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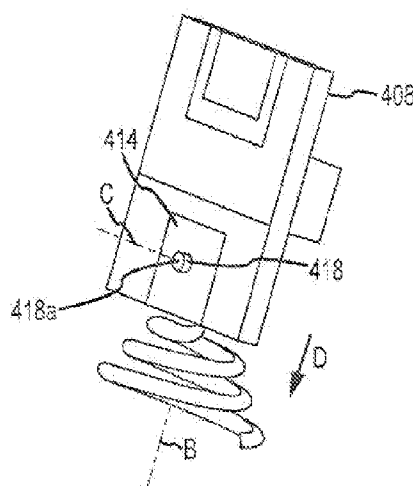


FIG. 4B

(57) Abstract: An antenna assembly having a radiating element and a circuit board is provided. The radiating element is coupled to the circuit board by a conductive extension and hook portion where the hook portion extends into and possibly through a bore on the circuit board.

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BROADBAND VHF ANTENNA

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

[Para 1] None.

CROSS-REFERENCE TO RELATED APPLICATIONS

[Para 2] This application is related to United States Provisional Application 60/823,725, filed August 28, 2006.

FIELD OF THE INVENTION

[Para 3] The technology of the present application relates to antennas and, more particularly, to broadband VHF antennas.

BACKGROUND OF THE INVENTION

[Para 4] As wireless devices become more prevalent in our society, the user's of such devices put increasing demands on wireless device providers to provide more functionality in smaller and smaller wireless devices without degrading reception or connectivity. Thus, although the space available in a wireless device for an antenna continually decreases, the performance needs of the antenna continually increase. Moreover, many wireless devices today require the ability to operate over multiple frequency ranges that frequently require the use of multiple antennas to cover the functionality of the device, exasperating the problem.

[Para 5] One useful antenna for wireless devices includes a helical antenna contained in a sheath. The helical antenna is a time tested antenna and does not require excessive volume internal to the wireless device as the bulk of the unit resides external to a housing of the wireless device. Moreover, multiple frequencies can be accommodated by varying the windings of the helical antenna, such as, for example, the pitch of the antenna.

[Para 6] Radio frequency power can be supplied to the helical antenna using any number of conventional feed mechanisms commonly known in the art. Often, the power supplied to the radiating element requires an impedance matching network to be implemented between the radio frequency power source and the radiating element itself.

[Para 7] To accommodate the need for an impedance matching network, some external antennas, including helical antennas, include an impedance matching network. For example, international publication number WO 2005/119841, published December 15, 2005, by applicant Radiall Antenna Technologies, Inc. provides a circuit component in the antenna connector portion of the antenna assembly. Similarly, United States Patent Number 5,835,064, issued

November 10, 1998, by Gomez et al., provides a circuit board in the antenna assembly. As one of ordinary skill in the art would appreciate on reading those disclosures, the circuit component and/or board provides, among other things, an impedance matching function.

[Para 8] One difficulty with providing the printed circuit board in the antenna revolves around the mechanical connection of the radiator to the printed circuit board. Thus, against this background, it would be desirable to provide an improved connection between the radiating elements and the circuit board.

SUMMARY OF THE INVENTION

[Para 9] The technology of the present application provides an antenna assembly. The antenna assembly includes a circuit board and radiator where the circuit board has a power connection to couple to a radio frequency power supply. The radiator is coupled to the circuit board with a conductive path contained on the circuit board to connect the power connection to the radiator. The radiator is connected to the circuit board by a radiator connection. The radiator connection includes a hole contained in the circuit board and a hook extending into the hole. The hook is coupled to the conductive path. The hook is connected to a conductive extension that couples the hook and the radiator.

[Para 10] The foregoing and other features, utilities and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[Para 11] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the present invention, and together with the description, serve to explain the principles thereof. Like items in the drawings are referred to using the same numerical reference.

[Para 12] Figure 1 is an exploded perspective view of an exemplary embodiment of an antenna;

[Para 13] Figure 2 is a partially exploded view of a circuit board of figure 1;

[Para 14] Figure 2A shown a perspective view of Figure 2;

[Para 15] Figure 3 is a cross-section of a portion of antenna 100;

[Para 16] Figures 4A and 4B are an illustration of a connection between the radiator and the circuit board.

DETAILED DESCRIPTION

[Para 17] The technology of the present application will now be described with reference to the figures. While described in connection with a two-way radio, one of ordinary skill in the art will understand on reading the disclosure that the technology of the present application may be used in conjunction with many wireless devices, such as, for example, cellular telephones, PDAs, wireless computers, handheld computers, MP3 players, electronic game, portable televisions, or the like. Moreover, the antenna is generally described as a conventional helical antenna, but one of ordinary skill in the art would recognize on reading the disclosure that the technology of the present application could be implemented with other types of antenna designs.

[Para 18] Referring first to figure 1, a partially exploded antenna 100 is shown. Antenna 100 includes a connector 102 to connect the antenna 100 to the housing of a two-way radio or the like, not specifically shown, but generally understood in the art. Connector 102 is shown as a threaded connection but could be a snap fit connection or the like. An insulator 104 resides in the connector electrically insulating a contact 106 from connector 102. Contact 106 is connected to a circuit board 108. Circuit board 108 is attached to an adapter 110, which is contained in a sleeve 112. RF Power from the wireless device, such as the two-way radio is provided to antenna 100 by contact 106 through circuit board 108 as is further explained below.

[Para 19] Adapter 110 comprises a circuit board connection portion 114 and a coil connection portion 116 coupled together by a pressed fit, snap fit, friction fit or the like. A gap G (best seen in figure 3) resides between coil connection portion 116 and a sheath 130 to allow a coil 118 to be placed in gap G between coil connection portion 116 and sheath 130. As shown, coil 118 has a wider diameter base 120 to provide increase bandwidth of operation. Coil 118 is shown with a tapered section 122 reducing the diameter and pitch of the coils to a narrow diameter top 124. Instead of a tapered section 122 and a narrow diameter top 124, coil 118 could be a constant width from base to top. Moreover, tapered section 122 could be replaced with a flared portion 126 and an even wider top portion 128 as shown in outline over coil 118.

[Para 20] Antenna 100 is provided with sheath 130 and end cap 132. Sheath 130 may be overmolded or constructed in any conventional manner. As can be appreciated, for space considerations, sheath 130 generally conforms to the shape of coil 118.

[Para 21] Referring now to figure 2, connector 106 is coupled to circuit board 108 at connection point 202. Connection point 202 may be a soldered connection, a press fit connection, a snap fit connection, a crimp connection or the like. Similarly, circuit board 108 is connected to circuit board connection portion 114 at connection point 204. Connection point 204 may be a soldered connection, a press fit connection, a snap fit connection, a crimp connection or the like. Connection point 202 and connection point 204 are generally the same type of connection, for example, soldered connection, but may be different connections. Sleeve 112 fits over the circuit board 108 and extends from connector 102 to circuit board connection portion 114 as shown in Figure 2A.

[Para 22] The contact 106 provides RF power to coil 118 through circuit board 108 as best shown in figure 3. Circuit board 108 provides broadband impedance matching for coil 118. Conventionally, impedance matching generally provides a 50 ohm load across the operating frequency of interest. Placing circuit board 108 in antenna 100 provides more volume in the wireless device for increased circuitry to further enhance performance of the radio. Circuit board 108 may comprise, for example, a two – element L shaped network of a capacitor and shunt inductor for the 136 to 174 MHz range, but other elements and structures as are conventionally known in the art may be mounted on the antenna instead of in the housing of the wireless device. As can be seen best in figure 3, sleeve 112 may have shoulders 302 abutting a flanged surface 304 on the base of coil connection portion 116. Also, circuit board connection portion 114 and coil connection portion 116 of adapter 110 are coupled together by a coupling 306. Coupling 306 comprises a threaded bore 308 in circuit board connection portion 114 and a threaded protrusion 310 extending from flanged surface 304. However, threaded bore 308 and threaded protrusion 310 may be reversed and/or replaced by a friction fitting as desired.

[Para 23] Referring now to figures 4A and 4B, a connection 400 between a radiator 402 and circuit board 404 is provided. Radiator 402 is shown as a helical coil to be consistent with the technology described above, but could be other types of radiators as now would be appreciated by those of ordinary skill in the art. Figure 4A shows a perspective view of a first side 406 of circuit board 404 and figure 4B shows a perspective view of a second side 408 of circuit board 404. As shown, circuit board 404 may have any conventional surface mount technology elements 410, such as, for example, capacitors, inductors, resistors, or the like, as well as conductive traces 412.

[Para 24] Connection 400 between circuit board 404 and radiator 402 may be formed by providing a conductive extension 416 from radiator 402 that terminates in a hook portion 418 that extends through a through hole 414 extending from first side 406 to second side 408 of circuit board 404. Conductive extension 416 and hook portion 418 may be referred to as a L-shaped hook or a J shaped hook. In some instances, hook portion 418 may terminate in a protrusion 418a to provide additional resistance to pull through force tending to cause hook portion 418 to pull out of through hole 414. The hook portion 418 would be sized to fit in and through through hole 414 to provide a mechanical connection between circuit board 404 and radiator 402. While described as a through hole or bore, hole 414 does not need to be circular, but could have any desired shape. Moreover, hook portion 418 would be similarly shaped. Also, hole 414 may be in the form of a detent or blind hole instead of a complete through hole. In that case, hook portion 418 would not extend through hole 414, but rather into hole 414. The bore of hole 414, which may be other than circular, may have a receiving recess to fit protrusion 418a in the case where the hole 414 does not penetrate through circuit board 404.

[Para 25] Circuit board 404 forms a plane A. Conductive extension 416 has a longitudinal axis B generally parallel to plane A. Notice, while conductive extension 416 is shown as a straight extension, conductive extension 416 could have a meandering pattern as a matter of design choice. Conductive extension 416 may converge or diverge from radiator 402 to hook portion 418. Such convergence or divergence will generally be due to manufacturing tolerances, but could be related to specific antenna design considerations. Hook portion 418 is shown having a longitudinal axis C. Longitudinal axis C is generally perpendicular to Plane A and longitudinal axis B. Hook portion 418 and conductive extension portion generally form a 90° angle to facilitate inserting hook portion 418 through through hole 414 as well as provide a resistance to the tendency of radiator 402, shown a coil, to compress in direction D. While the 90° angle facilitates both features, any angle less than 180° is possible although an acute angle or right angle is preferred over an obtuse angle. Electrical connection 420 is made by any conventional means to connect conductive traces 412 and hook portion 418. Such electrical connection may be a solder connection, a press fit connection, a stamped metal connection, or the like.

[Para 26] As shown in this case, radiator 402 is a coil radiator. Conductive extension 416 and hook portion 418 are shown as extensions of the coil. Radiator 402, conductive

extension 416, and hook portion 418 need not be single unit, but multiple connected units as desired.

[Para 27] The previous description of the disclosed embodiment is provided to enable any person skilled in the art to make or use the technology of the present application. Various modifications to the embodiment will be readily apparent to those skilled in the art on reading the disclosure, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

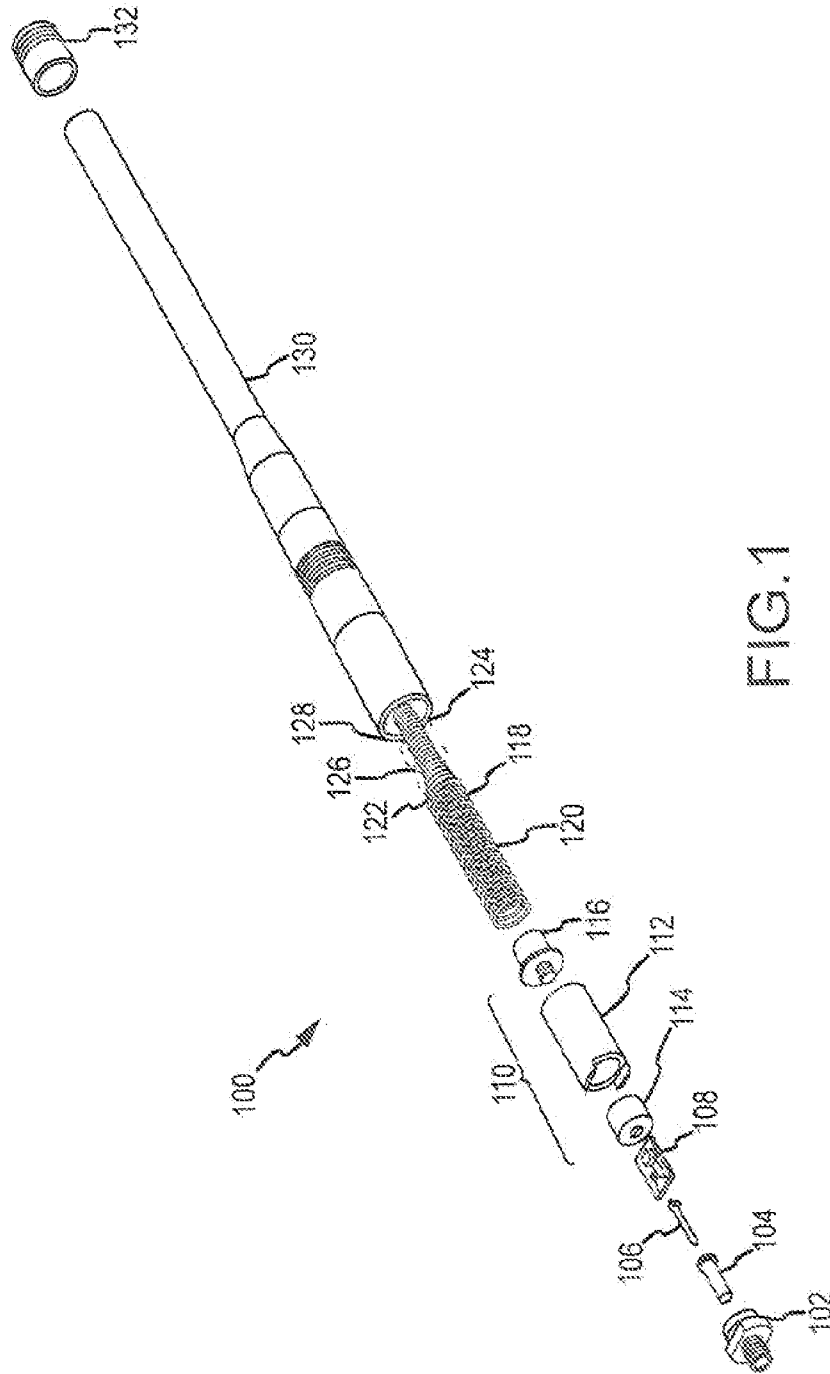
[Para 28] What is claimed is:

CLAIMS

1. A circuit board and radiator for use in an antenna assembly comprising:
 - a circuit board, the circuit board comprising a power connection to couple to a radio frequency power supply;
 - a radiator coupled to the circuit board;
 - a conductive path contained on the circuit board connecting the power connection to the radiator;
 - a radiator connection coupling the radiator to the circuit board comprising:
 - a hole contained in the circuit board;
 - a hook portion extending into the hole, the hook portion coupled to the conductive path; and
 - a conductive extension coupling the hook portion to the radiator, wherein radio frequency power is supplied to the radiator via the conductive path and the radiator connection.
2. The antenna assembly of claim 1, wherein the radiator is a helical radiator.
3. The antenna assembly of claim 2, wherein the helical radiator comprises a plurality of coil pitches.
4. The antenna assembly of claim 2, wherein the conductive extension is an extension of the helical radiator.
5. The antenna assembly of claim 4, wherein the hook portion is a single integral part with the conductive extension.
6. The antenna assembly of claim 1, wherein the circuit board defines a plane and the conductive extension has a longitudinal axis parallel to the plane.
7. The antenna assembly of claim 6, wherein the hook portion has a longitudinal axis perpendicular to the plane.

8. The antenna assembly of claim 1, wherein the hole is a through hole.
9. The antenna assembly of claim 8, wherein the hole has a longitudinal axis perpendicular to a plane defined by the circuit board.
10. The antenna assembly of claim 8, wherein the conductive extension has a longitudinal axis parallel to the plane and the hook portion has a longitudinal axis perpendicular to the plane.
11. The antenna assembly of claim 10, wherein the hook portion extends through the hole.
12. The antenna assembly of claim 6, wherein the hook has a longitudinal axis defining an acute angle with the longitudinal axis of the conductive extension.
13. The antenna assembly of claim 1, further comprising an impedance matching network on the circuit board coupled between the power connection and the radiator connection.
14. A circuit board and radiator for use in an antenna assembly comprising:
 - a circuit board, the circuit board comprising a power connection to coupled to a radio frequency power supply;
 - means for radiating coupled to the circuit board;
 - means for coupling the means for radiating to the circuit board; and
 - means on the circuit board for coupling the power connection to the means for radiating.
15. The antenna assembly of claim 14, wherein the means for radiating comprises a helical antenna.
16. The antenna assembly of claim 14, wherein the means for coupling the power connection to the means for radiating comprises at least one conductive trace.

17. The antenna assembly of claim 14, further comprising an impedance matching network residing on the circuit board and coupled between the power connection and the means for radiating.
18. The antenna assembly of claim 14, wherein the means for coupling the means for radiating to the circuit board comprises a L shaped hook.
19. The antenna assembly of claim 14, wherein the means for coupling the means for radiating to the circuit board comprises a J shaped hook.



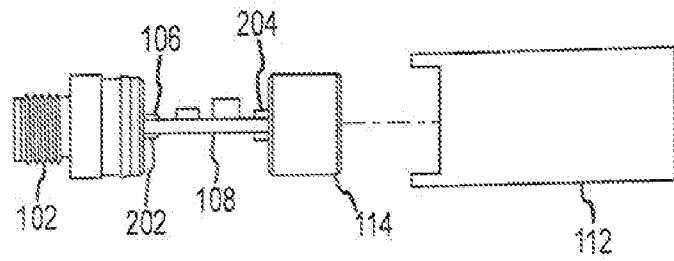


FIG. 2

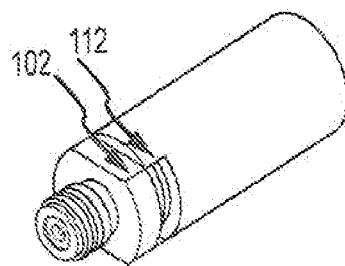
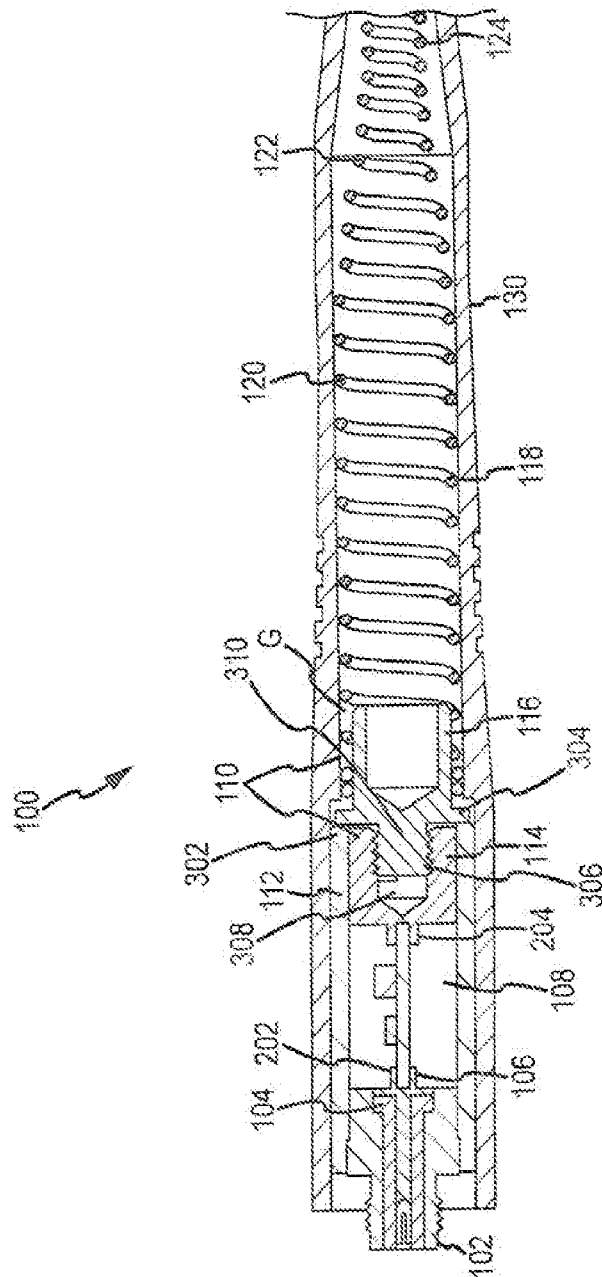


FIG. 2A



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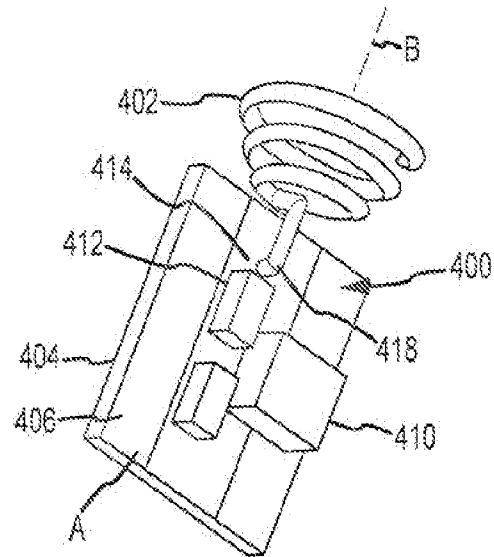


FIG. 4A

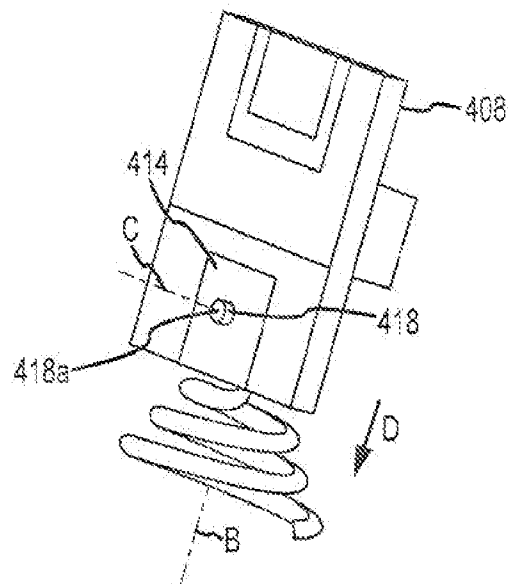


FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2008/068201

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01Q 1/36 (2008.04)

USPC - 343/895

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)

IPC(8) - H01Q 1/36 (2008.04)

USPC - 343/895

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 practicable, search terms used)

PatBase, MicroPatent

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 6,107,970 A (HOLSHOUSER et al) 22 August 2000 (22.08.2000), entire document	1-17 ----- 18, 19
Y	US 6,089,880 A (MIYAGAWA et al) 18 July 2000 (18.07.2000), entire document	18
Y	US 4,249,582 A (JACOBS) 10 February 1981 (10.02.1981), entire document	19

☐ 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

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"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)

"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

"&" document member of the same patent family

Date of the actual completion of the international search

03 October 2008

Date of mailing of the international search report

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Name and mailing address of the ISA/US

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