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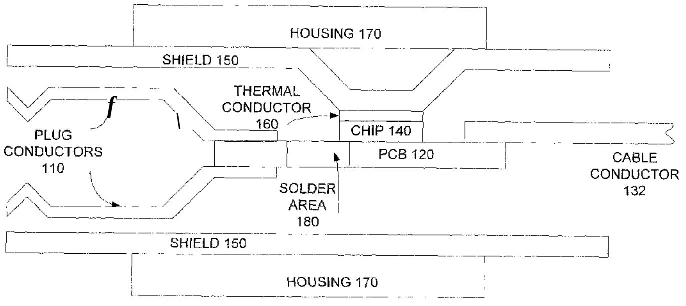

FIGURE 1

(57) Abstract: High speed connector inserts and cables having improved heat conduction, high strength, and may be manufactured in a reliable manner. One example may provide a connector insert having several paths by which heat may be removed from circuitry in the cable insert. In one example, heat may be removed from one or more circuits (140) by forming a thermal path (160) between a circuit and a shield (150) of the connector insert. Another path may include one or more pads (1040) on a side of an integrated circuit board that are soldered directly to the shield (1030). A braiding (234) surrounding a cable (230) may be soldered or otherwise thermally connected to the shield (250). Another example may provide a cable having a braiding that includes one or more types of fibers, such as aramid fibers (550). Another example may provide for increased manufacturability by using a wire comb (910) and a solder bar (1140).

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METHOD OF MANUFACTURING A CONNECTOR INSERT, CONNECTOR INSERT AND CABLE

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of United States provisional patent applications numbers 61/360,436, filed June 30, 2010, 61/360,432, filed June 30, 2010, and 61/408,052, filed October 29, 2010, and claims priority from United States application number 13/033,562, filed February 23, 2011, and is related to United States applications numbers 12/895,842, filed September 30, 2010, and 13/033,553, filed February 23, 2011, which are all incorporated by reference.

BACKGROUND

[0002] The amount of data transferred between and among electronic devices has increased tremendously. Applications such as high-definition video require huge amounts of data to be transferred at very high data rates. Unfortunately, high-speed communications between electronic devices have become so fast that simple cables consisting of two inserts connected by wires are no longer suitable. These simple cables degrade signals and cause skews such that high-speed data communication is not reliable.

[0003] Accordingly, new cables are needed. These cables may be active in that they include active electronic components, such as integrated circuits. These circuits consume power and thus create heat. This heat can degrade reliability of the cable and its circuitry, and can also be unpleasant for a user to touch.

[0004] These cables may experience forces and mechanical stress during use. Given their complexity, it may be useful to provide cables having increased strength. Also, given their complexity, problems with manufacturability may be a concern.

[0005] Thus, what is needed are circuits, methods, and apparatus for high-speed cables that can reliably convey signals in high-speed communications. The cable inserts may be able to transfer heat in a way to improve user experience and cable reliability. The cables may have increased strength. The cables and connector inserts may be arranged in such a way as to provide improved manufacturability.

SUMMARY

[0006] Accordingly, embodiments of the present invention may provide high speed connector inserts and cables having improved heat conduction, high strength, and may be manufactured in a reliable manner.

[0007] An exemplary embodiment of the present invention may provide a connector insert having improved heat conduction. This connector insert may include several paths by which heat may be removed from circuitry in the cable insert. In one example, heat may be removed from one or more circuits by forming a thermal path between the circuit, which may be an integrated circuit or other device, and a shield of the connector insert. This path may include a thermally conductive material to further reduce its thermal resistance. Another example may include one or more pads on a side of an integrated circuit board. These pads may be soldered directly to the shield, or otherwise thermally connected to the shield.

[0008] To improve heat conduction in another example, braiding surrounding a cable may be soldered or otherwise thermally connected to the shield. This connection may be covered by a cap to avoid electromagnet interference (EMI) leakage. This cap may be crimped to provide a robust mechanical connection. This crimping may be accomplished by applying force to the cap in multiple directions. In one specific embodiment of the present invention, force may be applied to the cap in four directions during crimping. The cap may be soldered to portions of either or both the connector insert and cable for improved heat conduction and mechanical reliability.

[0009] Another exemplary embodiment of the present invention may provide a cable having a high strength. To provide this increased strength, a braiding surrounding the cable or one or more of its conductors may include one or more types of fibers. For example, aramid fibers may be included in the braiding around the cable. To simplify soldering of the braiding, the aramid or other fibers may be bunched or grouped, such that they may be pulled out of the way. In various embodiments of the present invention, these fibers may be pulled out of the way using static electricity, or by other mechanisms. A specific embodiment of the present invention may use a braiding formed of counter-rotating spirals to assist in the separation of the aramid fibers.

[0010] Another exemplary embodiment of the present invention may provide for a reliable manufacturability. One specific example may align several pairs of twisted pairs of conductors in the cable using a wire comb. Specifically, a wire comb having a plurality of openings may be used to hold twisted pairs in an aligned manner. This may allow soldering of the cables to a printed circuit board or other appropriate substrate. In various embodiments of the present invention, this soldering may be accomplished in a reliable manner using a solder bar.

[0011] Various embodiments of the present invention may incorporate one or more of these and the other features described herein. A better understanding of the nature and advantages of the present invention may be gained by reference to the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figure 1 illustrates a connector plug according to an embodiment of the present invention;

[0013] Figure 2 illustrates a side view of a connection between a cable and a connector insert shield;

[0014] Figure 3 illustrates a cap that may be located over solder locations joining a cable braiding and connector insert shield;

[0015] Figure 4 illustrates a crimping technique that may be employed by embodiments of the present invention;

[0016] Figure 5 is a cross-section of a high-speed cable according to an embodiment of the present invention;

[0017] Figure 6 is a more detailed view of a twisted pair according to an embodiment of the present invention;

[0018] Figure 7 illustrates a side view of a portion of the cable according to an embodiment of the present invention;

[0019] Figure 8 illustrates the construction of a cable according to an embodiment of the present invention;

[0020] Figure 9 illustrates a wire comb that may be used to align twisted-pairs emerging from a cable according to an embodiment of the present invention;

[0021] Figure 10 illustrates a plurality of conductors that may be soldered to solder pads on a printed circuit board;

[0022] Figure 11 illustrates a method of soldering conductors to a printed circuit board according to an embodiment of the present invention;

[0023] Figure 12 illustrates a connector insert according to an embodiment of the present invention; and

[0024] Figure 13 illustrates an exploded view of a connector insert according to an embodiment of the present invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0025] Figure 1 illustrates a side view of a connector plug according to an embodiment of the present invention. This figure, as with the other included figures, is shown for illustrative purposes and does not limit either the possible embodiments of the present invention or the claims.

[0026] Again, this plug may be part of an active cable for high-speed data communications. As such, it may include active circuitry, such as chip 140, which consumes power and generates heat. This heat can reduce the reliability of the active circuitry and make for an unpleasant user experience if it becomes excessively hot. Thus, it is desirable to remove heat from this connector plug. Accordingly, embodiments of the present invention may provide several low thermal resistance paths to dissipate this heat.

[0027] This connector plug includes plug connectors 110, which may mate with conductors of a connector receptacle (not shown). Plug connectors 110 may mechanically attach to printed circuit board 120. These plug connectors 110 may electrically connect to chip 140 using traces on printed circuit board 120. Plug connectors and chip 140 may connect to wires and cable 130 via traces on printed circuit board 120. Housing 170 may be used to surround shield 150.

[0028] Chip 140 may be an example circuit of many circuits that may generate the majority of heat in this plug. Again, embodiments of the present invention may employ several paths by which heat can be dissipated. In the first, heat can be removed from chip 140 directly to shield 150. Accordingly, a thermal conductor layer 160 may be used to provide a thermal path from chip 140 to shield 150. In a second path, chip 140 may attach to printed circuit board 120, thereby allowing heat to flow into printed circuit board 120. A solder area 180, which may be on the side, bottom, or top of printed circuit board 120, may be soldered to a portion of shield 150, thereby creating a low thermal resistance path from the printed circuit board to the shield for heat dissipation. From the shield, head can dissipate out through the cable. In a specific embodiment of the present invention, a side of the printed circuit board 120 is plated and soldered to the shield. The heat thus travels from the chip to the printed circuit board, then to the shield via the edge plating, then to the cable via cable braiding.

[0029] In a third path, the cable (not shown) also provides a path for heat to leave this plug. As will be seen below, a braiding or other layer of the cable may be soldered or otherwise attached to shield 150. This may allow head to dissipate through the cable. In other embodiments of the present invention, a low thermal path, which may include liquid, metal, or other material, may be included in the cable.

[0030] Plug conductors 110 may also provide a heat path into a device receptacle. The device receptacle may be designed to provide low thermal resistance paths to further aid in the dissipation of heat in the plug.

[0031] Again, much of the heat generated by active circuitry in the connector insert can be removed via conduction through the cable. An example of how this is done is shown in the following figures.

[0032] Figure 2 illustrates a side view of a connection between cable 230 and connector insert shield 250. Cable braiding 234 may be pulled away from cable 230 and soldered to shield 250 at solder locations 236. Conductors (not shown) in cable 230 may connect to circuitry inside shield 250. Housing 270 may surround portion of shield 250 to provide thermal insulation and the location for a user to grasp the connector insert.

[0033] As cable braiding 234 is separated from cable 230, one or more openings 238 may form. For example, shield 250 may have a width greater than its height. Some or all of cable braiding 234 may attach to shield 250 along the width of shield 250, thereby leaving opening 238 along the height (or side) of shield 250. Opening 238 may provide a path for electromagnetic interference to be emitted from the cable conductors (not shown). Accordingly, embodiments of the present invention may employ a cap or other structure over the opening 238. An example is shown in the following figure.

[0034] Figure 3 illustrates a cap 339 that may be located over solder locations 236 between a cable braiding 234 and connector insert shield 250 consistent with embodiments of the present invention. Cap 339 may be formed of metal such as aluminum, stainless steel, or other material. During manufacturing, cap 339 may be placed over solder locations 236 and crimped to be held in place. Cap 339 may also be soldered to provide additional shielding and mechanical support.

[0035] Conventional techniques used to crimp caps, such as cap 339, often smash the cap and distort it, thereby possibly damaging the cable. Accordingly, embodiments of the present invention may crimp cap 339 by applying forces in multiple directions. An example is shown in the following figure.

[0036] Figure 4 illustrates a crimping technique employed by various embodiments of the present invention. In this particular example, force is applied in four directions by tool die 410 on cap 439. These forces may crimp cap 439 in a highly symmetrical manner for improved yield, improved EMI isolation, and mechanical stability. Also, this technique may reduce asymmetric forces that cable 330 would otherwise experience, thereby reducing the chance of damage to interior conductors (not shown) in cable 330 during manufacturing.

[0037] In this particular embodiment of the present invention, force may be applied to cap 439 in four directions, though in other embodiments of the present invention, force may be applied in other numbers of directions, such as two, three, or more than four directions.

[0038] Again, embodiments of the present invention may provide a cable having a high strength. To provide this increased strength, a shield or braiding surrounding the cable or one or more of its conductors may include one or more types of fibers. For example, aramid fibers may be included in a shield or braiding around the cable. Unfortunately, aramid fibers may interfere with the soldering process outlined above. To simply soldering of the braiding, the aramid or other fibers may be bunched or grouped in the cable shield or braiding, such that they may be pulled out of the way during soldering. In various embodiments of the present invention, these fibers may be pulled out of the way using static electricity, or by other mechanisms. An example of such a cable is shown in the following figure.

[0039] Figure 5 is a cross-section of a high-speed cable according to an embodiment of the present invention. This cable may include four twisted pairs 520 and four single wires 530. Twisted pairs 520 may be used to carry differential signals, multiple single ended signals, power, ground, bias, control, status, or other types of signal, power, status, or control lines. Single wires 530 may be used to convey single ended signals, one side of a differential signal, power, ground, bias control, status, or other types of signal, power, status, or control lines. In other embodiments the present invention, cables consistent with embodiments of the present invention may include other numbers of twisted pairs and single wires.

[0040] In this example, twisted-pairs 520 and single wires 530 surround a nylon core 560, which is used for mechanical support. In other embodiments of the present invention, nylon core 560 may be substituted by a wire, one or more fiber-optic lines, or other conductor or fiber. These connectors may be bound by shield tape 580.

[0041] Shield braid 540 may surround the cable. Jacket 570 may surround shield braid 540 and provide mechanical support for the cable. Again, aramid fibers 550 may be dispersed or grouped in shield braid 540. Shield braid 540 may be a conventional interwoven braiding, shield braid 540 may be formed of one or more counter-rotating spirals, or shield braiding 540 may be formed in other various ways.

[0042] Figure 6 is a more detailed view of twisted pair 520 according to an embodiment of the present invention. Twisted pairs 520 may include two conductors 610 surrounded by insulation layer 630. Spiral shield 620 may surround twisted-pair 520 and provides shielding against electromagnetic interference. Spiral shield 620, like shield braid 540, may be formed of braiding, one or more counter-rotating spirals, or other ways. Copper Mylar tape layer 670 may bind and provide mechanical support for spiral shield 620 and conductors 610.

[0043] Again, embodiments of the present invention may employ one, two, or more counter-rotating spirals as a shield. An example is shown in the following figure.

[0044] Figure 7 illustrates a side view of a portion of the cable according to an embodiment of the present invention. This figure illustrates a cable surrounded by jacket 710. Jacket 710 has been cut away to reveal a first counter-rotating spiral 720 and a second counter-rotating spiral 730. The first of these spirals may have an angle approximately equal to phi 740. In a specific embodiment of the present invention, phi may be equal to 17 degrees. In other embodiments of the present invention, other angles may be used. The second of these may have approximately the same relative angle, shown here as negative phi 742 to indicate a different absolute direction.

[0045] In this way, during manufacturing, the wires in the counter-rotating spirals 720 and 730 may be easily peeled away, straightened, and soldered or otherwise electrically connected to locations in a connector plug.

[0046] Utilizing counter-rotating spirals 720 and 730 may also improve flexibility of the cable. For example, when the cable is twisted in a first direction, counter-rotating spiral 720 may tighten while counter-rotating spiral 730 may loosen. The tightening of counter-rotating spiral 720 may protect the internal conductors. Similarly, when the cable is twisted in a second direction, counter-rotating spiral 730 may tighten while counter-rotating spiral 720 may loosen. The tightening of counter-rotating spirals 730 may protect the internal conductors.

[0047] Again, one or more different types of fibers may be employed by embodiments of the present invention. These fibers may be interspersed singly or in groups in one or more of the counter-rotating spirals 720 and 730. These fibers may be included for various reasons.

[0048] In a specific embodiment of the present invention, aramid fibers may be included for additional strength. Again, aramid fibers may interfere with soldering of the counter-rotating spirals 720 and 730 to locations such as a shield of, or pads in, a connector insert. Accordingly, in various embodiments of the present invention, these fibers may be pulled away from the wires in the counter-rotating spirals 720 and 730 by static electricity, air movement, or other methods.

[0049] The cable shown here may be made in a number of ways. In one, the wires and twisted pairs are pulled from spools and then wrapped in various layers for mechanical support. To improve reliability of the cable and reduce the chance of damage when the cable is used, the spools holding the wires and twisted pairs may be rotated during cable manufacturing. An example is shown in the following figure.

[0050] Figure 8 illustrates the construction of a cable according to an embodiment of the present invention. In this example, a number of spools 810 may each hold one of the conductors 820. As the cable is formed, spools 810 may rotate, thereby individually twisting the wires. Also, spools 810 may twist as a group, thus twisting the wires as a group. For example, spools 810 may twist one-half turn, one turn, two turns, or other fractions or numbers of turns per length of cable. This combined twisting action may be referred to as planetary wire feeding, or as a planetary twist. In other embodiments of the present invention, other types of assembly may be used. For example, a back twist, or no twist, may be used. The various conductors may be bound together, for example using tape 825. A jacket may be extruded at 830, thus sealing the wires.

[0051] Spools 810 may hold various types of conductors or groups of conductors. For example, they may hold single conductors, coaxial cables, twisted pairs or shielded twisted pairs, or other types of conductors or groups of conductors. In a specific embodiment of the present invention, the conductors on one or more spools 810 are grouped in pairs, referred to as twinaxial, or twinax cables.

[0052] Again, cables according to embodiments of the present invention may include a number of twisted pairs 520 and single wires 530, as shown in Figure 5. The wires may connect to a printed circuit board in a connector insert, such as printed circuit board 120 in Figure 1. However, twisted pairs 520 may emerge from an end of the cable in any orientation. As such, it may be difficult to solder the twisted pairs 520 to printed circuit board 120. Accordingly, embodiments of the present invention may employ a wire comb to align the twisted pairs 520 in order to simplify soldering to printed circuit board 120. Use of such a comb may improve the manufacturability of connector inserts according to embodiments of the present invention. An example of such a wire comb is shown in the following figure.

[0053] Figure 9 illustrates a wire comb 910 that may be used to align twisted-pairs emerging from a cable according to an embodiment of the present invention. Wire comb 910 may include a plurality of non-circular openings 920 and circular openings 930. Twisted pairs 520 may be untwisted to the point where they fit in openings 920, then passed through openings 920. Single wires 530 may be passed through openings 930. In this way, connectors from a cable may be aligned as they emerge from wire comb 910. This allows the conductors to be soldered to printed circuit board 120, as shown in the following figure.

[0054] Figure 10 illustrates a plurality of conductors 1010 that may be soldered to solder pads 1040 and 1070 on a printed circuit board, such as printed circuit board 120. Specifically, connectors 1010 are covered by jacket 1020. Jacket 1020 may be removed thereby exposing braiding or shield layers 1030. Shield layers 1030 may be soldered to pads 1040. An internal isolation layer 1050 may be stripped away leaving connector terminals 1060, which may be soldered to pads 1070.

[0055] Once conductors 1010 are aligned, it may be desirable to be able to solder shield layers 1030 to pads 1040 and connectors 1060 to pads 1070 in a reliable manner. Accordingly, embodiments of the present invention may employ a shaped solder bar during the soldering process. An example is shown in the following figure.

[0056] Figure 11 illustrates a method of soldering conductors to a printed circuit board according to an embodiment of the present invention. In this example, twisted-pair conductors 1120 are to be soldered to pads on a printed circuit board 1130. A shaped solder bar 1140 may be placed over connectors 1120. Hot bar 1110 may be heated, for example by passing a current from one end to another. Hot bar 1110 may be lowered such that solder bar 1140 is heated and flows, thereby soldering a shield layer of twisted pair is 1120 to pads on printed circuit board 1130. In this example, hot bar 1110 may include recesses 1150 such that solder bar 1140 is evenly heated. This configuration may provide a reliable solder connection between a shield braid of twisted-pair 1120 and a pad on printed circuit board 1130.

[0057] Figure 12 illustrates a connector insert according to an embodiment of the present invention. This connector insert includes an insert portion 1210 to fit in a compliant connector receptacle. Housing 1220 may be included such that a user can manipulate the connector insert. Stress relief and cable 1230 are also included for illustrative purposes.

[0058] Figure 13 illustrates an exploded view of a connector insert according to an embodiment of the present invention. Conductors of cable 1305 pass through wire comb 1140 as described above. These conductors attach to printed circuit board 1350. One or more circuits 1355 may be located on printed circuit board 1350. Contacts 1365 may be supported by structure 1360, and attach to printed circuit board 1350. Frame portions 1310 and 1312 may encapsulate printed circuit board 1350 and active circuitry 1355. Housing portions 1332 and 1320 may form a housing around the connector insert. A dust shield 1370 may be provided to protect the connector insert during transport and shipment.

[0059] The above description of embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form described, and many modifications and variations are possible in light of the teaching above. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications to thereby enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. Thus, it will be appreciated that the invention is intended to cover all modifications and equivalents within the scope of the following claims.

WHAT IS CLAIMED IS:

1. A method of manufacturing a connector insert comprising:

separating a plurality of fibers in a cable shield layer from a plurality of metallic wires;

forming a solder connection between the plurality of metallic wires to a shield of the connector insert;

placing a cap over the solder connection; and

crimping the cap.

2. The method of claim 1 wherein the plurality of fibers are aramid fibers.

3. The method of claim 1 wherein the cable shield layer is a braided layer.

4. The method of claim 1 wherein the cable shield layer is formed of a plurality of counter-rotating spirals.

5. The method of claim 1 wherein the cap is crimped by applying forces in a plurality of directions.

6. The method of claim 1 wherein the cap is crimped by applying forces in four directions.

7. The method of claim 6 further comprising:

soldering the cap to the connector insert.

8. The method of claim 1 further comprising:

soldering a conductive pad on a printed circuit board to an inside wall of the connector insert.

9. The method of claim 8 wherein the conductive pad is on an edge of the printed circuit board.

10. The method of claim 8 further comprising:

thermally coupling an active device on the printed circuit board to the shield.

11. A method of manufacturing a connector insert comprising:

separating a plurality of shielded twisted pairs of wires in a cable, each shielded twisted pair having a non-circular shape;

untwisting each of the shielded twisted pairs to enable their insertion into a corresponding opening in a block, each corresponding opening in the block having a non-circular shape similar to the a non-circular shape of the shielded twisted pairs; and

soldering shields for each of the shielded twisted pairs to a substrate using a shaped bar of solder.

12. The method of claim 11 wherein the non-circular shape is an ellipse.

13. The method of claim 11 wherein the non-circular shape is approximately elliptical.

14. The method of claim 11 wherein the block is a wire comb.

15. The method of claim 11 further comprising separating a plurality of wires in the cable; and

inserting the wires into corresponding openings in the block,

wherein the wires and corresponding openings are at least approximately circular.

16. The method of claim 15 wherein the shaped bar of solder is shaped to approximately fit the plurality of wires and plurality of shielded twisted pairs.

17. A connector insert and cable apparatus comprising:

an insert shield;

a cable comprising a plurality of twisted pairs, a plurality of wires, and a shield layer electrically connected to the insert shield;

a cap over a connection between the shield layer and the insert shield;

a block having a plurality of non-circular openings for the twisted pairs and a plurality of approximately circular openings for the wires, wherein the plurality of twisted pairs and a plurality of wires pass through the block using the openings;

a printed circuit board coupled to at least one of the twisted pairs, the printed circuit board having a pad connected to the insert shield; and

an active device fixed to the printed circuit board and thermally coupled to the insert shield.

18. The connector insert and cable apparatus of claim 17 wherein the cable shield layer is soldered to the insert shield.

19. The connector insert and cable apparatus of claim 17 wherein each of the plurality of non-circular openings are approximately elliptical.

20. The connector insert of claim 17 wherein the pad is located on a side of the printed circuit board.

21. The connector insert of claim 17 wherein the cap is crimped over the connection between the shield layer and the insert shield.

22. The connector insert of claim 21 wherein the cap is soldered to the connector insert.

23. The connector insert of claim 17 further comprising:
a plastic housing covering a portion of the insert shield.

24. The connector insert of claim 17 wherein the cable shield layer comprises a plurality of fibers.

25. The connector insert of claim 24 wherein the plurality of fibers comprises aramid fibers.

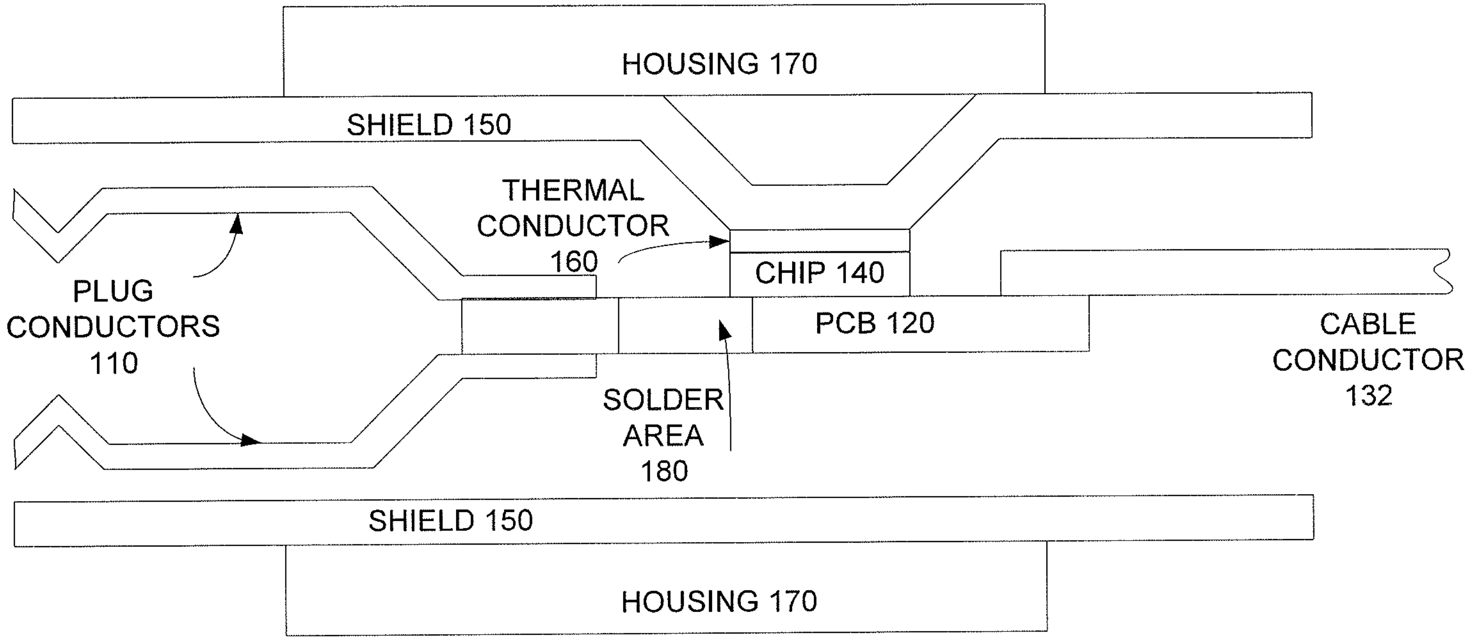
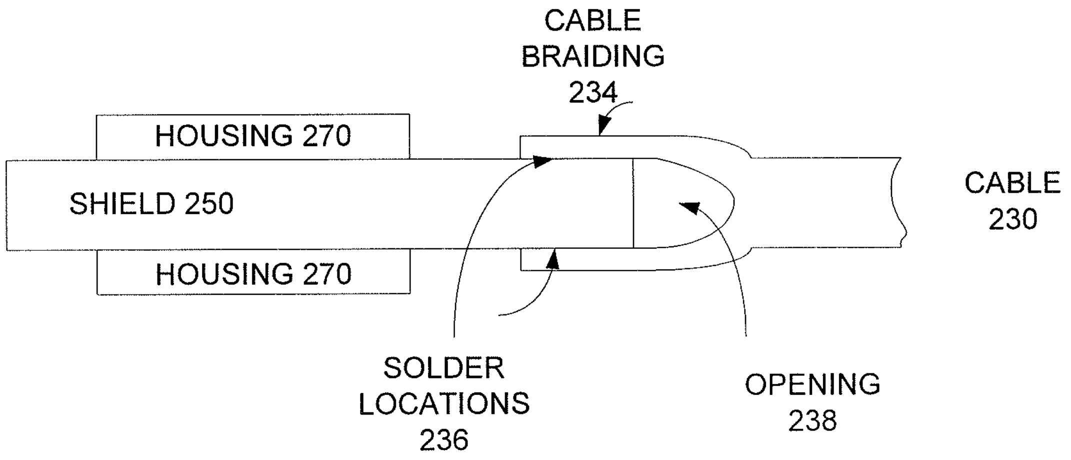

HOUSING 170
SHIELD 150
THERMAL CONDUCTOR 160
CHIP 140
PLUG CONDUCTORS 110
PCB 120
CABLE CONDUCTOR 132
SOLDER AREA 180
SHIELD 150
HOUSING 170

FIGURE 1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SOLDER
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OPENING
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FIGURE 2

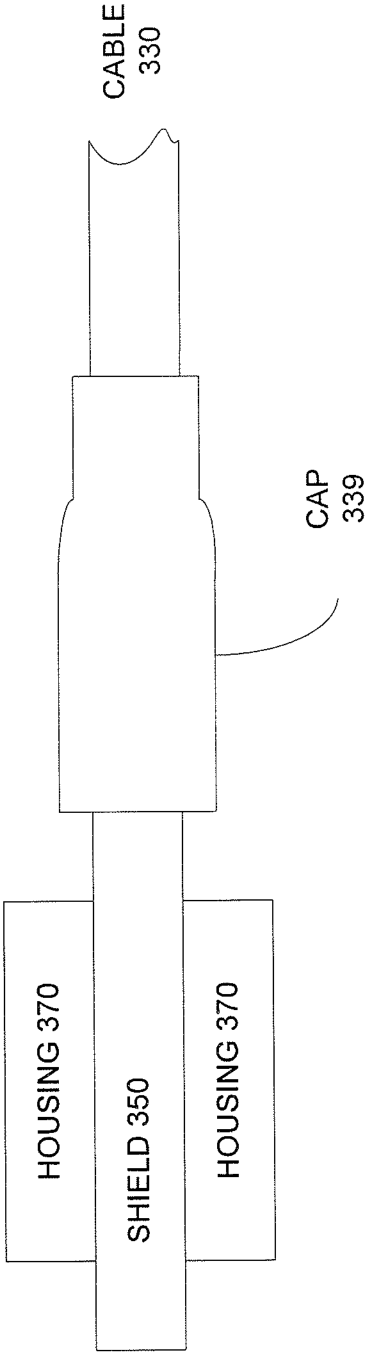


FIGURE 3

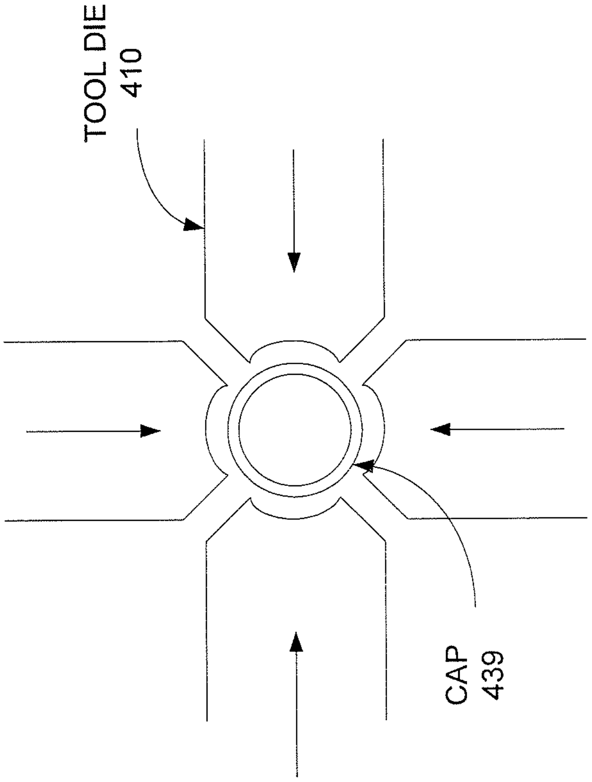
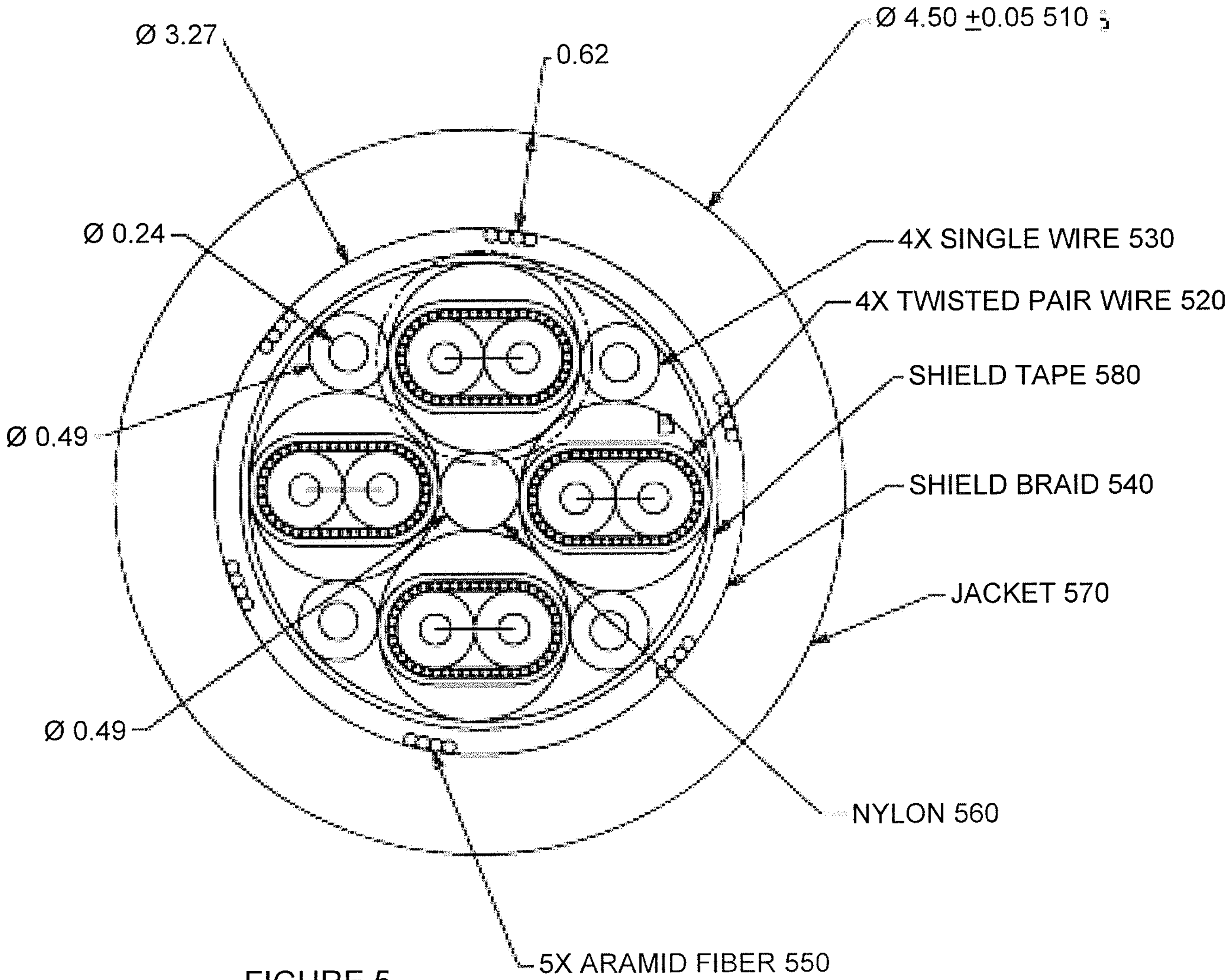


FIGURE 4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0.62
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4X SINGLE WIRE 530
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Ø 0.49
SHIELD BRAID 540
JACKET 570
Ø 0.49
NYLON 560
5X ARAMID FIBER 550

FIGURE 5

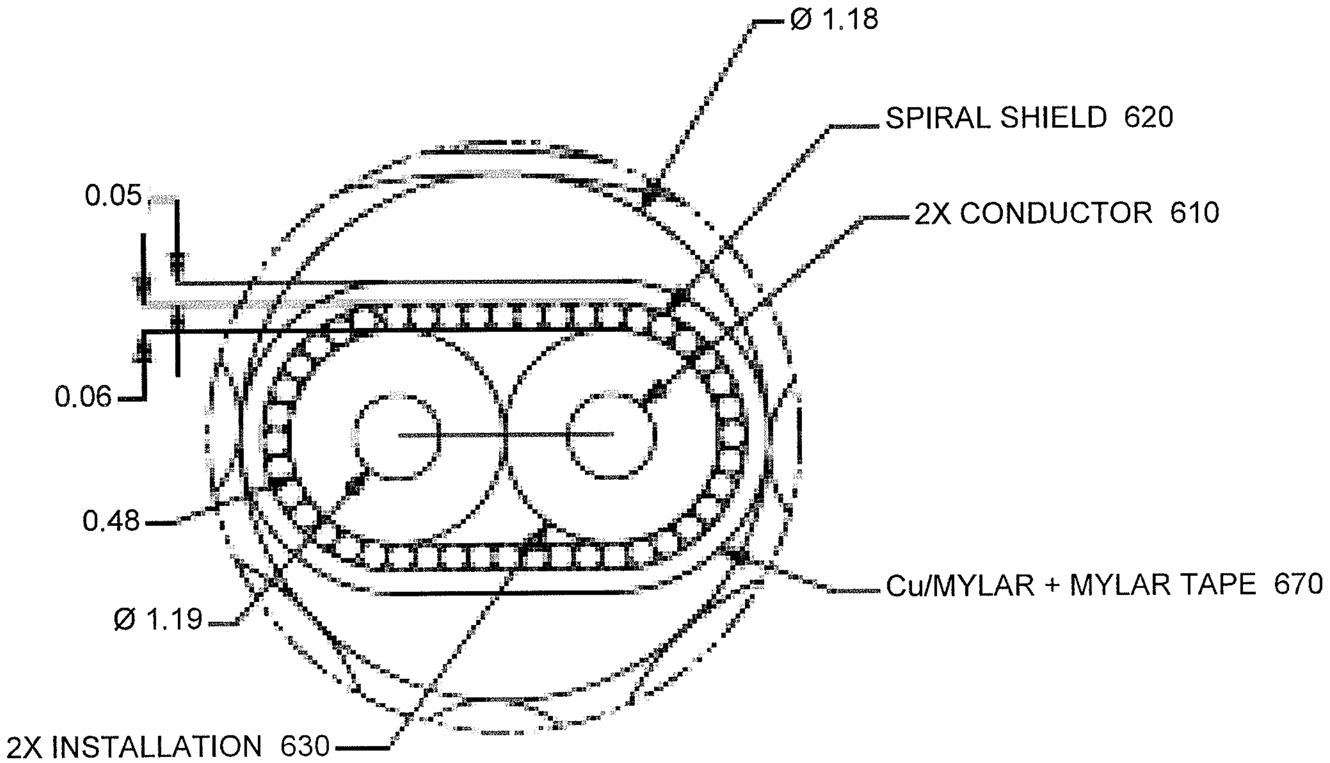
Ø 1.18
SPIRAL SHIELD 620
2X CONDUCTOR 610
0.05
0.06
0.48
Ø 1.19
Cu/MYLAR + MYLAR TAPE 670
2X INSTALLATION 630

FIGURE 6

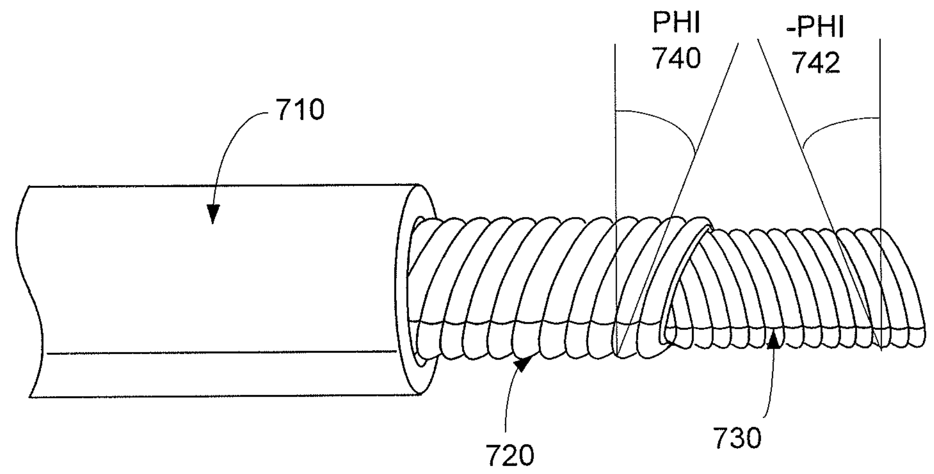

FIGURE 7

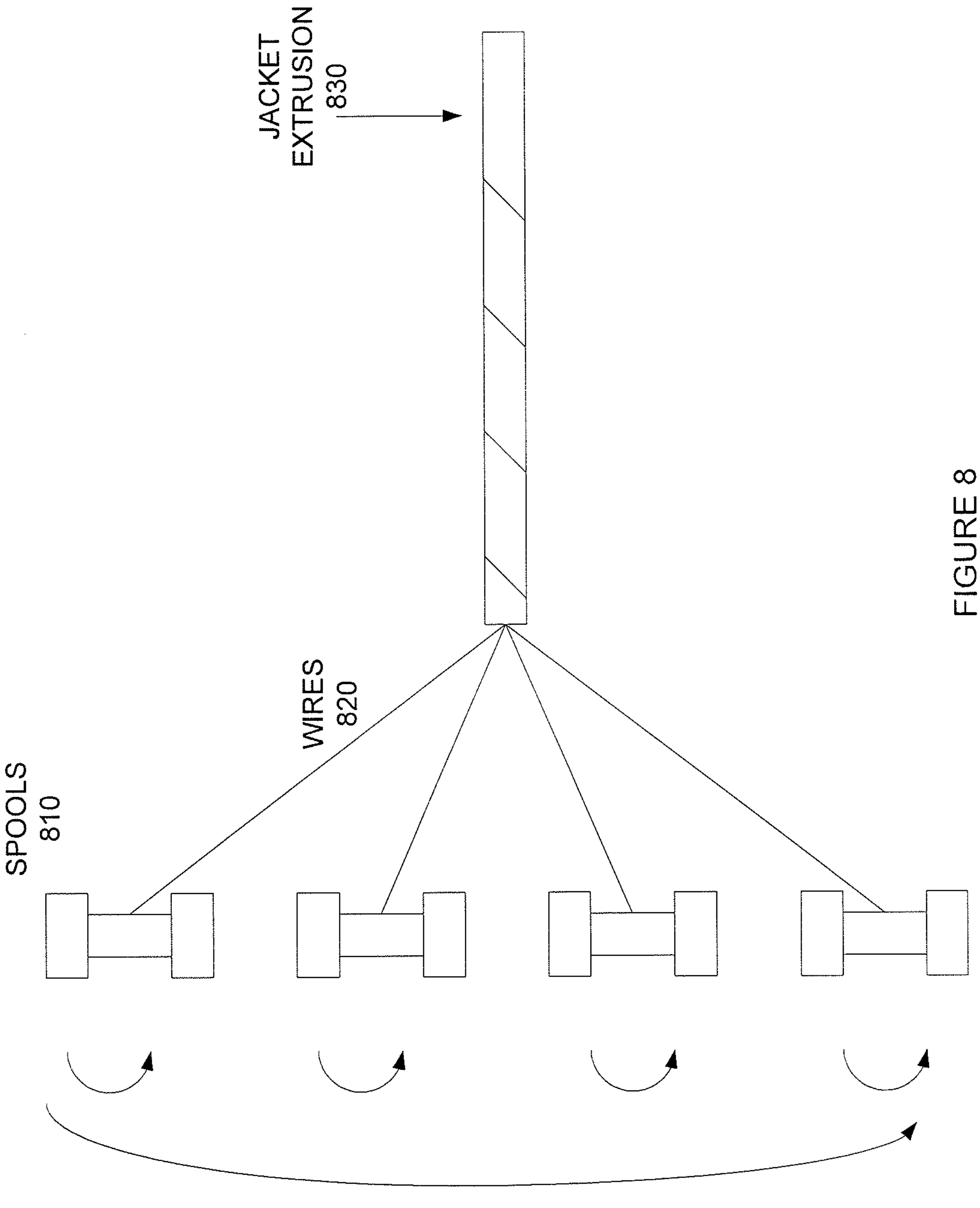

FIGURE 8

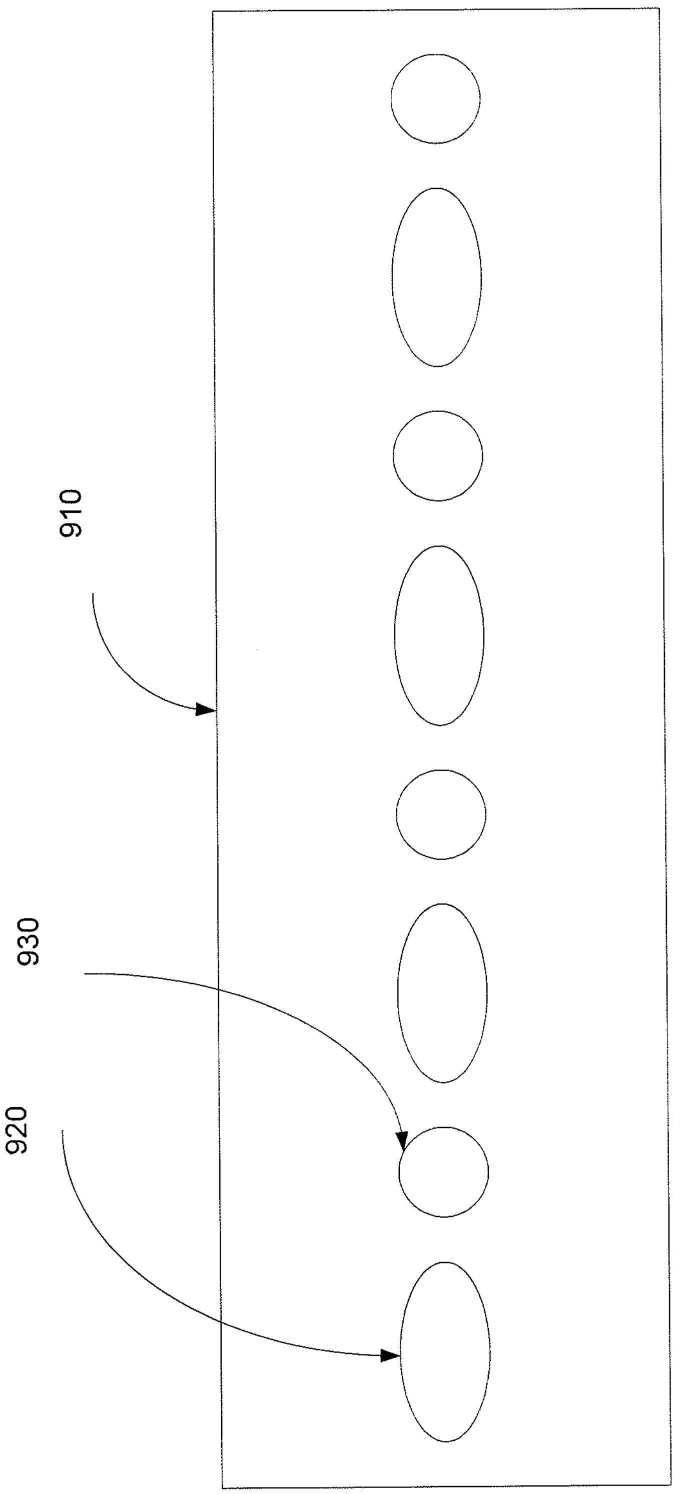

FIGURE 9

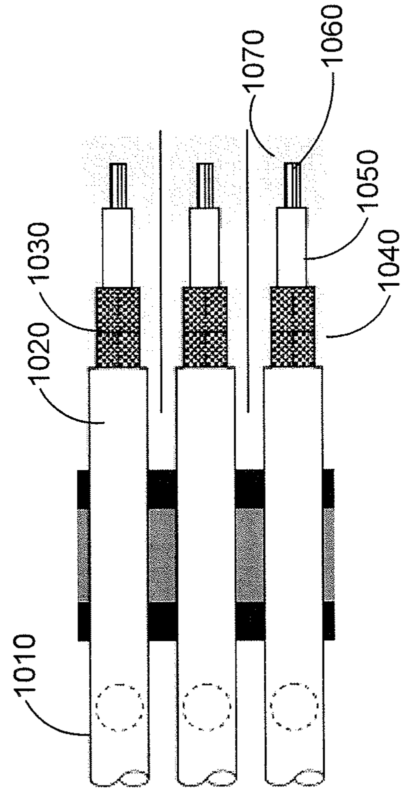

FIGURE 10

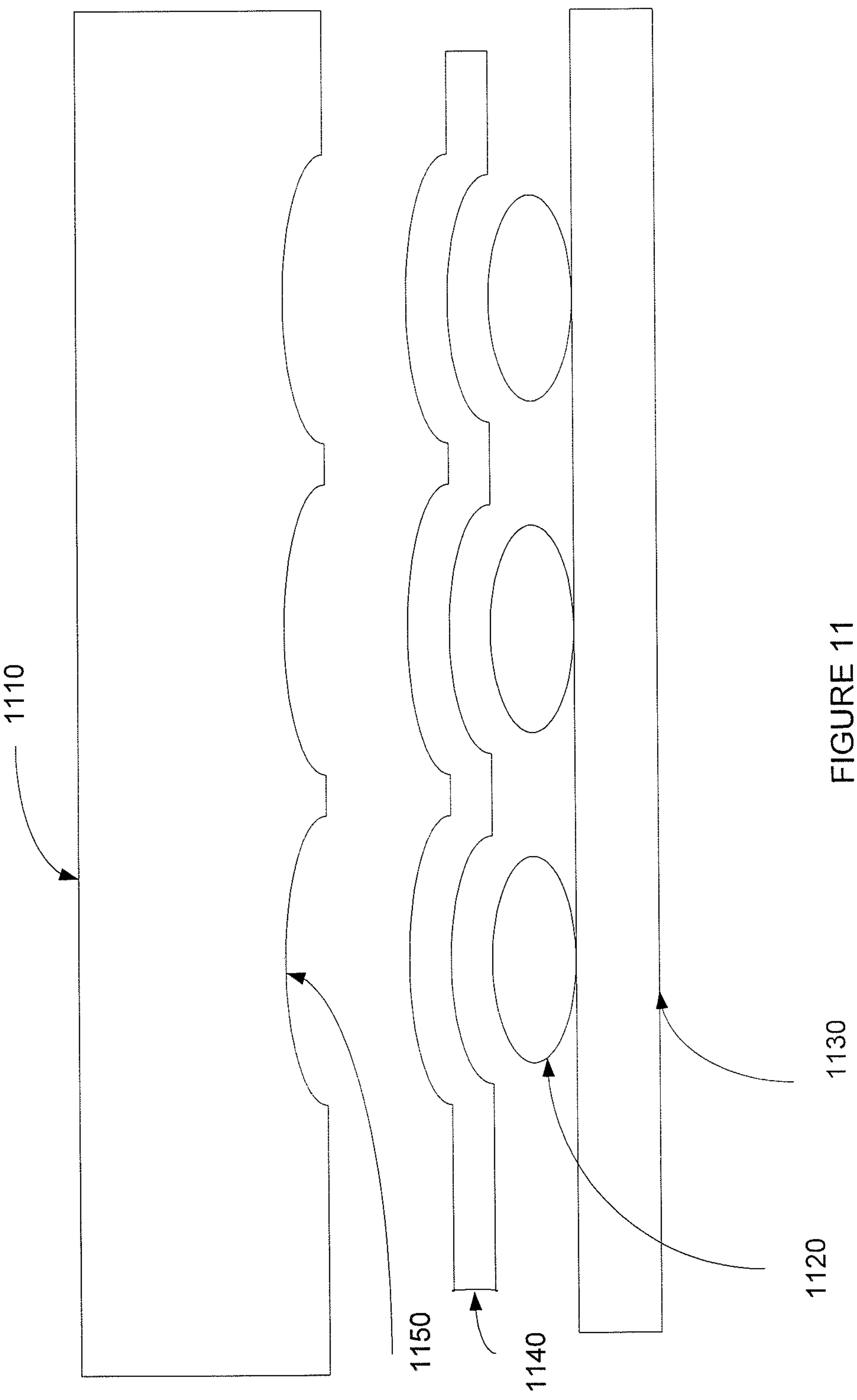

FIGURE 11

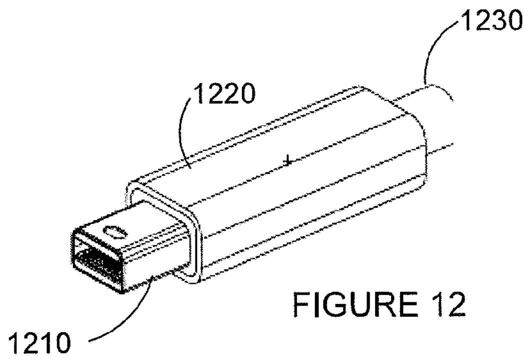

FIGURE 12

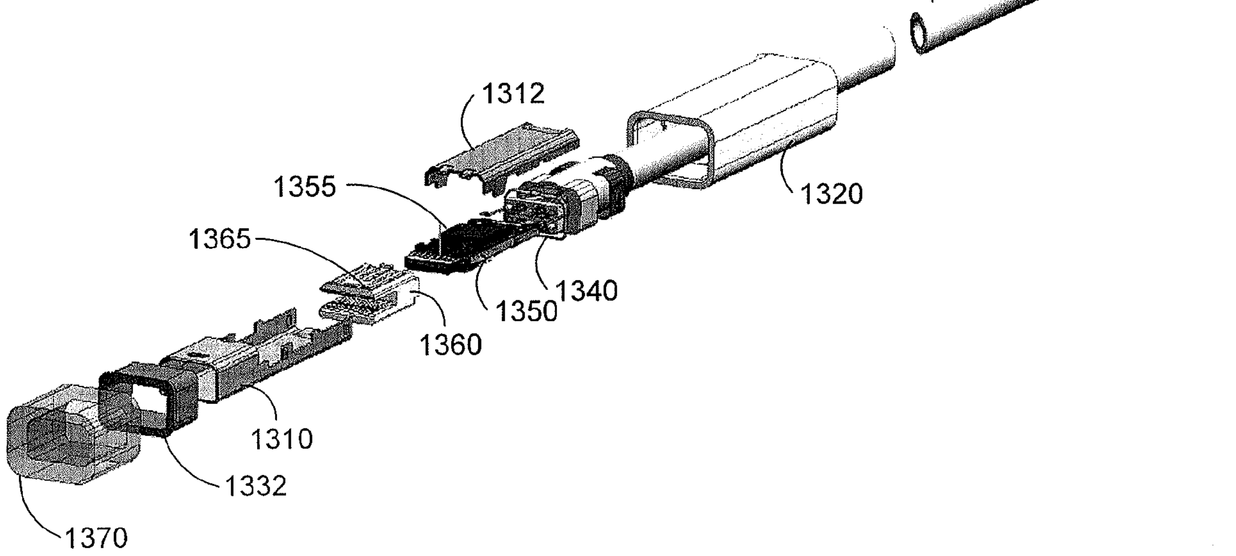

FIGURE 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/042634

A. CLASSIFICATION OF SUBJECT MATTER

INV.	H01R13/6592	H01R13/658	H01R43/02	
ADD.	H01R12/53	H01R9/03	H01R13/66	H01R107/Q0

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

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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7 255 602 Bl (DRIESSEN DARIN R [US] ET AL) 14 August 2007 (2007-08-14) column 2, line 21 - line 44; figure 1 -----	1-10
A	EP 1 202 419 Al (TYCO ELECTRONICS AMP KK [JP]) 2 May 2002 (2002-05-02) paragraph [0008] - paragraph [0015]; figures 1-5 -----	1
Y	US 2004/115988 Al (WU JERRY [US]) 17 June 2004 (2004-06-17) figures 1,2,3 ,4,5 ,5, 10 paragraph [0032] -----	17-25
Y	Wo 2009/039287 A2 (3M INNOVATIVE PROPERTIES CO [US]; KUWAHARA KENJI [JP]; END0H T0SHIR0H) 26 March 2009 (2009-03-26) figures 2,4a ----- -/--	17-25

☒ 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

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

"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 24 November 2011	Date of mailing of the international search report 30/11/2011
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Esmiol, Marc-01ivier

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/042634

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7 422 471 B1 (WU JERRY [US]) 9 September 2008 (2008-09-09) figures 1,2,6,8 -----	17-25
A	WO 2006/102606 A2 (PULSE ENG INC [US]; GUTIERREZ AURELIO J [US]; RENTERIA VICTOR [US]; MA) 28 September 2006 (2006-09-28) figure 1k -----	17

4

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/042634

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos. :

1-10, 17-25

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10

   method of manufacturing a connector insert by soldering metallic wires of the cable shield layer to a shield and by crimping a cap over the solder connection

   ---

2. claims: 11-16

   method of manufacturing a connector insert by soldering shields of shielded twisted pairs to a substrate using a bar of solder

   ---

3. claims: 17-25

   connector insert and cable apparatus comprising an insert shield, a cable having a shield layer electrically connected to the insert shield and twisted pairs and plurality of wires passing through a block

   ---

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2011/042634

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7255602 Bl	14-08-2007	NONE	
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		EP 1202419 Al	02-05-2002
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		US 2010210138 Al	19-08-2010
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		W0 2009039287 A2	26-03-2009
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		US 7422471 Bl	09-09-2008
WO 200610226Q6 A2	28-09-2006	CN 101248559 A	20-08-2008
		EP 1872447 A2	02-01-2008
		US 2007015416 Al	18-01-2007
		WO 2006102606 A2	28-09-2006