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(54) Title: KNIT EMI SHIELD AND METHOD OF CONSTRUCTION THEREOF

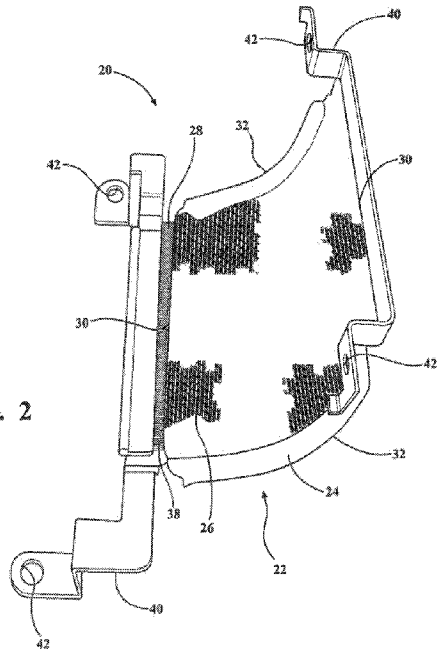

FIG. 2

(57) Abstract: An electromagnetic interference (EMI) shield assembly (20) and method of construction is provided. The assembly (20) includes a body (22) having a wall (24) of warp knit nonmetallic yarn (26) having opposite sides (30) extending generally parallel with one another between opposite ends (32) and a plurality of weft inserted metal wires (28). The wire (28) is inserted to provide discrete bundles (44) each arranged in side-by-side relation with one another and extending beyond the opposite sides (30) of the wall (24) to provide a plurality of exposed free ends (38). The nonmetallic yarn (26) is looped about the wires (28), thereby fixing the wire (28) relative to the nonmetallic yarn (26) and to other wires (28) in an optimal EMI shielding position. Metal brackets (40) adapted for ready attachment to a source of electrical ground are attached to the exposed free ends (38). The individual bundles (40) of wires extend parallel to one another, with a gap (46) having a predetermined width (w) extending between the adjacent bundles (44).

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KNIT EMI SHIELD AND METHOD OF CONSTRUCTION THEREOF

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 62/010,910 filed June 11, 2014, U.S. Utility Application Serial No. 14/643,638, filed March 10, 2015, which are incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] This invention relates generally to electromagnetic interference shields, and more particularly to textile electromagnetic interference shields.

2. Related Art

[0003] It is known to fabricate electromagnetic interference (EMI) shields 1 entirely from wire, such as shown in FIG. 1. The wire, being too stiff to be knit, is generally woven to form a mesh of a predetermined mesh size to prevent the passage of EMI therethrough, thereby acting as a barrier or shield to the EMI.

[0004] The manufacture of woven wire EMI shields is not a simple process. The metal wire material typically employed in such woven EMI shields is fairly stiff and this lends to the material being generally difficult to weave. Special care must be taken in controlling the process to ensure that a uniform mesh size is achieved and this adds to the cost and complexity of producing such a product. And it is important to control the mesh size to produce an EMI shield with uniform properties and to make certain that the mesh size is not so large as to permit the transmission of EMI through the shield. Careful controls must be in place to obtain a commercially usable product.

[0005] A further disadvantage of woven wire EMI shields, apart from the difficulty in manufacturing them, is their robustness when placed in service. When first installed, the mesh size is desirably present in its as-manufactured uniform condition and would be effective at shielding EMI. However, it has been found that the woven nature of such shields enables the relative positions of the wires to shift either during installation or over time, with some of the wires getting pushed closer together while others end up being drawn further apart. Such change in the mesh size is undesirable as it yields inconsistent performance from one product to another and even within the mesh field of a given product. Moreover, in cases where the wires have shifted apart to increase the mesh size (either locally or over a larger region or regions), the increased gap can be large enough to allow EMI to pass through the shield which is highly undesirable.

SUMMARY OF THE INVENTION

[0006] In accordance with one aspect of the invention, a knit EMI shield is provided. The knit EMI shield includes a wall of knit nonmetallic yarn and at least one inserted wire. The knit nonmetallic yarn is looped about the inserted wire to maintain the inserted wire in its "as inserted" position, thereby fixing the inserted wire relative to the nonmetallic yarn and relative to itself and/or other inserted wire. Accordingly, the inserted wire is prevented from moving by knit loops of the nonmetallic yarn, thereby maintaining the inserted wire in its optimal EMI shielding position.

[0007] In accordance with another aspect of the invention, the inserted wire extends beyond opposite sides of the wall of knit nonmetallic yarn to provide exposed free ends of the wire for operable connection to a source of electrical ground.

[0008] In accordance with another aspect of the invention, the wall of knit nonmetallic yarn is warp knit.

[0009] In accordance with another aspect of the invention, the wire is inserted in bundles containing a plurality of the wires in side-by-side relation with one another, wherein the individual bundles extend parallel to one another.

[0010] In accordance with another aspect of the invention, the knit EMI shield provides crash impact protection and mechanical protection.

[0011] In accordance with another aspect of the invention, a method of constructing an EMI shield assembly is provided. The method includes initiating knitting of one or more nonmetallic yarns with one another to form a body including a wall having opposite sides extending generally parallel with one another lengthwise between opposite ends. The method proceeds with the step of laying-in at least one wire into the wall. The next step is forming knit loops of the nonmetallic yarn about the wire. The method further includes the step of capturing the wire in a predetermined position with the loops, wherein the wire is fixed relative to the nonmetallic yarn and relative to other wires.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] These and other aspects, features and advantages of the present invention will become more readily appreciated when considered in connection with the following detailed description of presently preferred embodiments and best mode, appended claims and accompanying drawings, in which:

[0013] Figure 1 is a woven EMI shield constructed in accordance with the prior art shown disposed over a plurality of wire bundles,

[0014] Figure 2 is an EMI shield constructed in accordance with one embodiment of the invention;

[0015] Figure 3 is a partial front plan view of the EMI shield of Figure 2;

[0016] Figure 4 is an enlarged partial back plan view of the EMI shield of Figure 2;

[0017] Figure 5 is an enlarged partial front plan view of the EMI shield of Figure 3; and

[0018] Figure 6 is a flow chart illustrating the steps of constructing the EMI shield of an embodiment.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENTS

[0019] Referring in more detail to the drawings, FIG. 2 illustrates an electromagnetic interference (EMI) shield assembly constructed in accordance with one embodiment of the invention. The EMI shield assembly **20** is operable for attachment to shield a conductor, cable, or plurality thereof, such as high voltage conductors or cables to prevent EMI from having an adverse effect on the conductors or cables, as well as on electronic apparatus nearby the conductors or cables. The EMI shield assembly **20** is also well suited to provide impact crash protection and mechanical protection to the contents thereof.

[0020] The EMI shield assembly **20** includes a body **22** having a wall **24** of knit nonmetallic yarn **26** and at least one inserted metal wire **28**. The wall **24** has opposite sides **30** that extend generally parallel with one another lengthwise between opposite ends **32**. The knit nonmetallic yarn **26** is looped about the wire **28** via knit stitches, also referred to as loops **34** to maintain the wire **28** in its "as inserted" position, thereby fixing the wire **28** relative to the nonmetallic yarn **26** and relative to itself and/or other wires **28**. Accordingly, the wire **28** is prevented from moving by the knit stitches or loops **34** (Figure 5), of the nonmetallic yarn **26**, thereby maintaining the inserted wire **28** in its optimal EMI shielding position, as initially inserted and fixed via the loops **34**.

[0021] The wall **24** of knit nonmetallic yarn **26** of the exemplary embodiment is warp knit, and the wire **28** is inserted along a weft direction in the desired position during the warp knitting process to allow the loops **34** to capture and retain the wire **28** or wires **28**

in their intended position so that the wire **28** remains fixed relative to the wall **24**. In other words, the wire **28** is knit into the wall **24** using a weft insertion or laying-in technique. A knitting machine such as the Mach 2X manufactured by Shima Seiki Mfg., Ltd. may be used to knit the wall **24** of nonmetallic yarn **26**, insert the wire **28**, and form the EMI shield assembly **20**. If warp knit, the wall **24** may be knit using any type of warp knitting such as, but not limited to tricot knit, Milanese knit, or Raschel knit. The wall **24** of the exemplary embodiment also includes a plurality of edge stitches **36** (FIGS. 3 and 5) of the nonmetallic yarn **26** adjacent to the opposite sides **30** of the wall **24** for securing the nonmetallic yarn **26** in the wall **24**. The edge stitches **36** can take on many forms, such as, but not limited to selvage-edge knitting, sideways-edge knitting, or cast-on edge knitting. Although the wall **24** of the exemplary embodiment is warp knit and the wire **28** is inserted in a weft direction, it should be understood that the wall **24** could instead be weft knit for example and the wire **28** could then be inserted in a warp direction.

[0022] The nonmetallic yarn **26** can be provided as any desired yarn, depending on the application, such as, by way of example and without limitations, polyester, nylon, polypropylene, polyethylene, acrylic, cotton, rayon, and fire retardant (FR) versions of all the aforementioned materials, though high temperature ratings are generally not required if provided as FR materials. If high temperature ratings are desired along with FR capabilities, then some presently preferred nonconductive yarns include m-aramid (Nomex, Conex, Kermel), p-aramid (Kevlar, Twaron, Technora), PEI (Ultem), PPS, and PEEK, for example.

[0023] Although not utilized in the exemplary embodiment of the invention, the wall **24** of the nonmetallic yarn **26** may be heat-set to help establish a specific profile or shape of the wall **24**. Heat-setting may allow the wall **24** to better conform to a component to which the EMI shield assembly **20** will protect or shield. In the event that the wall **24** is heat-

set, the nonmetallic yarns 26 may be chosen to be heat-settable. Heat-setting may also assist in the maintaining of the wire 28 in its "as inserted" position and prevent any movement of the wire 28 relative to the nonmetallic yarn 26 and and/or other wires 28.

[0024] The wire 28 of the exemplary embodiment is solid wire 28, however, it should be understood that the wire 28 may instead be stranded or braided, for example. Although solid wire 28 may be more mechanically rugged, stranded or braided wire 28 may be better suited to applications in which the EMI shield assembly 20 experiences bending stress, to provide redundancy, or if the EMI shield assembly 20 must be more flexible. Additionally, each wire 28 may also include jacketing, insulation, or other coating. For example, each wire 28 could include a coating intended to prevent corrosion if the EMI shield assembly 20 is intended to be used in a harsh environment. Coating on the wires 28 may also have the benefit of reducing the occurrence of fretting and can provide a separation of dissimilar metals to slow or stop the galvanic reaction of the wires 28 with any dissimilar metals the wires 28 contact.

[0025] The wire 28 is shown as extending beyond the opposite sides 30 of the wall 24 to provide a plurality of exposed free ends 38 extending beyond each of the sides. The free ends 38 are adapted for operable connection to a source of electrical ground. To facilitate attachment to the source of electrical ground, a conductive bracket, such as a metal bracket 40, is operably attached in electrical communication to each of the exposed free ends 38, with each metal bracket 40 being adapted for ready attachment to the source of electrical ground, such as via fastener openings 42 configured to align with corresponding faster receptacles in the member to which the EMI shield assembly 20 is attached. As best shown in FIG. 5, the wire 28 is shown as being inserted to provide discrete bundles 44 of the wire 28, wherein each bundle 44 has a plurality of the wires 28 or segments of the wire 28 arranged in side-by-side relation with one another. The individual bundles 44 extend parallel

to one another, with a gap 46 having a predetermined width w extending between the adjacent bundles 44. The width w of each gap 46 is maintained in size during manufacture, assembly and use due to the loops 34 fixing the bundles 44 against relative movement with the wall 24. As such, the bundles 44 are assured of providing continual protection against EMI.

[0026] As illustrated in FIGS. 4 and 5, wires 28 of the exemplary embodiment of the invention each include at least one bend 48 between their free ends 38 that extends lengthwise between adjacent wales of the edge stitches 36 of the nonmetallic yarn 26. Thus, each wire 28 is captured so that movement of the wire 28 along a widthwise direction between the sides 30 of said wall 24 is prevented. While the loops 34 themselves help establish and retain the arrangement of wires 28 lengthwise relative the wall 24, without any bend 48, the wire 28 may be allowed to slide widthwise out of its "as inserted" position. In some applications, this may be desirable, such as to allow widthwise adjustment of the wire 28, therefore it should be appreciated that wires 28 of other embodiments may not include bends 48 captured between loops 34 of the nonmetallic yarn 26. The knit courses forming the loops 34 of nonmetallic yarn 26 may be formed of the same type of knit stitches as the remainder of the wall 24, or may be formed by different knit stitches.

[0027] As illustrated by a flow chart in FIG. 6, a method of constructing an EMI shield assembly 20 is also disclosed. The method includes the step of 100 laying-in at least one wire 28 into a wall 24 having opposite sides 30 extending generally parallel with one another lengthwise between opposite ends 32 while knitting one or more nonmetallic yarns 26 with one another to form a body 22 including the wall 24. As described above, the wall 24 of nonmetallic yarn 26 is warp knit, therefore in the exemplary embodiment, the step of 100 laying-in at least one wire 28 into a wall 24 having opposite sides 30 extending generally parallel with one another lengthwise between opposite ends 32 while knitting one

or more nonmetallic yarns 26 with one another to form a body 22 including the wall 24 is further defined as laying-in at least one wire 28 into the wall 24 along a weft direction while warp knitting of one or more nonmetallic yarns 26. The next step is 102 forming knit loops 34 of the nonmetallic yarn 26 about the wire 28 and capturing the wire 28 in a predetermined position with the loops 34, wherein the wire 28 is fixed relative to the nonmetallic yarn 26 and relative to other wires 28.

[0028] The method of constructing the EMI shield assembly 20 of the exemplary embodiment further includes the step of providing a plurality of exposed free ends 38 of the wire 28 extending beyond sides of the wall 24. While the wires 28 of the exemplary embodiment simply are sized to allow the free ends 38 to extend beyond the sides of the wall 24, it should be appreciated that the wall 24 may be trimmed in a secondary operation in order to expose the free ends 38. Consequently, the method may define the step of providing a plurality of exposed free ends 38 of the wires 28 as cutting the wall 24 of the nonmetallic yarn 26 at the opposite sides 30 to expose the free ends 38 of the wire 28. The method of constructing the EMI shield assembly 20 of the exemplary embodiment also includes the step of connecting the free ends 38 to at least one conductive bracket.

[0029] Referring back to FIG. 4, the method of constructing the EMI shield assembly 20 of the exemplary embodiment includes bending a portion of the wire 28 and capturing the bent portion between the loops 34 of the nonmetallic of the wall 24. As previously described, the wires 28 of the exemplary embodiment are arranged in side-by-side relation to one another to provide a discrete bundle 44 of a plurality of wires 28. Therefore, the method may also include the step of forming at least one discrete bundle 44 of the wires 28. Furthermore, the method may utilize wires 28 which are stranded or braided. The method of at least one embodiment may further include the step of forming edge stitches 36 with the nonmetallic yarns 26 to finish the opposite sides 30 of the body 22 of the wall 24.

[0030] Many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that the invention may be practiced otherwise than as specifically described, and that the scope of the invention is defined by any ultimately allowed claims.

CLAIMS

What is claimed is:

1. An EMI shield assembly, comprising;

a knit wall of nonmetallic yarn having opposite sides extending lengthwise between opposite ends,

at least one wire fixed to said wall by a plurality of loops of said nonmetallic yarn, and

said at least one wire extending beyond each of said opposite sides for operable connection to a source of ground.

2. The EMI shield assembly as set forth in claim 1 wherein said wire includes a plurality of said wires forming a plurality of discrete bundles of said wires and each of said bundles extends generally parallel with one another, said bundles being spaced laterally from one another.

3. The EMI shield assembly as set forth in claim 3 wherein a gap having a predetermined width W extends between adjacent said bundles, said gap being maintained by said loops fixing said bundles against relative movement with said wall.

4. The EMI shield assembly as set forth in claim 1 wherein said at least one wire is stranded.

5. The EMI shield assembly as set forth in claim 1 wherein said at least one wire is braided.

6. The EMI shield assembly as set forth in claim 1 wherein said at least one wire is insulated.

7. The EMI shield assembly as set forth in claim 1 wherein said wire includes a plurality of free ends and at least one bend extending lengthwise between said free ends and disposed between said loops of said nonmetallic yarn.

8. The EMI shield assembly as set forth in claim 1 wherein said wall is formed by more than one type of knit pattern.

9. The EMI shield assembly as set forth in claim 1 wherein said wall includes a plurality of edge stitches of said nonmetallic yarn adjacent said opposite sides of said wall.

10. The EMI shield assembly as set forth in claim 1 wherein said wire includes a plurality of free ends and said assembly further includes conductive brackets operably attached to each of said free ends.

11. A method of constructing an EMI shield assembly comprising the steps of:

laying-in at least one wire into a wall having opposite sides extending generally parallel with one another lengthwise between opposite ends while knitting one or more nonmetallic yarns with one another to form a body including the wall,

forming knit loops of the nonmetallic yarn about the wire and capturing the wire in a predetermined position with the loops, wherein the wire is fixed relative to the nonmetallic yarn and relative to other wires.

12. The method of claim 11 wherein the step of laying-in at least one wire into a wall having opposite sides extending generally parallel with one another lengthwise between opposite ends while knitting one or more nonmetallic yarns with one another to form a body including the wall is further defined laying-in at least one wire into the wall along a weft direction while warp knitting of one or more nonmetallic yarns.

13. The method of claim 11 further including providing a plurality of exposed free ends of the wire extending beyond the opposite sides of the wall.

14. The method of claim 13 further including connecting the free ends to at least one conductive bracket.

15. The method of claim 13 further defining providing a plurality of exposed free ends of the wires as cutting the wall of the nonmetallic yarn at the opposite sides to expose the free ends of the wire.

16. The method of claim 11 wherein the wire is a plurality of wires and the method further includes forming at least one discrete bundle of the wires.

17. The method of claim 11 wherein the at least one wire is stranded.

18. The method of claim 11 further including forming edge stitches with the nonmetallic yarns to finish the opposite sides of the body of the wall.

19. The method of claim 11 further including bending a portion of the wire and capturing the bent portion between the loops of the nonmetallic yarn of the wall.

20. The method of claim 11 wherein the step of laying-in at least one wire into the wall is further defined as creating a gap extending between adjacent wires and maintaining the gap between the wires in their predetermined positions.

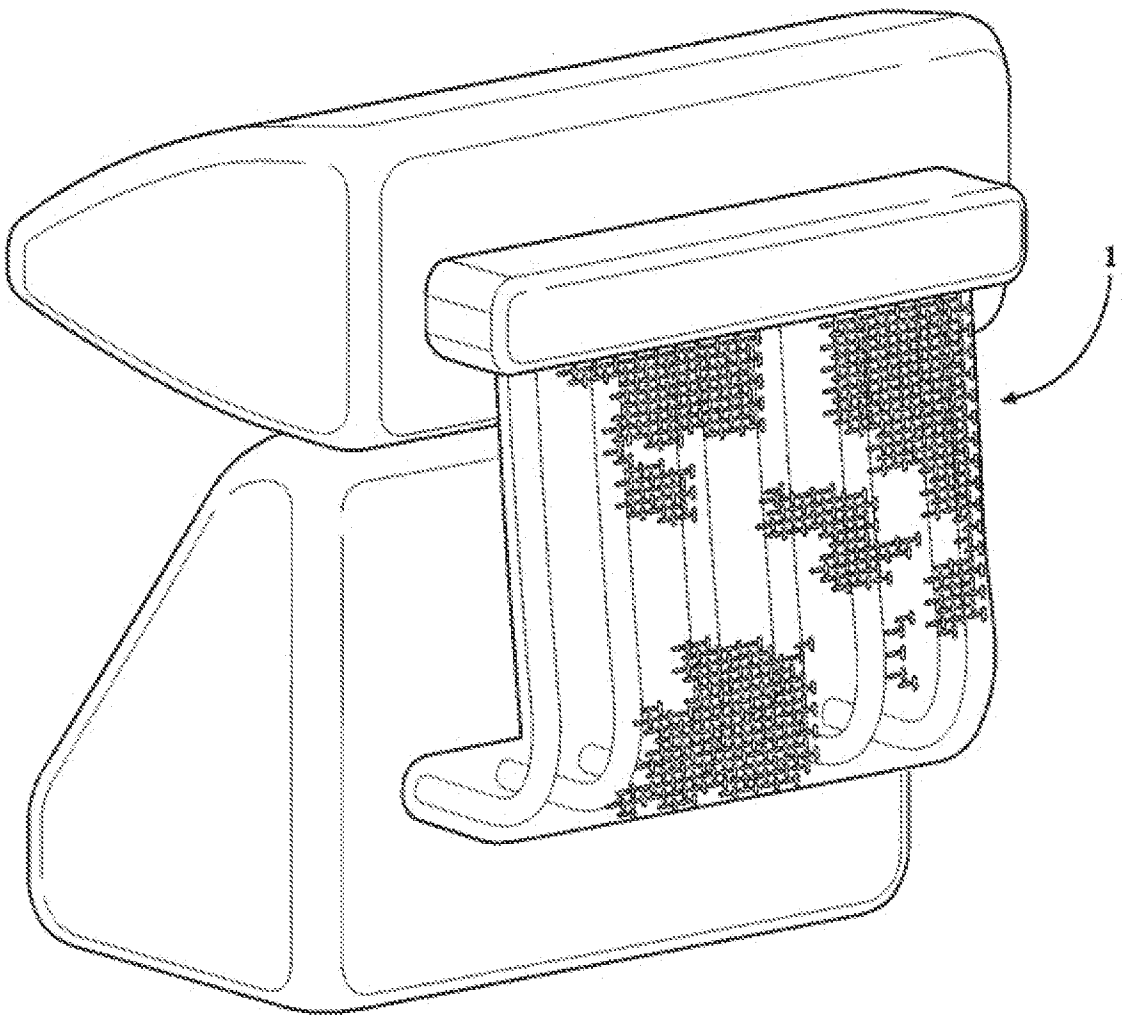

FIG. 1
PRIOR ART

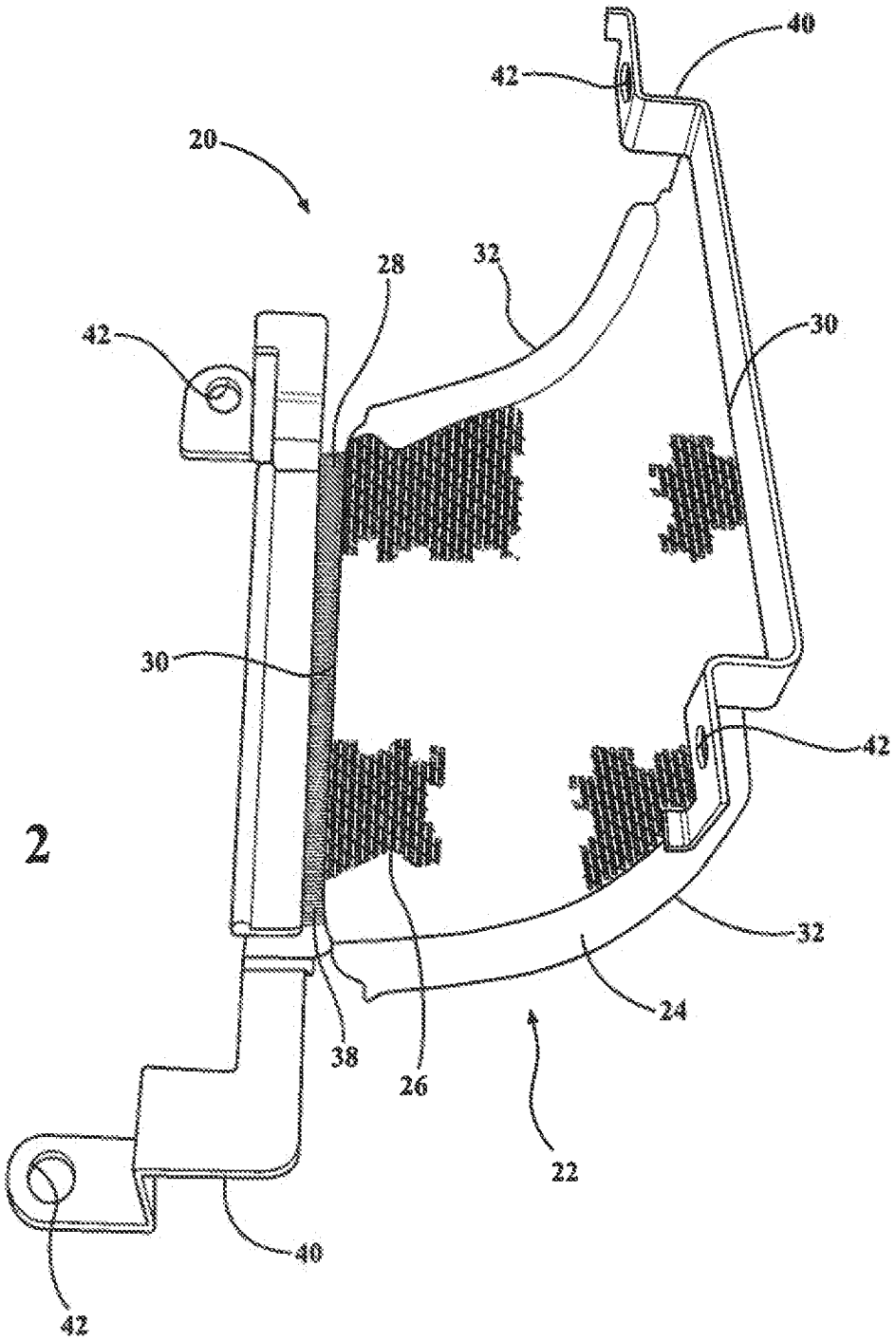

FIG. 2

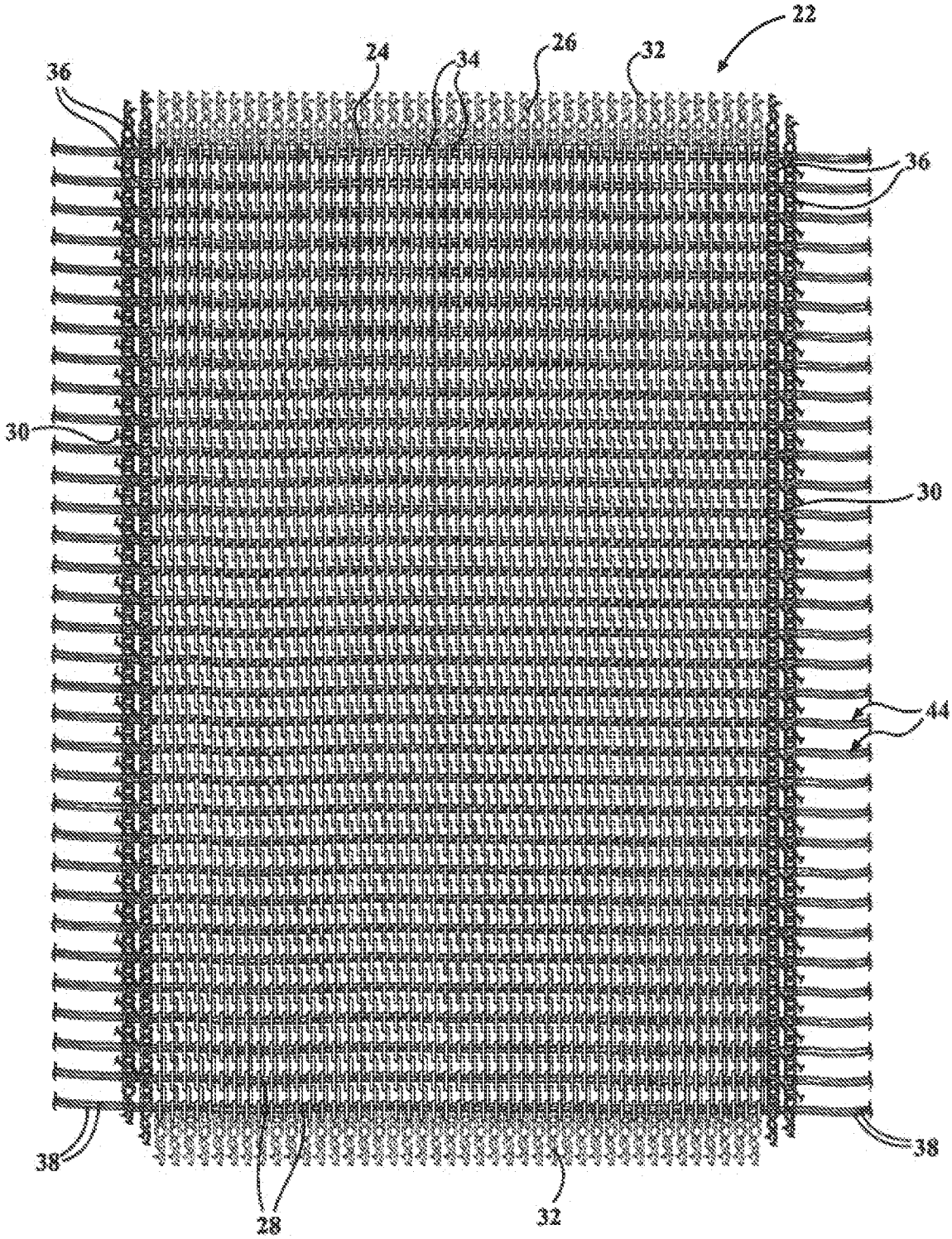

FIG. 3

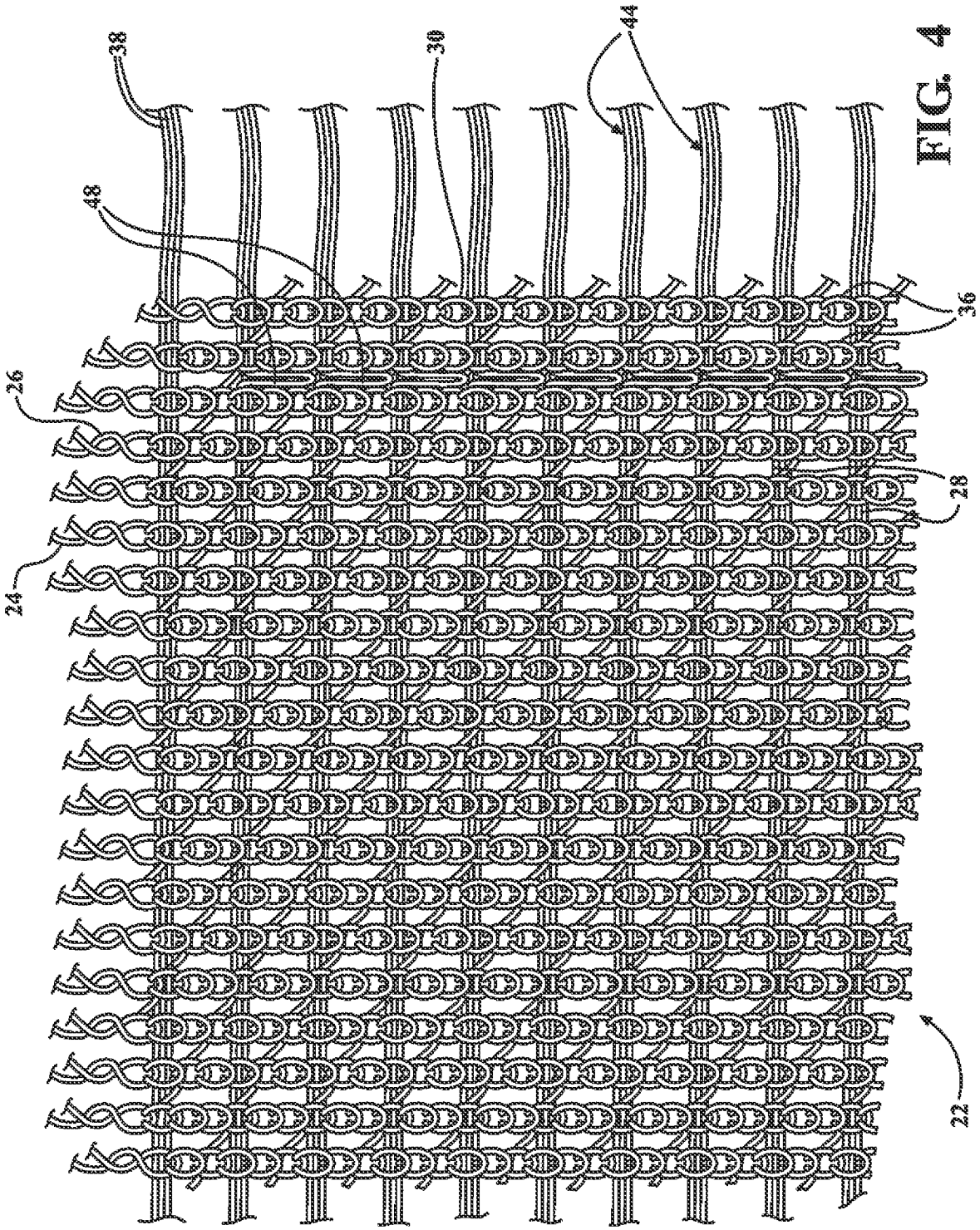

FIG. 4

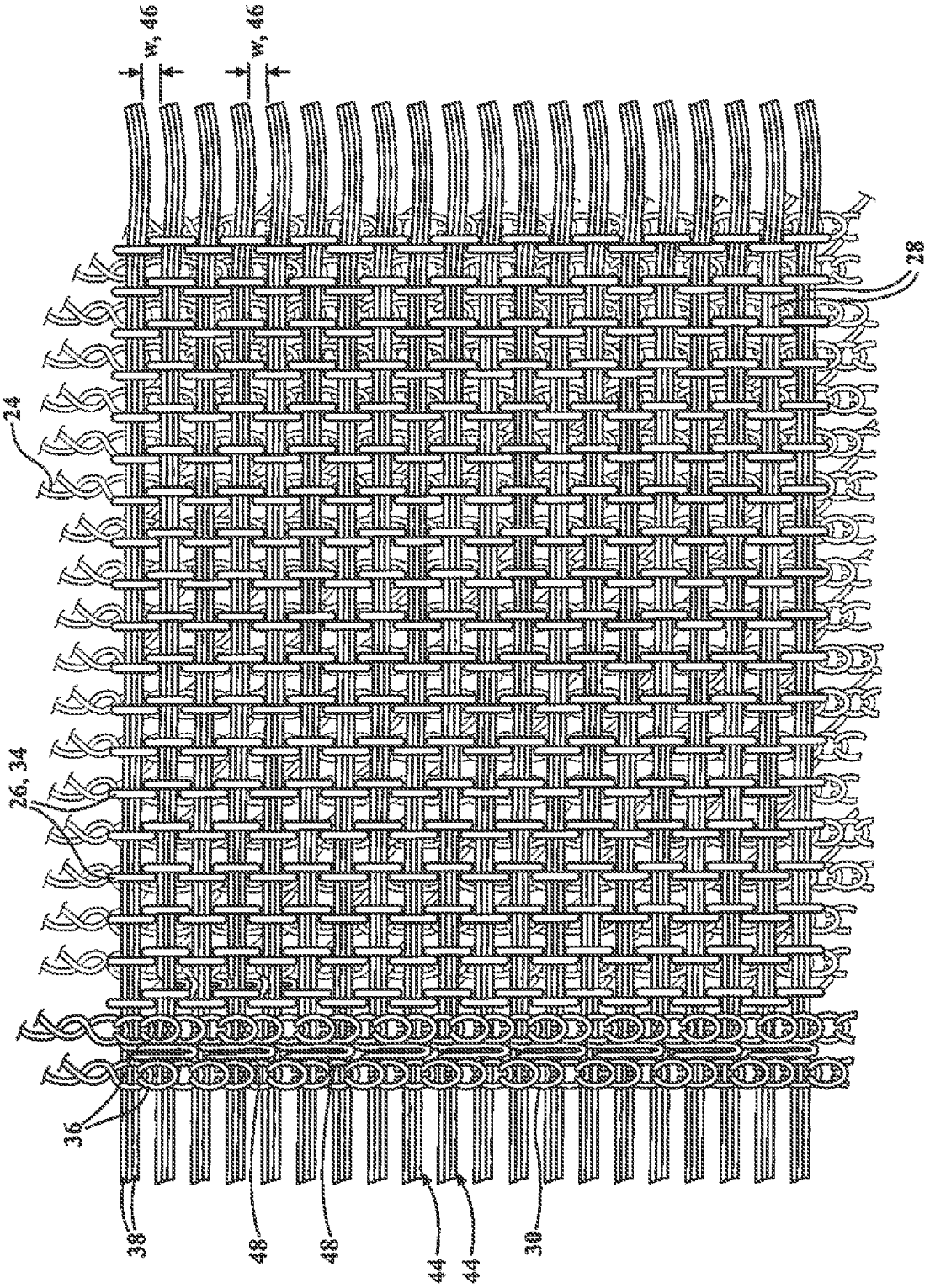

FIG. 5

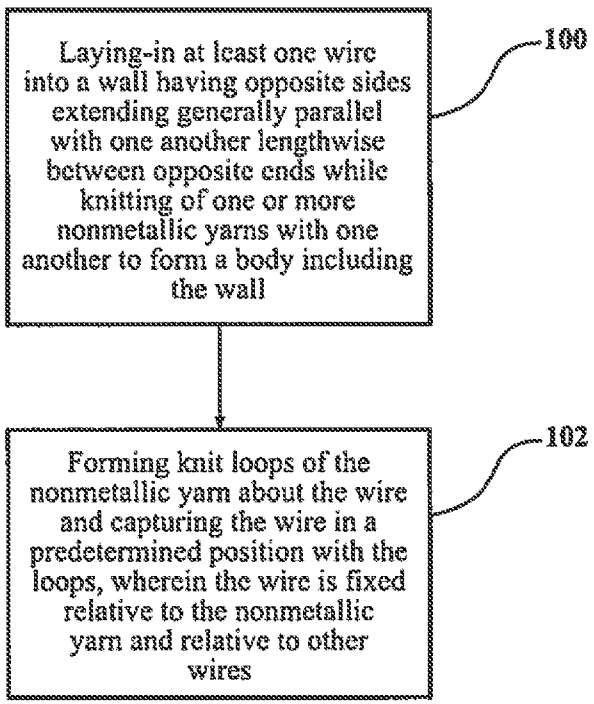
Laying-in at least one wire into a wall having opposite sides extending generally parallel with one another lengthwise between opposite ends while knitting of one or more nonmetallic yarns with one another to form a body including the wall
100
Forming knit loops of the nonmetallic yarn about the wire and capturing the wire in a predetermined position with the loops, wherein the wire is fixed relative to the nonmetallic yarn and relative to other wires
102

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/019863

A. CLASSIFICATION OF SUBJECT MATTER
INV. D04B21/08 D04B21/14 D04B1/12 D04B1/14 H05K9/00
ADD.

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)
H05K D04B

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	GB 2 385 605 A (BALL & SON LTD W [GB]) 27 August 2003 (2003-08-27) page 3, lines 10-21; claims 1-5; figure 1	1-4, 10-17,20 5-9,18, 19
Y A	US 2002/195260 A1 (MARKS PHILIP E [US]) 26 December 2002 (2002-12-26) paragraphs [0006], [0026], [0027], [0030], [0033], [0040]; claims 1, 2, 4, 22, 24, 25-27; figures 1, 4	1-4, 10-17,20 5-9,18, 19
A	US 2007/275199 A1 (CHEN MING-MING [US]) 29 November 2007 (2007-11-29) paragraphs [0025], [0036]; claims 1, 16, 17, 28-30, 33; figure 2	1-20
A	US 2005/124249 A1 (URIBARRI PETER V [US]) 9 June 2005 (2005-06-09) sentences 0022, 0023; claim 1; figures 1-3	1,3,11, 12

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

☒ See patent family annex.

* Special categories of cited documents :

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"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	Date of mailing of the international search report
22 May 2015	05/06/2015

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2015/019863

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2385605 A	27-08-2003	NONE	
US 2002195260 A1	26-12-2002	AU 2002316250 A1	08-01-2003
		BG 108525 A	28-02-2005
		BR 0210562 A	22-06-2004
		CA 2451207 A1	03-01-2003
		CN 1543654 A	03-11-2004
		CZ 20040064 A3	16-06-2004
		EP 1410447 A2	21-04-2004
		HR P20040029 A2	31-08-2004
		HU 0400929 A2	30-08-2004
		JP 4112488 B2	02-07-2008
		JP 4740968 B2	03-08-2011
		JP 2004531898 A	14-10-2004
		JP 2008193106 A	21-08-2008
		KR 20040034616 A	28-04-2004
		MX PA04000062 A	21-05-2004
		PL 367304 A1	21-02-2005
		RU 2286613 C2	27-10-2006
		TN SN03152 A1	09-04-2005
		TW 533762 B	21-05-2003
		US 2002195260 A1	26-12-2002
		WO 03001566 A2	03-01-2003
		ZA 200309832 A	27-09-2004
US 2007275199 A1	29-11-2007	CA 2647615 A1	18-10-2007
		CN 101461013 A	17-06-2009
		EP 1999762 A2	10-12-2008
		JP 5463137 B2	09-04-2014
		JP 5546061 B2	09-07-2014
		JP 2009532015 A	03-09-2009
		JP 2013123368 A	20-06-2013
		KR 20080111466 A	23-12-2008
		US 2007275199 A1	29-11-2007
		US 2009272570 A1	05-11-2009
		WO 2007117883 A2	18-10-2007
US 2005124249 A1	09-06-2005	DE 04816527 T1	22-02-2007
		EP 1692332 A1	23-08-2006
		ES 2269019 T1	01-04-2007
		JP 4395518 B2	13-01-2010
		JP 2007514068 A	31-05-2007
		US 2005124249 A1	09-06-2005
		WO 2005056898 A1	23-06-2005