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Figure 6 illustrates a possible termination configurations for the electrical wire 200 according to the exemplary embodiments of the present invention therein;

Figure 7 illustrates an electrical wire that can be considered as forming a series of capacitors with an equivalent capacitive circuit according to the exemplary embodiments of the present invention;

5 Figures 8-10 provide schematic illustrations of a typical two plate capacitors, four plate capacitor and three plate capacitor, respectively, according to the exemplary aspects of the present invention; and

Figures 11-12 illustrates how capacitively coupled current may be canceled in the electrical wire, according the exemplary aspects of the present invention;

10 Figure 13 provides a schematic diagram of an exemplary configuration for detecting group loop continuity using the electrical wire, according to the exemplary aspects of the present invention;

Figure 14 provides a conceptual illustration for providing split ground signaling, according to the exemplary aspects of the present invention;

15 Figure 15 illustrates a method 1500 of fabricating an electrical wire according to the exemplary aspects of the present invention; and

Figures 16-17 provide exemplary configurations of the electrical wire 200 according to the exemplary aspects of the present invention.

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DETAILED DESCRIPTION OF EXEMPLARY

EMBODIMENTS OF THE INVENTION

Referring now to the drawings, and more particularly to Figures 2A-17, the present

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invention includes an electrical wire 200 and a method 1500 of fabricating the electrical wire.

As illustrated in Figure 2A, an the exemplary embodiment of present invention is directed to an electrical wire 200 including at least one electrifiable conductor 210, and first and second return conductors 221 which are respectively formed on opposing sides of the at least one

5 electrifiable conductor 210, such that the at least one electrifiable conductor is at least substantially entrapped by the first and second return conductors 221. The wire 200 may also include a first insulating layers 215 and second insulating layers 225.

It should be noted that unless otherwise noted, any of the layers (e.g., conductors, insulating layers, etc.) in the present invention and discussed herein may be formed of a plurality
10 of layers. Thus, for example, insulating layer 215 should be construed as at least one insulating layer 215, an electrifiable conductor should be construed to mean at least one (e.g., a plurality of) electrifiable conductors, and so on.

The electrical wire may used for a basically unlimited range of voltage applications (e.g., 0V to 240 V and higher). For example, the wire may include a Class 1 or Class 2 capability
15 and other low voltage/current capabilities, and may be used for commercially available utility voltages such 120V AC and 240V AC, and may be used for other applications other than Class 1 or Class 2, or these commercially available voltages.

As illustrated in Figure 2B, the electrical wire 200 may have a longitudinal (e.g., lengthwise) direction, L, and a transverse (e.g., widthwise) direction, W. These directions may
20 also be referred to as a horizontal dimension of the wire. The wire may further be considered as having a thickness (e.g., a total thickness of all of the stacked layers) which may be referred to as a vertical dimension.

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The wire 200 may also include terminal portions (e.g., terminations) (e.g., not illustrated in Figure 2B) formed at the ends of the wire 200 in the longitudinal direction. For example, one end (e.g., terminal portion) of the wire 200 may be connected to a source module (e.g., power source, voice/data transmission source, etc.) and the other end (e.g., terminal portion) may be
5 connected to a destination module (e.g., switch, outlet, electronic device, etc.). It should be noted that the present invention does not necessarily include any particular form termination (e.g., current source, earth ground, etc.) but may include a longitudinal portion of wire formed between two termination points.

As further illustrated, the first and second return conductors 221 are formed such that the
10 at least one electrifiable conductor is at least substantially entrapped (e.g., enveloped, surrounded, encased) by the first and second return conductors. By "substantially entrapped" it is meant that for all practical purposes, the electrifiable conductor 210 cannot be contact with a foreign object (e.g., a nail, screw, staple, etc.) without first touching the one of the return conductors 221. The term "substantially entrapped" does not necessarily mean that the return
15 conductors 221 completely surround the electrifiable conductor (although such a design is possible). Instead, it means that any distance between the return conductors and the electrifiable conductor (e.g., the thickness of an insulating layer between the electrifiable conductor and a return conductor) is so small (e.g., about 0.030" or less) that such a foreign object cannot reasonably go between the return conductors and the electrifiable conductor without touching the
20 return conductors.

For example, as illustrated in Figure 2B, the electrical wire 200 may be formed of layers (e.g., substantially flat layers) having a stacked configuration. At least some of these layers (e.g.,

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mechanical deformations and thermal fusing without the addition of any adhesive.

Referring again to the drawings, Figures 3A-3W illustrate cross-sectional views of possible configurations of the electrical wire 200 according the exemplary aspects of the present invention (for simplicity, the insulating layers are not identified in Figures 3A-3W).

- 5 For example, the wires of Figures 3A and 3M are similar to the wires of Figures 2B and 2C, respectively. As shown in Figures 3B, 3E and 3N, the conductors may have a staggered arrangement and may include non-uniform widths (e.g., in a transverse direction).

- As illustrated in Figure 3C, the conductors (e.g., hot conductor 210 may be folded over on themselves). Further, as illustrated in Figure 3D, another conductor (e.g., return
10 conductor 221) may be folded over a folded conductor (e.g., Electrifiable conductor 210).

- As illustrated in Figure 3F, the conductors may be treated (e.g., thermally, chemically or mechanically) or bonded by some manner on a side. For example, in Figure 3F, an upper conductor 222 is joined (e.g., by stitching, seam welding, chemical bonding, or other mechanical means) to a lower conductor 222. This may be used to provide a more protective barrier along
15 the longitudinal edges of the electrical wire, making it more difficult for an object to penetrate the electrical wire and contact the electrifiable conductor from such longitudinal edge.

- Figure 3G-3I illustrates a wire in which a conductor 210 has a round shape, whereas conductors 221 and 222 are wave-shaped or substantially flat. Further, Figures 3J-3L illustrate a wire in which the conductors may each be bent such that they are formed in more than one plane.
20 For example, in Figure 3J, the conductor 221 has a bent configuration for substantially surrounding the conductors 210.

Figure 3O and 3S illustrate a wire in which a conductor 210 has a substantially oblong

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transmission signals. For example, the wire may be used as part of power line carrier (PLC) communication system in which the wire (e.g., a portion of the wire) is used to provide AC electrical power, and is also used (e.g., a portion of the wire is used) as a network medium to transmit voice and/or data communication signals. Thus, the wire may be used to provide high speed network access points wherever there is an AC electrical outlet.

Specifically, the wire may transmit electrical communication signals during the time proximity of zero-crossing of an AC power supply. In addition, there can be many different types (e.g., formats) of communication signals transmitted by the wire including RS485, HDTV, etc., according to the present invention.

- 10 For example, as illustrated in Figure 4A, the electrical wire 200 may also include a portion 450 which may be reserved for an electrical signal (e.g., a communications signal) in addition to an electrical power being supplied elsewhere by the "hot zone". For example, the conductors in this reserved portion 450 may include patterned conductors such as those described in McCurdy, et al., U. S. Pat. No. 6,688,912 (NON-UNIFORM TRANSMISSION LINE
- 15 AND METHOD OF FABRICATING THE SAME) which was filed on May 28, 2002 and published on December 4, 2003, and which is commonly assigned with the present Application and is incorporated by reference herein. Further, the wire 200 may include a plurality of such portions 450 which may each be dedicated to carrying the same or different types (e.g., formats) of communication signals.

- It should be noted that the electrical wire according to the exemplary aspects of the
- 20 present invention may be used for transmitting communication signals independently of any electrical current. That is, the Electrifiable conductors may be dedicated entirely to communication signals or entirely to an electrical power supply.

CLAIMS

What is claimed is:

1. An electrical wire comprising:
5 at least one electrifiable conductor; and
first and second return conductors which are respectively formed on opposing sides of
said at least one electrifiable conductor, such that said at least one electrifiable conductor is at
least substantially entrapped by said first and second return conductors.
- 10 2. The electrical wire according to claim 1, further comprising:
first and second insulating layers which are formed between said at least one electrifiable
conductor and said first and second return conductors, respectively.
3. The electrical wire according to claim 1, wherein said at least one electrifiable conductor
15 and said first and second return conductors comprise substantially flat conductive layers having a
stacked arrangement.
4. The electrical wire according to claim 3, wherein a distance between said at least one
electrifiable conductor and each of said first and second return conductors is no greater than
20 about 0.030 inches.

5. The electrical wire according to claim 1, wherein said first and second return conductors contact each other along a longitudinal edge of said electrical wire, such that said electrifiable conductor is completely entrapped by said first and second return conductors.

5 6. The electrical wire according to claim 1, wherein said first and second return conductors are treated by at least one of a mechanical, chemical and thermal treatment to form a protective longitudinal edge of said electrical wire, said protective edge inhibiting a foreign object from penetrating said electrical wire and contacting said Electrifiable conductor without contacting one of said first and second return conductors.

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7. The electrical wire according to claim 2, wherein said first and second insulating layers, contact each other along a longitudinal edge of said electrical wire.

8. The electrical wire according to claim 7, wherein said first and second insulating layers
15 are treated by at least one of a mechanical, chemical and thermal treatment to form a protective longitudinal edge of said electrical wire, said protective edge inhibiting a foreign object from penetrating said electrical wire and contacting said Electrifiable conductor.

9. The electrical wire according to claim 2, further comprising:
20 an outer insulating layer formed on said first and second return conductors.

10. An electrical wire comprising:

at least one electrifiable conductor;

first and second insulating layers formed on opposing sides of said at least one electrifiable conductor;

first and second return conductors formed on said first and second insulating layers,
5 respectively, such that said at least one electrifiable conductor is at least substantially entrapped
by said first and second return conductors;

third and fourth insulating layers formed on said first and second return conductors,
respectively;

first and second grounding conductors formed on said third and fourth insulating layers,
10 respectively; and

fifth and sixth insulating layers formed on said first and second grounding conductors,
respectively.

11. The electrical wire according to claim 10, wherein said first and second return conductors
15 are treated by at least one of a mechanical, chemical and thermal treatment to form a protective
longitudinal edge of said electrical wire, said protective edge inhibiting a foreign object from
penetrating said electrical wire and contacting said Electrifiable conductor without contacting
one of said first and second return conductors.

20 12. The electrical wire according to claim 10, wherein an area between said first and second
return conductors forms a hot zone, said at least one electrifiable conductor being disposed
within said hot zone.

13. The electrical wire according to claim 12, wherein said at least one Electrifiable conductor comprises a plurality of Electrifiable conductors which are formed in said hot zone and comprise a plurality of horizontal segments across a width of said wire and a plurality of
5 vertical segments across a thickness of said wire.
14. The electrical wire according to claim 13, wherein at least one segment in said plurality of horizontal segments of said Electrifiable conductors is used to transmit a communication signal, and
10 wherein at least one segment in said plurality of horizontal segments of said Electrifiable conductors is used to supply one of AC and DC electrical power.
15. The electrical wire according to claim 14, wherein said communication signal comprises one of a voice communication signal and a data communication signal.
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16. The electrical wire according to claim 10, wherein a capacitance formed between said at least one Electrifiable conductor and said first and second return conductors is given as $C = 1.5 \cdot W \cdot L \cdot \epsilon / d$, where W is the width of the return and electrifiable conductors, L is the length of the return and electrifiable conductors, ϵ is the dielectric constant for the first and second insulating
20 layers, and d is the distance between each of the return and electrifiable conductors.
17. The electrical wire according to claim 10, further comprising:

an adhesive for bonding adjacent insulation layers and conductors in said electrical wire.

18. The electrical wire according to claim 10, wherein an object penetrating an outer surface of said electrical wire contacts one of said first and second grounding conductors and one of said
5 first and second return conductors, before contacting said at least one Electrifiable conductor.

19. The electrical wire according to claim 10, wherein said first and second grounding conductors inhibit power transmission signals and load-generated electrical noise from being emitted from said electrical wire.

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20. The electrical wire according to claim 10, wherein said first and second return conductors and said first and second grounding conductors comprise a rate of heat dissipation which is greater than a rate of heat dissipation for an round conductor, for a given cross-sectional area.

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21. The electrical wire according to claim 10, wherein said electrical wire comprises one of alternating current (AC) electrical wire and direct current (DC) electrical wire for supplying an electrical current having potential of greater than 0V.

20 22. The electrical wire according to claim 10, wherein said electrical wire comprises surface-mountable electrical wire.

23. The electrical wire according to claim 10, wherein said first and second return conductors each have a thickness T_G , and said first and second grounding conductors each have a thickness T_N , and said Electrifiable conductor has a thickness T_H , such that a ratio of thicknesses $R = (T_G + T_N)/T_H$ is at least 1.00

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24. An electrical wire comprising:

at least one electrifiable conductor;

a first insulating layer formed around said at least one electrifiable conductor;

a return conductor formed around said first insulating layer, such that said at least one

10 electrifiable conductor is at least substantially entrapped by said return conductor; and

a second insulating layer formed around said return conductor.

25. The electrical wire according to claim 24, further comprising:

a grounding conductor formed around said second insulating layer; and

15 a third insulating layer formed around said grounding conductor.

26. The electrical wire according to claim 24, wherein said electrifiable conductor, said return conductor and said grounding conductor comprise one of substantially curvilinear-shaped cross-sectional geometries and substantially rectilinear cross-sectional geometries.

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27. The electrical wire according to claim 24, wherein said electrifiable conductor, said return conductor and said grounding conductor are formed in substantially parallel planes.

28. The electrical wire according to claim 24, wherein said electrical wire comprises a substantially flat electrical wire having a total thickness of no more than about 0.050 inches.
- 5 29. The electrical wire according to claim 24 wherein said electrifiable conductor, said return conductor and said grounding conductor comprise substantially oval-shaped conductors.
30. A method of fabricating an electrical wire, comprising:
forming at least one electrifiable conductor; and
10 forming first and second return conductors on opposing sides of said at least one electrifiable conductor, such that said at least one electrifiable conductor is at least substantially entrapped by said return conductors.
31. An electrical current delivery system comprising the electrical wire of claim 1.
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32. An electrical signal transmission system comprising the electrical wire of claim 1.