHER ACTION</b><br>see Form PCT/ISA/220<br>as well as, where applicable, item 5 below. |                                                         |
| International application No.<br>PCT/US2006/029653   | International filing date (day/month/year)<br>31/07/2006                                         | (Earliest) Priority Date (day/month/year)<br>04/08/2005 |
| Applicant<br>ILLINOIS TOOL WORKS INC.                |                                                                                                  |                                                         |

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed  
☐ a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No. III)

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant  
☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☐ the text is approved as submitted by the applicant  
☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 6

- ☐ as suggested by the applicant  
☒ as selected by this Authority, because the applicant failed to suggest a figure  
☐ as selected by this Authority, because this figure better characterizes the invention

b. ☐ none of the figures is to be published with the abstract

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2006/029653

Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

A connector block (52) is provided with a plurality of channels (55). Separating the channels are ribs (59) and conductors (71) are mounted in the channels. The conductors each include a soldering region (75) for joining with a surface conductor and a contact region (72) for joining with conductors on a mating connector block. The contact region includes a conductor that is bifurcated. The rib positioned between adjacent channels acts as a shield and may extend below the soldering region of the conductors so as to prevent solder from adjacent conductors from inadvertently forming a short.

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2006/029653

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. H01R13/41

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
H01R G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                   | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------|-----------------------|
| X         | US 2002/098740 A1 (OOYA MASAOKI [JP])<br>25 July 2002 (2002-07-25)                                   | 1-4, 8,<br>16-20      |
| Y         | paragraph [0041]; figures 6, 7                                                                       | 5-7, 9-15             |
| Y         | EP 1 162 699 A (ITT MFG ENTERPRISES INC<br>[US]) 12 December 2001 (2001-12-12)<br>figures 11, 21, 23 | 5-7, 9-15             |
| A         | EP 1 065 754 A1 (MOLEX INC [US])<br>3 January 2001 (2001-01-03)<br>figure 2                          | 5, 9                  |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

## \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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.

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Date of the actual completion of the international search

30 November 2006

Date of mailing of the international search report

11/12/2006

Name and mailing address of the ISA/

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Authorized officer

Langbroek, Arjen

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/029653

| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
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