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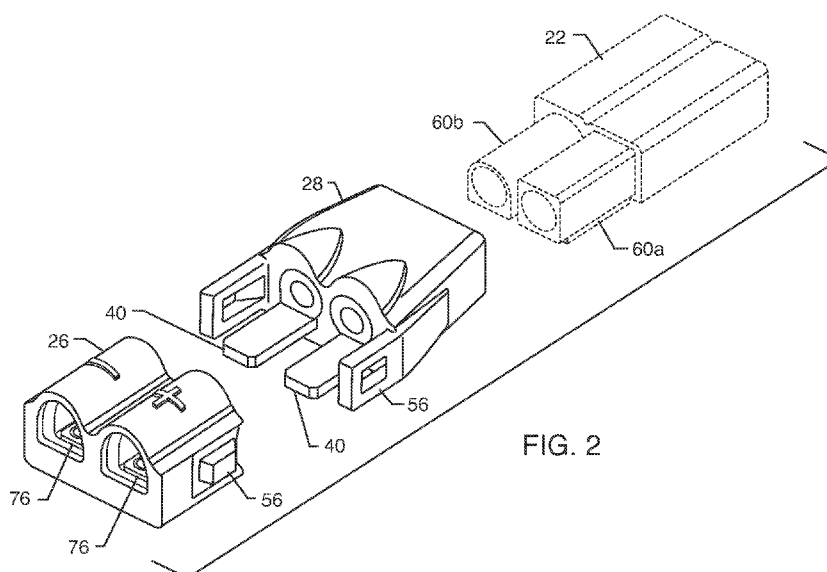


FIG. 2

(57) Abstract: A universal battery connector and system for R/C devices adaptable for use with different types of battery connection plugs. A battery and universal battery plug may be connected to either a Traxxas® or Molex® brand battery connection plug through the use of a specifically designed adaptor plug. The adaptor plug includes universal contacts for connection to a terminal on the universal battery plug. The adaptor plug also includes adaptor terminals configured for slide-fit reception of either a Traxxas® or Molex® brand battery connection plug.



## UNIVERSAL BATTERY CONNECTOR

### DESCRIPTION

#### BACKGROUND OF THE INVENTION

**[Para 1]** This invention relates generally to battery connectors for radio controlled (R/C) devices. More specifically, this invention relates to a universal battery connector for connection to multiple different battery connection plugs, i.e., Traxxas® or Molex® brand plugs.

**[Para 2]** The radio controlled hobby market is a popular and fast growing field. One problem that has arisen in the radio controlled hobby market is the existence of several competing battery plug types that are designed so as to not be interchangeable. What this means is that a battery configured with plug type A will only work on an R/C device that accepts plug type A. A battery with plug type B will only work on an R/C device that accepts plug type B. The plug types are not interchangeable such that if a hobbyist buys multiple R/C devices, the hobbyist may very well be required to buy multiple batteries of different plug types to work with each device.

**[Para 3]** For retail hobby and toy stores this lack of interchangeability creates a situation whereby they must carry the same battery pack but in two different plug types. In essence the batteries themselves are the same but the plug types on the batteries are different. Retailers who sell and support different brands of R/C

devices are forced to carry an excess of battery stock that would otherwise not be needed if plug types were interchangeable.

**[Para 4]** The present invention satisfies these needs and provides other related advantages.

## **SUMMARY OF THE INVENTION**

**[Para 5]** The present invention resides in a universal battery connector system for radio controlled devices. The system is adaptable for use with different types of battery connection plugs having different types of electrically conductive contacts. The system comprises a universal battery plug, a first adaptor, and a second adaptor. The first and second adaptors each include adaptor terminals configured for receipt of corresponding electrically conductive contacts on different types of battery connection plugs and universal contacts configured for connection to the universal battery plug.

**[Para 6]** The first adaptor is configured for conductively coupling the universal battery plug to electrically conductive contacts on a first battery connection plug. Preferably, the first adaptor is configured for slide fit reception with the first battery connection plug, which has two electrically conductive male contacts. Specifically, the first battery connection plug is a Traxxas® brand battery connection plug.

**[Para 7]** The second adaptor is configured for conductively coupling the universal battery plug to electrically conductive contacts on a second battery connection plug. Preferably, the second adaptor is configured for slide fit reception with the

second battery connection plug, which has two electrically conductive female contacts. Specifically, the second battery connection plug is a Molex® brand battery connection plug.

**[Para 8]** The system may also comprise a third adaptor configured for conductively coupling the universal battery plug to electrically conductive contacts on a third battery connection plug. The third adaptor includes adaptor terminals configured for receipt of the electrically conductive contacts and universal contacts configured for connection to the universal battery plug. The third battery connection plug is also configured for slide fit reception with the third battery connection plug, which has one electrically conductive male contact and one electrically conductive female contact.

**[Para 9]** The universal battery plug preferably comprises positive and negative universal terminals configured for connection to the universal contacts on the adaptors. The universal battery plug also includes battery contacts on the universal terminals. The battery contacts are configured to receive positive and negative battery terminals from a battery.

**[Para 10]** The adaptor terminals preferably comprise positive and negative adaptor terminals and the electrically conductive contacts preferably comprise positive and negative electrically conductive contacts. In this configuration, the positive and negative electrically conductive contacts are in electrical communication with the corresponding positive and negative adaptor terminals.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**[Para 11]** The accompanying drawings illustrate the invention. In such drawings:

**[Para 12]** FIGURE 1 illustrates a preferred embodiment of a universal battery connector of the present invention;

**[Para 13]** FIGURE 2 illustrates an exploded view of the universal battery connector in FIG. 1;

**[Para 14]** FIGURE 3 illustrates an exploded view of the universal battery plug from FIG. 1;

**[Para 15]** FIGURE 3A illustrates a cross-sectional view of the assembled universal battery plug taken along line 3A-3A of FIG. 3;

**[Para 16]** FIGURE 4 illustrates an exploded view of the adaptor plug from FIG. 1;

**[Para 17]** FIGURE 5 illustrates a view of the adaptor terminals on the adaptor plug of FIG. 1;

**[Para 18]** FIGURE 6 illustrates a view of the universal contacts on the adaptor plug of FIG. 1;

**[Para 19]** FIGURE 7 illustrates a side view of the adaptor plug of FIG. 1;

**[Para 20]** FIGURE 8 is a cross-section taken along line 8-8 of FIG. 6;

**[Para 21]** FIGURE 9 is a cross-section taken along line 9-9 of FIG. 6;

**[Para 22]** FIGURE 10 illustrates another embodiment of the universal battery connector of the present invention;

**[Para 23]** FIGURE 11 illustrates an exploded view of the universal battery connector of FIG. 10;

**[Para 24]** FIGURE 12 illustrates an exploded view of the adaptor plug of the universal battery connector in FIG. 10;

**[Para 25]** FIGURE 13 illustrates a view of the adaptor terminals of the adaptor plug of FIG. 10;

**[Para 26]** FIGURE 14 illustrates a view of the universal contacts of the adaptor plug of FIG. 10;

**[Para 27]** FIGURE 15 illustrates a side view of the adaptor plug of FIG. 10;

**[Para 28]** FIGURE 16 illustrates a cross-section along line 16-16 of FIG. 15;

**[Para 29]** FIGURE 17 illustrates a cross-section along line 17-17 of FIG. 15;

**[Para 30]** FIGURE 18 illustrates a cross-section along line 18-18 of FIG. 14;

**[Para 31]** FIGURE 19 illustrates various forms of battery connection plugs having various combinations of male and female electrically conductive contacts;

**[Para 32]** FIGURE 20 illustrates another embodiment of the universal battery connector of the present invention;

**[Para 33]** FIGURE 21 illustrates an exploded view of the universal battery connector of FIG. 20;

**[Para 34]** FIGURE 22 illustrates an exploded view of the adaptor plug from FIG. 20;

**[Para 35]** FIGURE 23 illustrates the universal contacts of the adaptor plug of FIG. 20;

**[Para 36]** FIGURE 24 illustrates a view of the adaptor terminals of the adaptor plug of FIG. 20;

**[Para 37]** FIGURE 25 illustrates a cross-section along line 25-25 of FIG. 21; and

**[Para 38]** FIGURE 26 illustrates a cross-section along line 26-26 of FIG. 21.

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

**[Para 39]** As shown in the drawings for purposes of illustration, the present invention is concerned with a universal battery connector for connection to multiple different battery connection plugs. The universal battery connector is generally designated in the accompanying drawings by the reference numeral 20.

**[Para 40]** In accordance with the present invention, and as shown in FIGS. 1 and 10, the universal battery connector 20 is configured for connection to multiple different battery connection plugs 22, 24. FIG. 1 illustrates the universal battery connection plug 20 coupled to a Molex® brand battery connection plug 22. FIG. 10 illustrates the universal battery connector 20 engaged with a Traxxas® brand battery connection plug 24. As discussed above, the Molex® brand battery connection plug 22 has a particular configuration that is incompatible with the Traxxas® brand battery connection plug 24. Accordingly, the present invention of a universal battery connector 20 was conceived so as to provide a battery 21 for an R/C device which is compatible with either a Molex® brand battery connection plug 22 or a Traxxas® brand battery connection plug 24.

**[Para 41]** FIGURES 1-9 illustrate the universal battery connector 20 which is compatible with a Molex® brand battery connection plug 22. In this embodiment, the universal battery connector 20 comprises a universal battery plug 26 and an adaptor plug 28. The universal battery plug 26 includes a housing which encloses a universal terminal 32. As illustrated in FIG. 3, the universal terminal 32

preferably comprises positive 32a and negative 32b terminals which are positioned within the housing 30. Biasing springs 34 are positioned beneath the universal terminals 32. The function of the biasing springs 34 will be described more fully below.

**[Para 42]** The adaptor plug 28 includes an adaptor housing 36 which encloses adaptor terminals 38. The adaptor terminals preferably comprise positive 38a and negative 38b terminals. Universal contacts 40 which preferably include positive 40a and negative 40b are partially enclosed by the housing 36. The universal contacts 40 are in physical contact with the adaptor terminals 38 such that there is electrical communication therebetween.

**[Para 43]** The adaptor housing 36 and universal battery plug housing 30 are configured for cooperative engagement. The universal contacts 40 are configured to engage slots 42 in the end of the universal battery plug housing 30. The slots 42 position the universal contacts 40 between the universal terminals 32 and the terminal springs 34. The slots 42 and the space between the universal terminals 32 and terminal springs 34 are illustrated more clearly in FIG. 3a. When a universal contact 40 enters the slot 42 the terminal spring 34 exerts a force which pushes the universal contact 40 into physical contact with the universal terminal 32. This physical contact results in electrical communication between the two elements.

**[Para 44]** FIGURES 4–9 detail the construction of the adaptor housing 36 and its related components. The adaptor terminals 38 have elongated bodies 44 with a mounting post 46 at one end thereof. The mounting posts 46 are positioned in



contact openings 48 on the adaptor housing 36 such that the elongated bodies 44 extend through a cavity 50 on the adaptor housing 36. The universal contacts 40 include mounting rings 52 which are configured to be positioned in the contact openings 48 and engage the mounting posts 46 on the adaptor terminals 38. The connection between the mounting rings 52 and mounting posts 46 may be secured by solder or any other common method of securing an electrical connection. The universal contacts 44 include contact legs 54 which are configured to engage slots 42 as described above.

**[Para 45]** The universal battery plug housing 30 and adaptor housing 36 include tab lock connectors 56 for securing the two housings together when they are cooperatively engaged. Other commonly used methods of securing two housings together may be utilized to achieve the same purpose.

**[Para 46]** The adaptor housing 36 further includes terminal openings 58 on a surface opposite from the contact openings 48. The terminal openings 58 are configured to receive electrically conductive contacts 60 from a Molex® brand battery connection plug 22. In a Molex® brand battery connection plug 22 the electrically conductive contacts 60 both have a female configuration one with a square cross-section 60a and the other with a semicircular cross-section 60b. The electrically conductive contacts fit into matching square 58a and semicircular 58b terminal openings on the adaptor housing 36. When the Molex® brand battery connection plug 22 is slide-fit into the adaptor housing 36 the female electrically conductive contacts 60 engage the mounting posts 46 on the male adaptor terminals 38. Because of the particular shapes of the electrically

conductive contacts 60 and terminal openings 58 one is assured of making the connection with the proper polarity.

**[Para 47]** FIGURES 10–18 illustrate an alternate embodiment of the universal battery connector 20 which is compatible with a Traxxas® brand battery connection plug 24. In this embodiment, the universal battery plug 26 is identical to that described above for the embodiment compatible with a Molex® brand battery connection plug 22. The difference in construction resides in the adaptor plug 28.

**[Para 48]** In this embodiment, as depicted in FIGS. 11–18, the adaptor plug 28 includes an adaptor housing 62 which encloses adaptor terminals 64 that have positive 64a and negative 64b terminals. Adaptor springs 66 are positioned above the adaptor terminals 64.

**[Para 49]** The adaptor terminals 64 are generally elongated bodies which pass through the adaptor housing from terminal openings 68 on one end to contact openings 70 on an opposite end. The adaptor terminals 64 extend through the contact openings 70 such that a portion of the adaptor terminals comprise universal contacts 72 which include positive 72a and negative 72b contacts. These universal contacts 72 engage the slots 42 on the universal battery plug 26 as with universal contacts 40 described above. The adaptor housing 62 includes mating tab lock connectors 56 to retain the adaptor plug 28 in cooperative engagement with the universal battery plug 26.

**[Para 50]** One face of the adaptor plug 28 includes terminal openings 68 which function in a manner similar to that described above for the terminal openings 58

of the prior embodiment. In the current embodiment, the terminal openings 68 comprise generally rectangular openings to accommodate the adaptor terminals 64. The terminal openings 68 have slightly varying sizes, i.e., wide 68a and narrow 68b, such that the Traxxas® brand battery connection plug 24 may only engage the adaptor plug 28 in one direction. The electrically conductive contacts 74 have slightly varying sizes, i.e., wide 74a and narrow 74b, to match the terminal openings 68. This assures that the correct polarity is achieved with each installation.

**[Para 51]** When the Traxxas® brand battery connection plug 24 is slide-fitted into the adapted plug 28, electrically conductive contacts 74 are positioned between the adaptor terminals 64 and the adaptor springs 66. The biasing action of the adaptor springs 66 forces the electrically conductive contacts 74 into physical contact with the adaptor terminals 64. In this way, electrical connection is achieved between the electrically conductive contacts 74 and the adaptor terminals 64.

**[Para 52]** Thus, a retail store need only carry one type of battery, the universal battery plug 26 and the two embodiments of the adaptor plug 28. Similarly, a consumer need only purchase one type of battery, the universal battery plug 26 and each type of adaptor plug 28. In this way, the battery may be connected to an R/C device regardless of whether it has a Molex® brand battery connection plug 22 or a Traxxas® brand battery connection plug 24. One need only switch the type of adaptor plug 28 which is used to accommodate either brand with a single battery and universal battery plug 26.

**[Para 53]** The universal battery plug 26 includes battery contacts 76 which are configured to receive positive and negative terminals from a battery (not shown). The battery contacts 76 are in electrical communication with the universal terminals 32 and are preferably part of the universal terminal 32.

**[Para 54]** In yet another alternate embodiment, the adaptor plug 28 may have terminal openings 58, 68 that can accommodate a combination of male and female electrically conductive contacts 60 on a battery connection plug 22, 24. As illustrated in FIG. 19, it is contemplated that alternate forms of the battery connection plugs 22, 24 can be presented with a combination of male and female electrically conductive contacts 60. To accommodate these combinations of male and female electrically conductive contacts 60 the adaptor plug 28 accordingly has combinations of terminal openings 58, 68 and adaptor terminals 38, 64 to accommodate the appropriate male and female electrically conductive contacts 60. A person of ordinary skill in the art will understand the appropriate combinations of universal contacts 40, adaptor terminals 38, 64 and terminal openings 58, 68 to be compatible with the combination male and female electrically conductive contacts 60.

**[Para 55]** FIGURES 20–26 illustrate an alternate embodiment of the present invention. In this embodiment, the adaptor plug 28 comprises adaptor housing 80 and universal contacts 82. The universal contacts include positive 82a and negative 82b contacts. The adaptor housing 80 also includes tab lock connectors 56. As with prior embodiments, the adaptor housing 80 is configured to engage

the universal battery plug 26 through mated engagement of the universal contacts 82 with the slots 42 on the universal battery plug 26.

**[Para 56]** The universal contacts 82 are one end of elongated members 83 which include adaptor terminals 84 at an opposite second end thereof. One of the elongated members 83 includes a stepped offset 86 such that the universal contact 82b is positioned at a different height from the corresponding adaptor terminal 84b. The other elongated member 83 has a rotated offset 88 such that the universal contact 82a is oriented in a plane having an orthogonal relationship to the plane of the corresponding adaptor terminal 84a. The universal contacts 82 extend through contact openings 90 in the adaptor housing 80. The adaptor terminals 84 extend through a cavity 92 in the adaptor housing 80 and are disposed proximate to terminal openings 94 in the adaptor housing 80. The terminal openings 94 have corresponding vertical 94a and horizontal 94b configurations to match with the orientations of the adaptor terminals 84a and 84b.

**[Para 57]** This embodiment of the adaptor plug 28 is configured to engage a battery connection plug 96 as described in U.S. Patent No. 5,533,915 (Deans). The Deans battery connection plug 96 has two electrically conductive contacts 98. One of these contacts 98a has a vertical orientation, whereas the other of these contacts 98b has a horizontal orientation. Both of these contacts 98 have a male configuration. The contacts 98 engage the terminal openings 94 on the face of the adaptor housing 80. These electrically conductive contacts 98 include biasing springs 100 to assure that the contacts 98 come into electrical contact with the

adaptor terminals 84 upon insertion into the terminal openings 94. The vertical 98a and horizontal 98b orientations of the contacts 98 are configured to match the vertical 94a and horizontal 94b orientations of the terminal openings 94 on the adaptor housing 80.

**[Para 58]** Although several embodiments have been described in detail for purposes of illustration, various modifications may be made without departing from the scope and spirit of the invention. Accordingly, the invention is not to be limited, except as by the appended claims.

**What is claimed is:**

**[Claim 1]** A universal battery connector system for radio controlled devices, adaptable for use with different types of battery connection plugs having electrically conductive contacts, comprising:

- a universal battery plug;
- a first adaptor configured for conductively coupling the universal battery plug to electrically conductive contacts on a first battery connection plug;
- a second adaptor configured for conductively coupling the universal battery plug to electrically conductive contacts on a second battery connection plug; and
- the first and second adaptors each including adaptor terminals configured for receipt of the corresponding electrically conductive contacts and universal contacts configured for connection to the universal battery plug.

**[Claim 2]** The system of claim 1, wherein the first adaptor is configured for slide fit reception with the first battery connection plug, the first battery connection plug having two electrically conductive male contacts.

**[Claim 3]** The system of claim 2, wherein the first battery connection plug is a Traxxas® brand battery connection plug.

**[Claim 4]** The system of claim 1, wherein the second adaptor is configured for slide fit reception with the second battery connection plug, the second battery

connection plug having two electrically conductive female contacts.

**[Claim 5]** The system of claim 4, wherein the second battery connection plug is a Molex® brand battery connection plug.

**[Claim 6]** The system of claim 1, further comprising a third adaptor configured for conductively coupling the universal battery plug to electrically conductive contacts on a third battery connection plug, the third adaptor including adaptor terminals configured for receipt of the electrically conductive contacts and universal contacts configured for connection to the universal battery plug, and the third battery connection plug configured for slide fit reception with the third battery connection plug, the third battery connection plug having one electrically conductive male contact and one electrically conductive female contact.

**[Claim 7]** The system of claim 1, wherein the universal battery plug comprises positive and negative universal terminals configured for connection to the universal contacts on the first and second adaptors.

**[Claim 8]** The system of claim 7, wherein the universal battery plug includes battery contacts on the universal terminals, wherein the battery contacts are configured to receive positive and negative battery terminals from a battery.



**[Claim 9]** The system of claim 1, wherein the adaptor terminals comprise positive and negative adaptor terminals and the electrically conductive contacts comprise positive and negative electrically conductive contacts, such that the positive and negative electrically conductive contacts are in electrical communication with the corresponding positive and negative adaptor terminals.

**[Claim 10]** A universal battery connector system for radio controlled devices, adaptable for use with different types of battery connection plugs having electrically conductive contacts, comprising:

- a universal battery plug;
- a first adaptor configured for conductively coupling the universal battery plug to two electrically conductive male contacts on a first battery connection plug, the first adaptor further configured for slide fit reception with the first battery connection plug;
- a second adaptor configured for conductively coupling the universal battery plug to two electrically conductive female contacts on a second battery connection plug, the second adaptor further configured for slide fit reception with the second battery connection plug; and
- the first and second adaptors each including adaptor terminals configured for receipt of the corresponding electrically conductive male or female contacts and universal contacts configured for connection to the universal battery plug.

**[Claim 11]** The system of claim 10, wherein the first battery connection plug is a Traxxas® brand battery connection plug.

**[Claim 12]** The system of claim 10, wherein the second battery connection plug is a Molex® brand battery connection plug.

**[Claim 13]** The system of claim 10, further comprising a third adaptor configured for conductively coupling the universal battery plug to electrically conductive contacts on a third battery connection plug, the third battery connection plug having one electrically conductive male contact and one electrically conductive female contact, the third adaptor including adaptor terminals configured for receipt of the electrically conductive male and female contacts and universal contacts configured for connection to the universal battery plug, and the third battery connection plug further configured for slide fit reception with the third battery connection plug.

**[Claim 14]** The system of claim 10, wherein the universal battery plug comprises positive and negative universal terminals configured for connection to the universal contacts on the first and second adaptors.

**[Claim 15]** The system of claim 14, wherein the universal battery plug includes battery contacts on the universal terminals, wherein the battery contacts are configured to receive positive and negative battery terminals from a battery.

**[Claim 16]** The system of claim 10, wherein the adaptor terminals comprise positive and negative adaptor terminals and the electrically conductive contacts comprise positive and negative electrically conductive contacts, such that the positive and negative electrically conductive contacts are in electrical communication with the corresponding positive and negative adaptor terminals.

**[Claim 17]** A universal battery connector system for radio controlled devices, adaptable for use with different types of battery connection plugs having electrically conductive contacts, comprising:

a universal battery plug;

a first adaptor configured for conductively coupling the universal battery plug to two electrically conductive male contacts on a Traxxas® brand battery connection plug, the first adaptor further configured for slide fit reception with the Traxxas® brand battery connection plug;

a second adaptor configured for conductively coupling the universal battery plug to two electrically conductive female contacts on a Molex® brand battery connection plug, the second adaptor further configured for slide fit reception with the Molex® brand battery connection plug; and

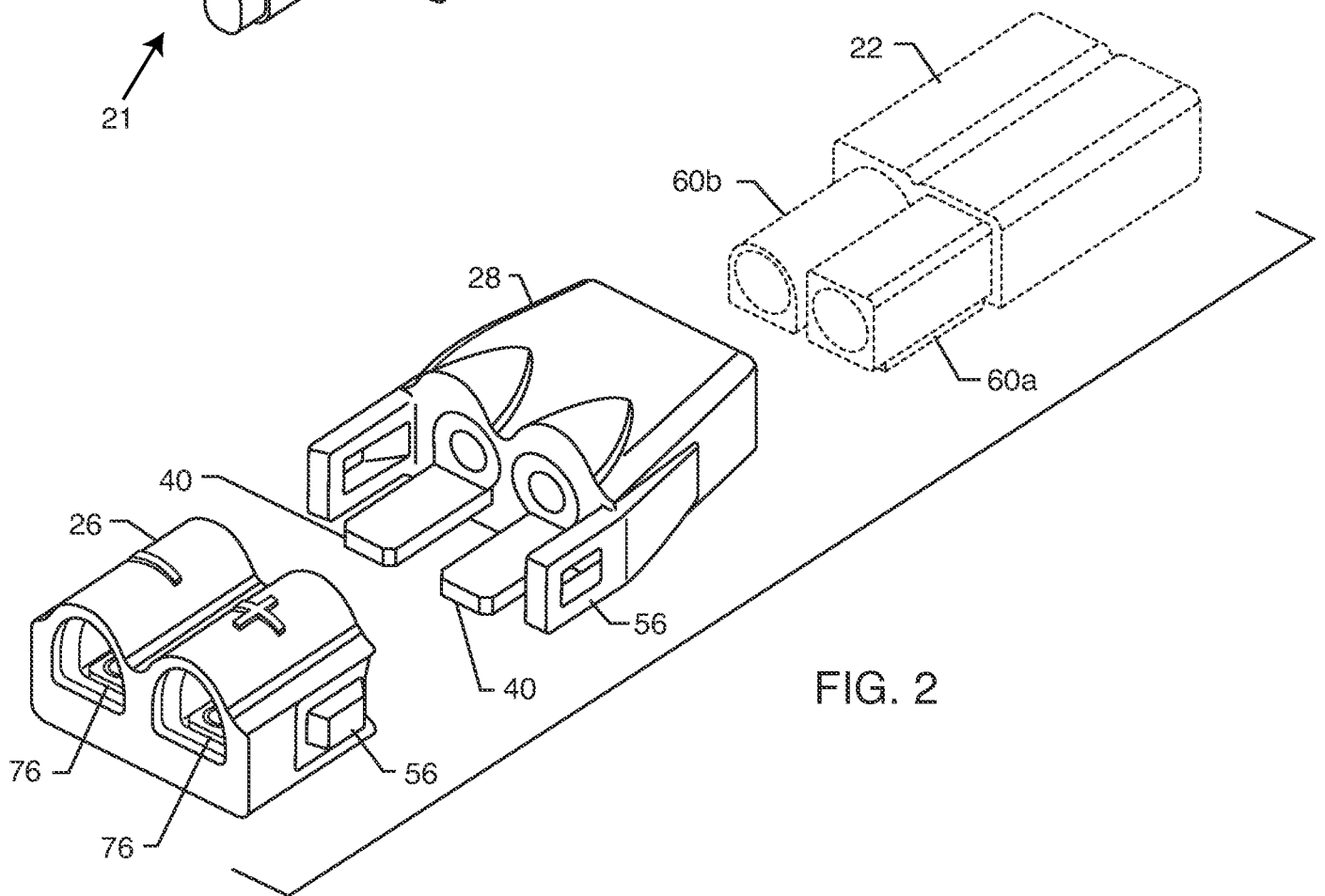
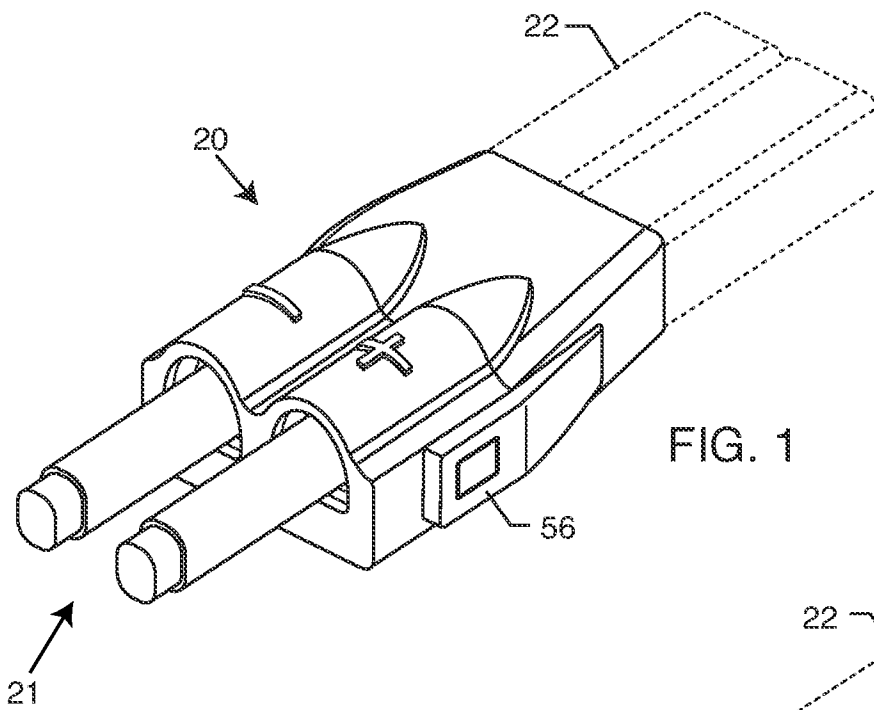
the first and second adaptors each including adaptor terminals configured for receipt of the corresponding electrically conductive male or female contacts and universal contacts configured for connection to the universal battery plug.

**[Claim 18]** The system of claim 17, further comprising a third adaptor configured for conductively coupling the universal battery plug to electrically conductive contacts on a third battery connection plug, the third battery connection plug having one electrically conductive male contact and one electrically conductive female contact, the third adaptor including adaptor terminals configured for receipt of the electrically conductive male and female contacts and universal contacts configured for connection to the universal battery plug, and the third battery connection plug further configured for slide fit reception with the third battery connection plug.

**[Claim 19]** The system of claim 17, wherein the universal battery plug comprises positive and negative universal terminals configured for connection to the universal contacts on the first and second adaptors, and the universal battery plug includes battery contacts on the universal terminals, wherein the battery contacts are configured to receive positive and negative battery terminals from a battery.

**[Claim 20]** The system of claim 17, wherein the adaptor terminals comprise positive and negative adaptor terminals and the electrically conductive contacts comprise positive and negative electrically conductive contacts, such that the positive and negative electrically conductive contacts are in electrical communication with the corresponding positive and negative adaptor terminals.

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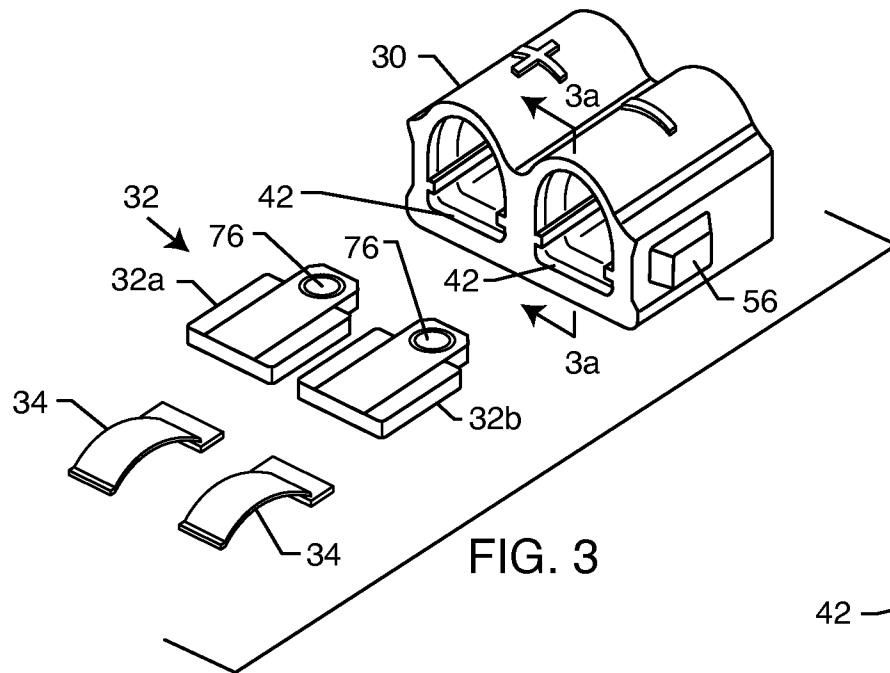


FIG. 3

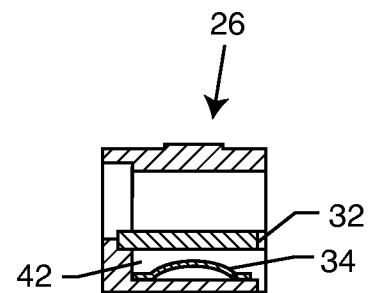


FIG. 3A

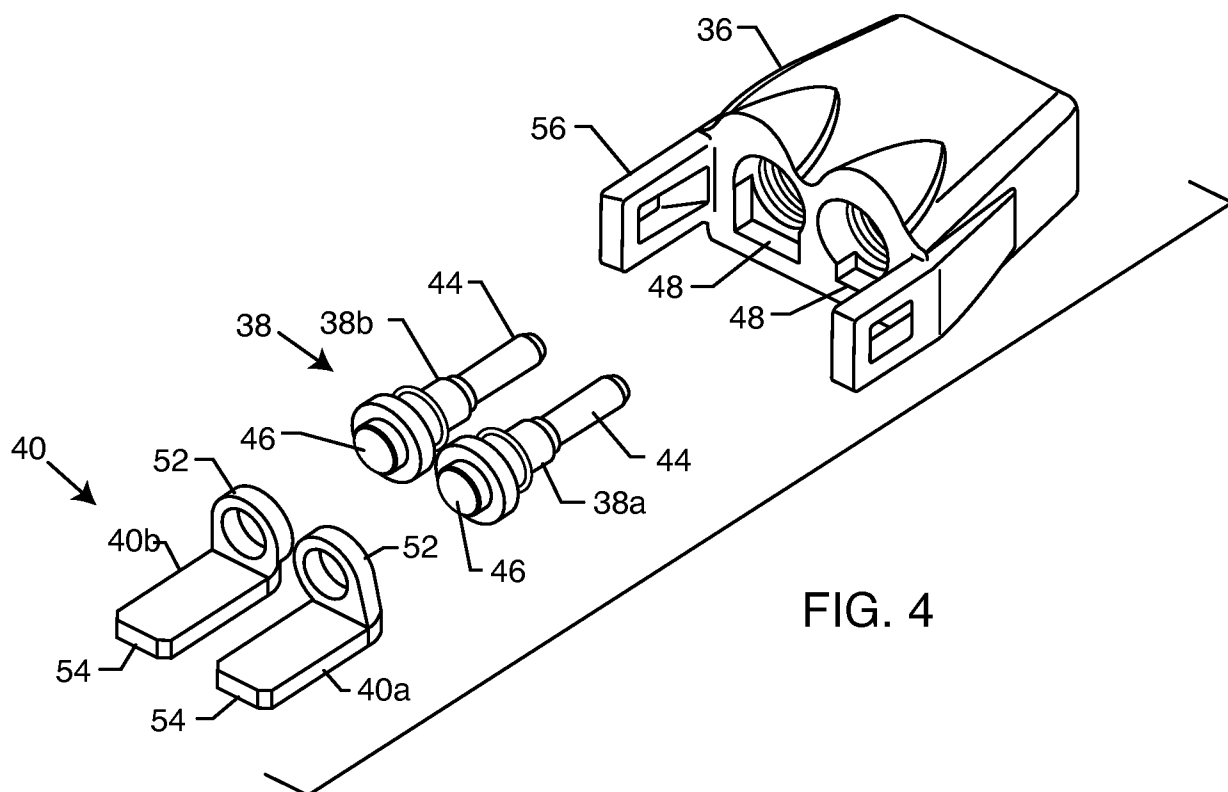


FIG. 4

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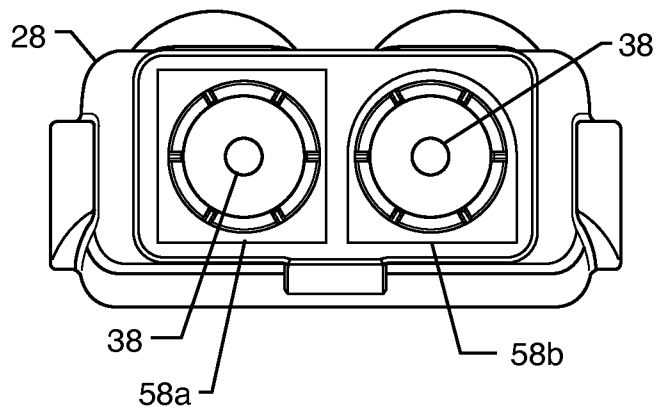


FIG. 5

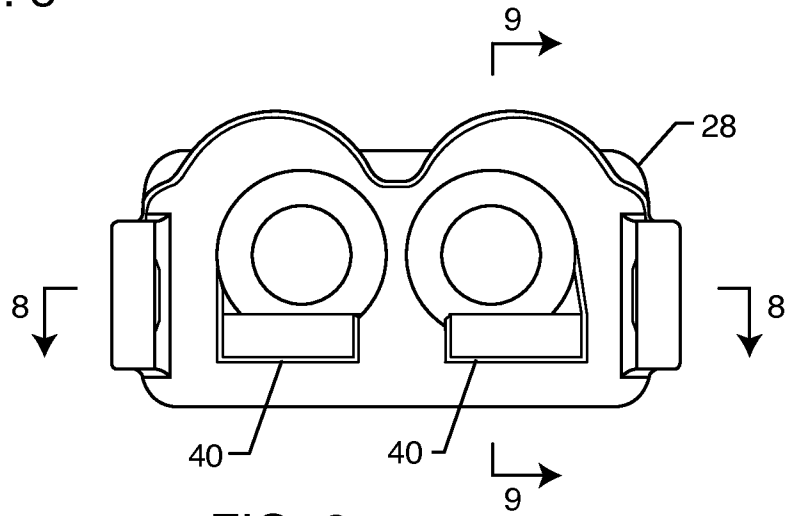


FIG. 6

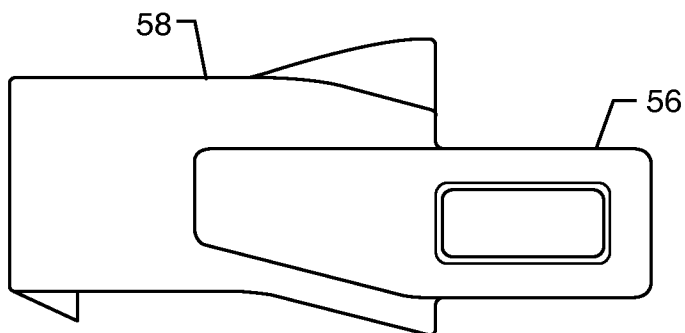


FIG. 7

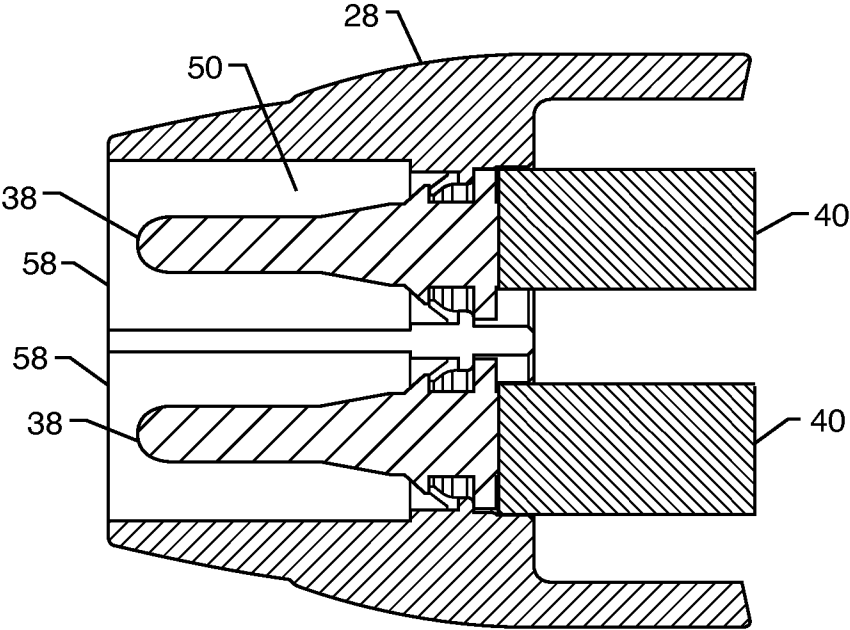


FIG. 8

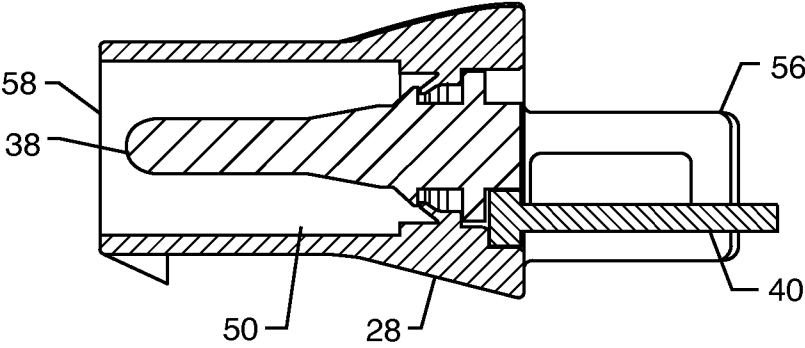


FIG. 9



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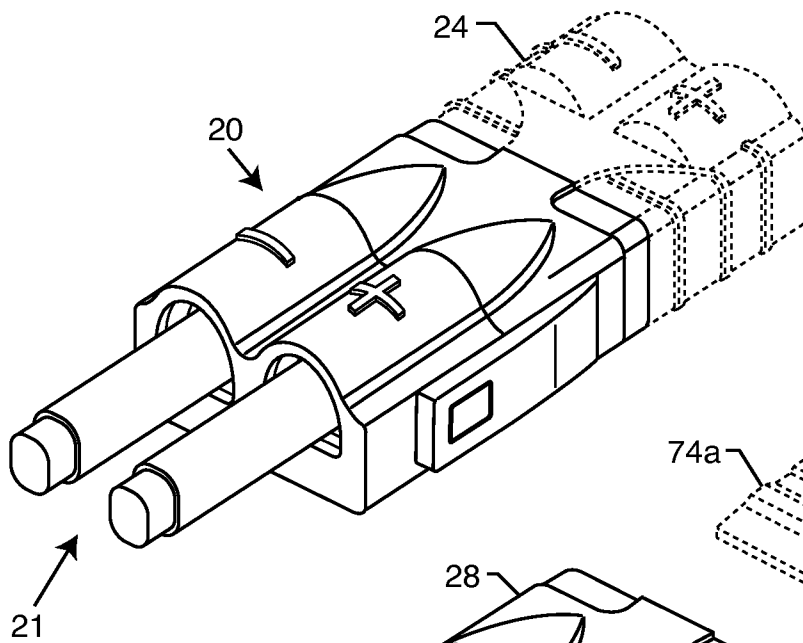


FIG. 10

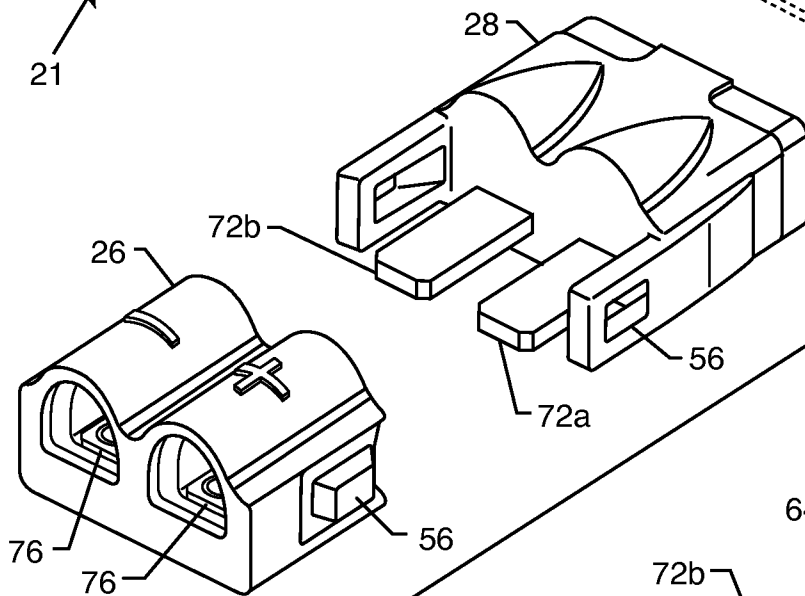


FIG. 11

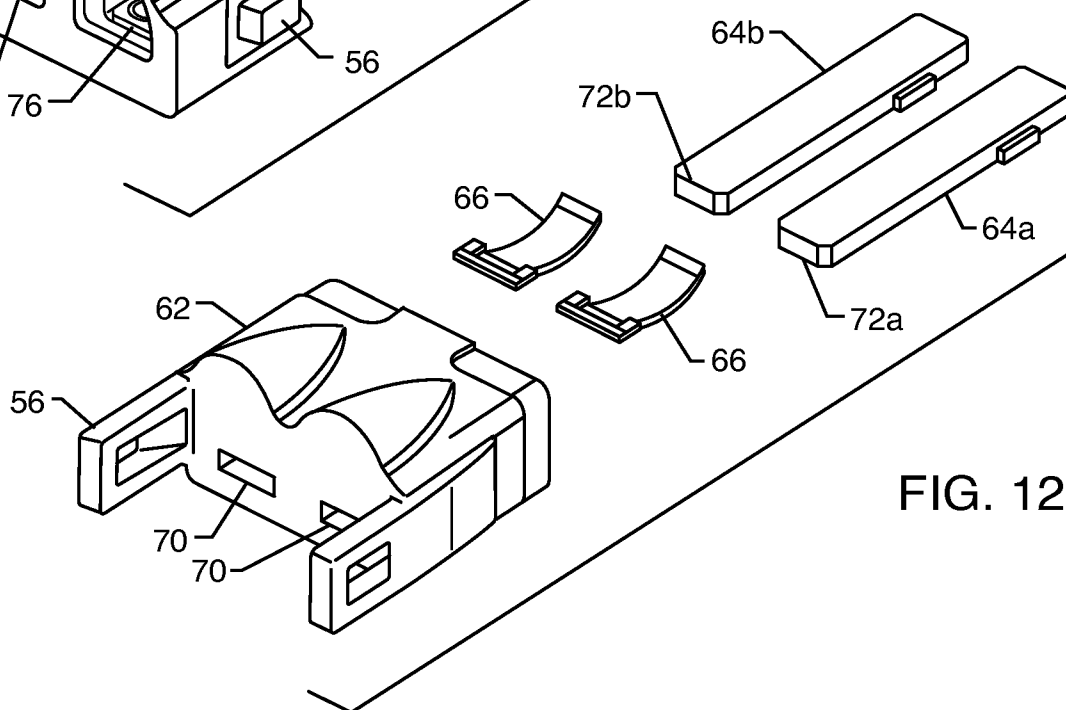


FIG. 12

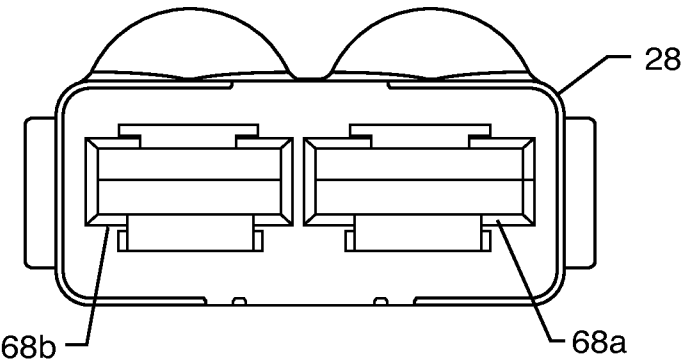


FIG. 13

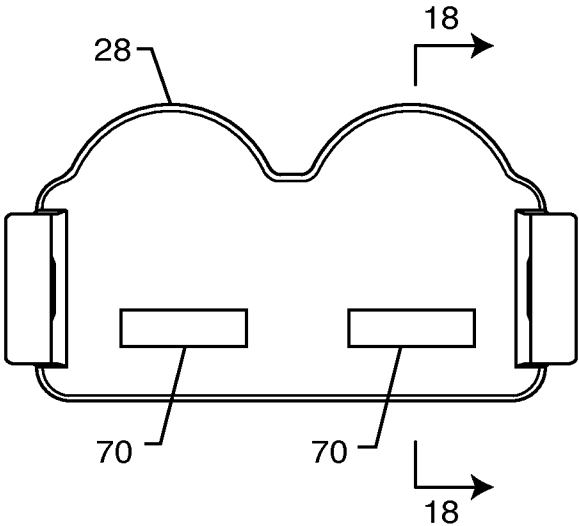


FIG. 14

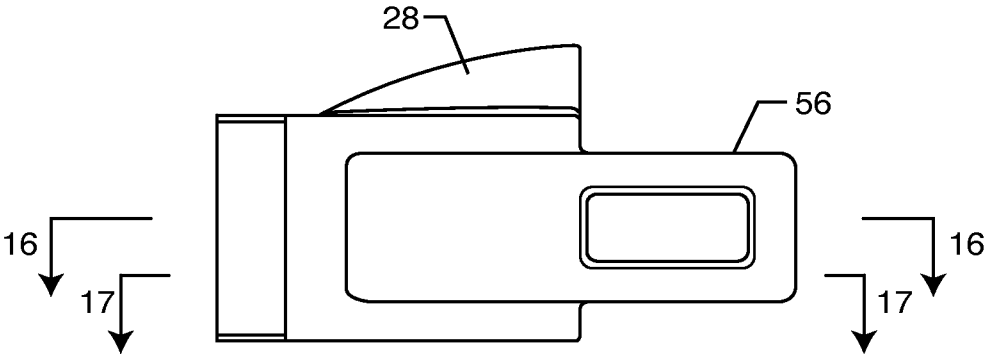


FIG. 15

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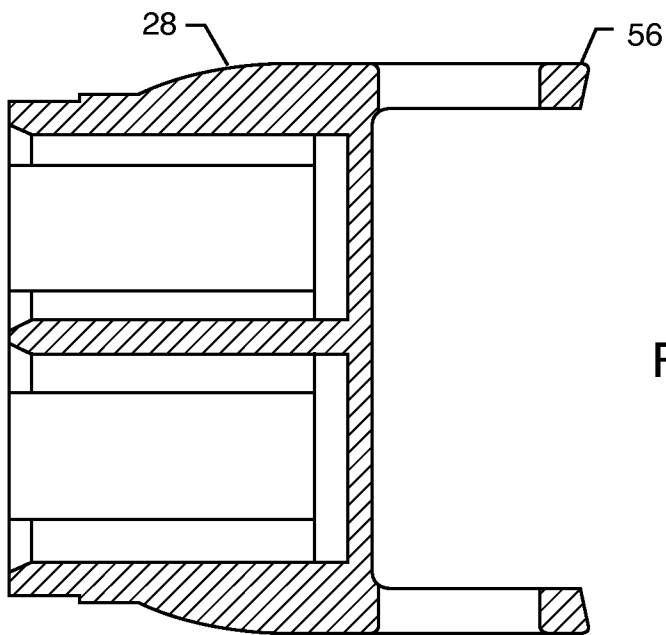


FIG. 16

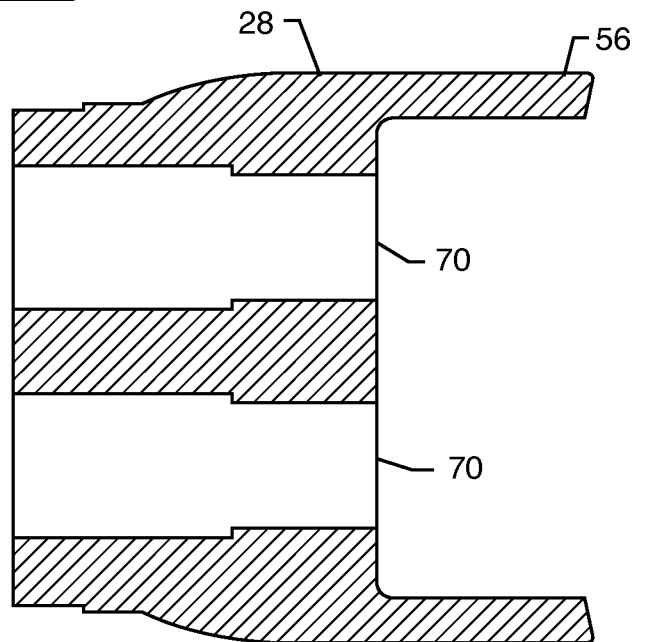


FIG. 17

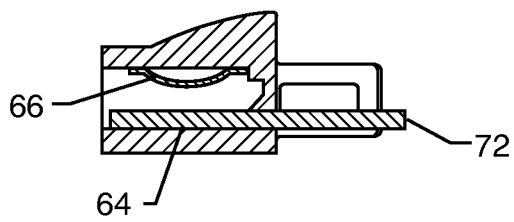


FIG. 18

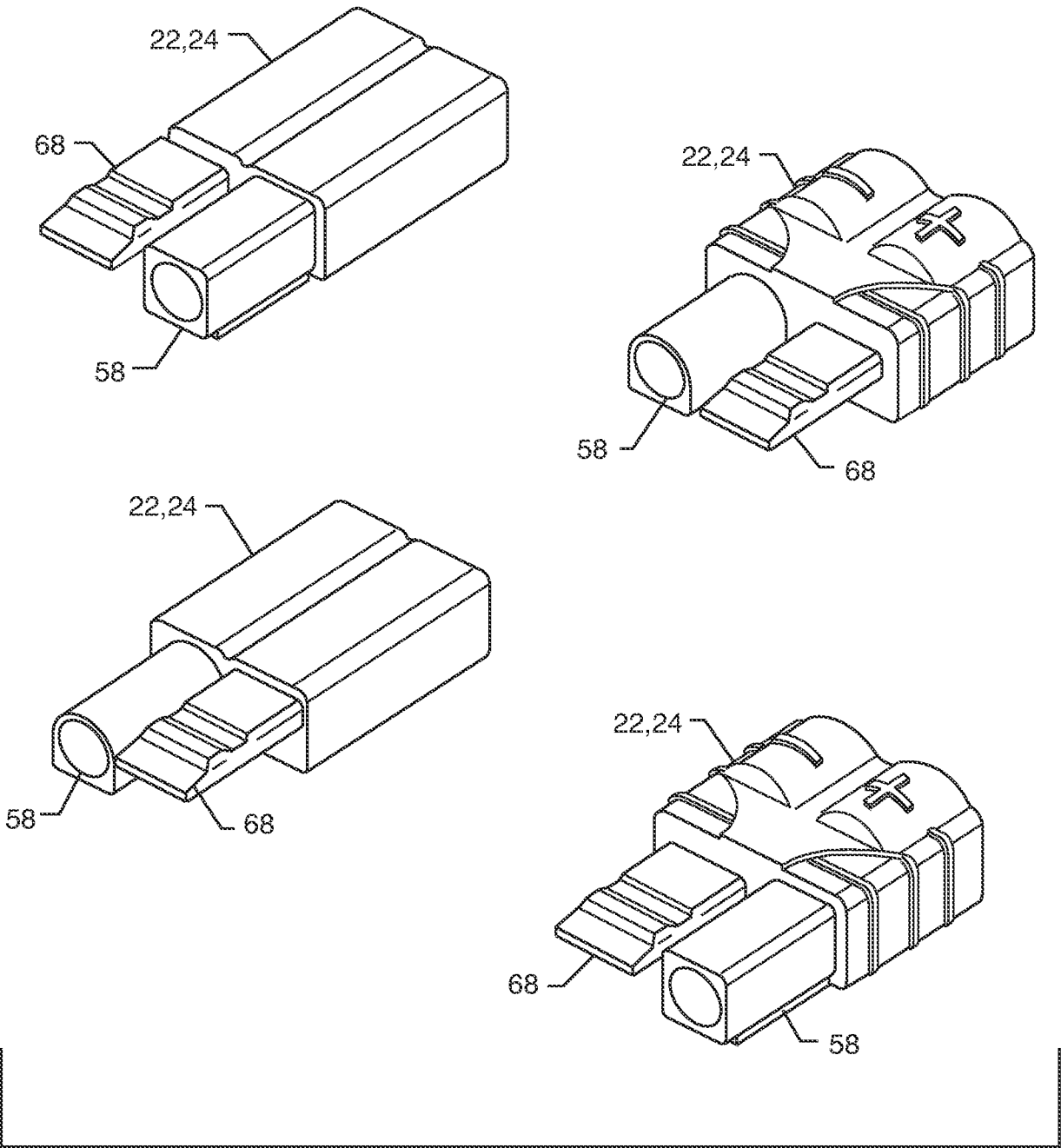
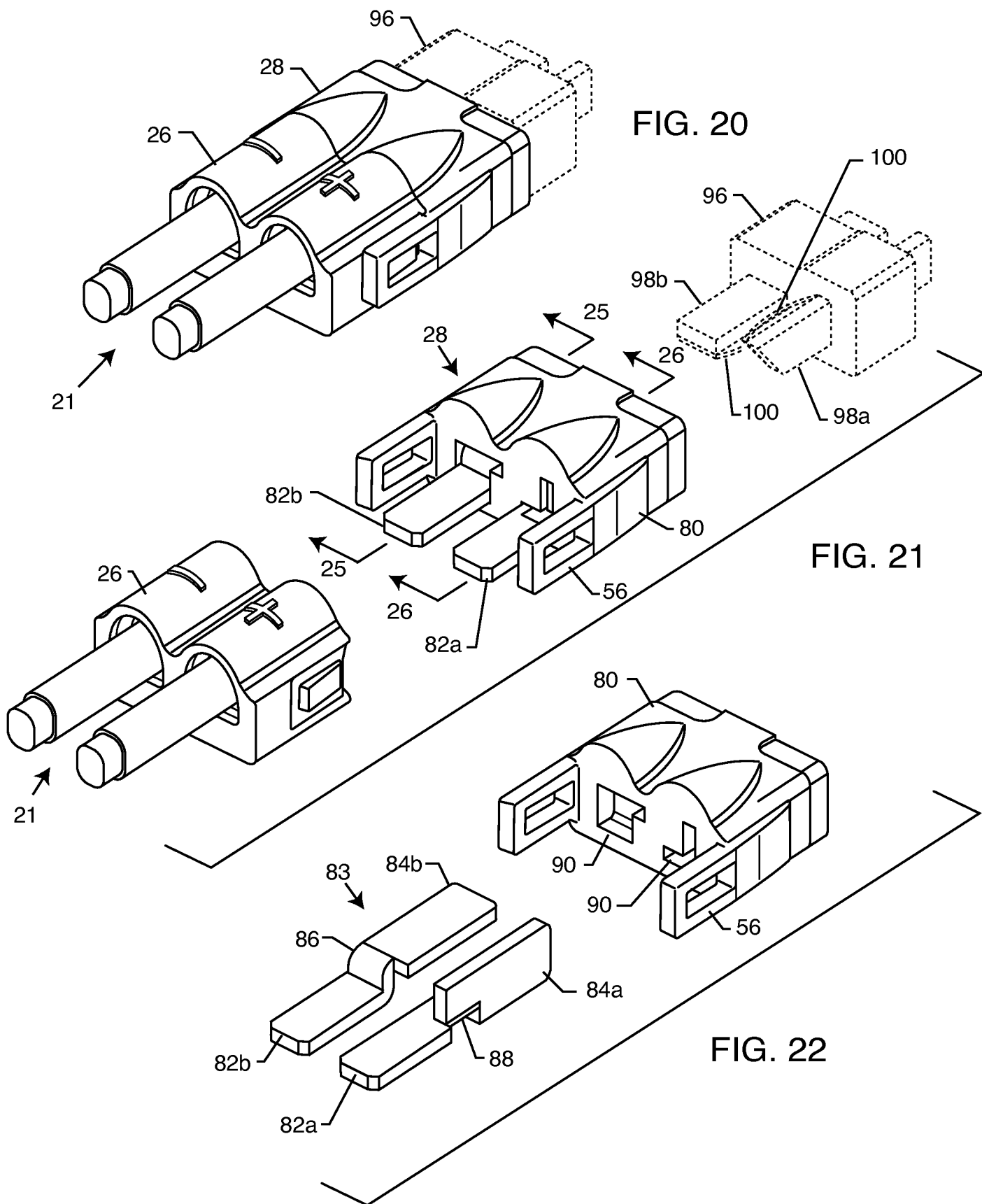


FIG. 19



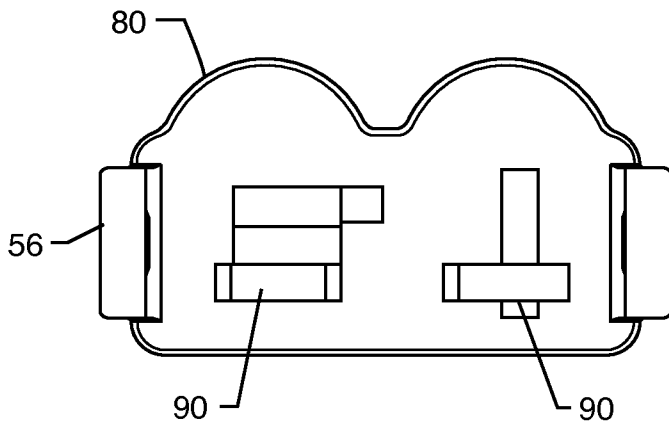


FIG. 23

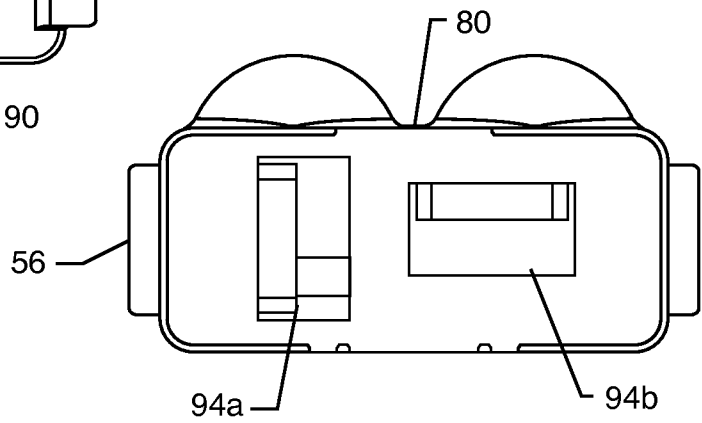


FIG. 24

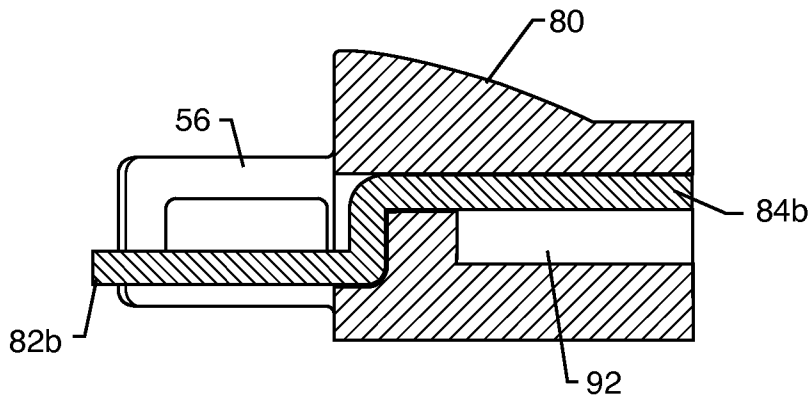


FIG. 25

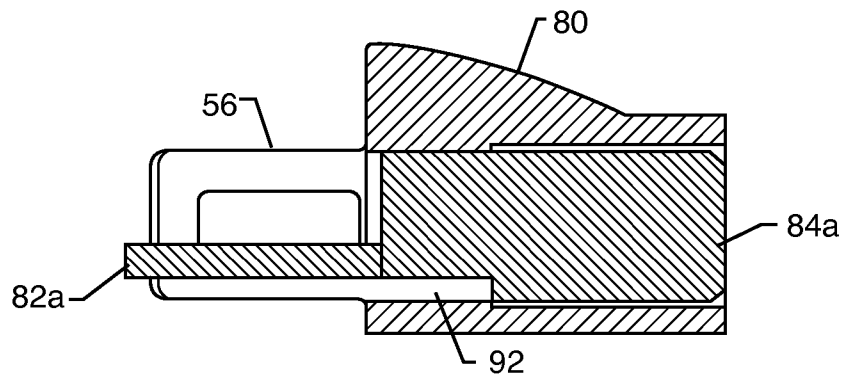


FIG. 26

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/20721

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01R 11/26 (2010.01)

USPC - 439/755

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)

USPC - 439/755

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
USPC - 439/755, 759, 760, 765; 320/108, 110 (text search)

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

PubWest (PGPB, USPT, EPAB, JPAB), Google,

Search terms used: universal, batter, adaptor, adapter, Traxxas, Molex, plug, slid, fit, positive, negative, terminal, female, charger, charger, battery

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,161,990 A (Ling et al.) 10 November 1992 (10.11.1992), Fig. 1, col. 2, ln. 53-57, col. 3, ln. 57-64, col. 4, ln. 51-67, col. 5, ln. 13-30, col. 6, ln. 64	1, 2, 4-10, 12-16 ----- 3, 11, 17-20
Y	US 2006/0178085 A1 (Sotereanos et al.) 10 August 2006 (10.08.2006), para [0019], [0040]	3, 11, 17-20
A	US 5,783,927 A (Chen) 21 July 1998 (21.07.1998), entire document	1-20
A	US 6,137,280 A (Ackermann et al.) 24 October 2000 (24.10.2004), entire document	1-20

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

\* Special categories of cited documents:

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

"E" earlier application or patent but published on or after the international filing date

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

18 February 2010 (18.02.2010)

Date of mailing of the international search report

02 MAR 2010

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