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Haensgen et al.

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(54) **CONNECTOR WITH SLIDING TAP**

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See application file for complete search history.

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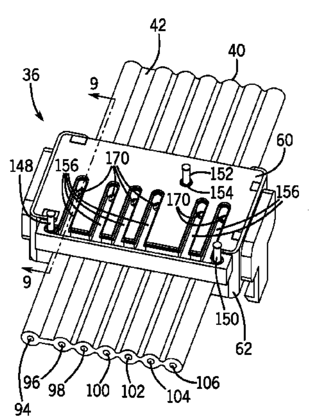
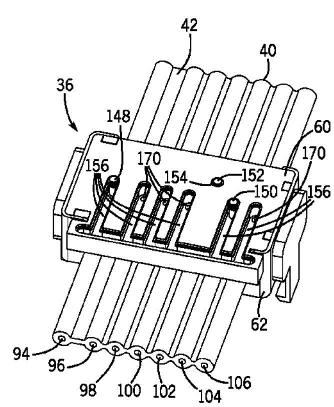
(57) **ABSTRACT**

The disclosed embodiments relate generally to a modular connector for a multi-conductor ribbon cable provided for power and data transmission to a network of devices. The modular connector is coupled to the conductors in the ribbon cable by insulation displacement members. The connector contains both fixed and movable conductor punches used to configure a network interface.

20 Claims, 10 Drawing Sheets





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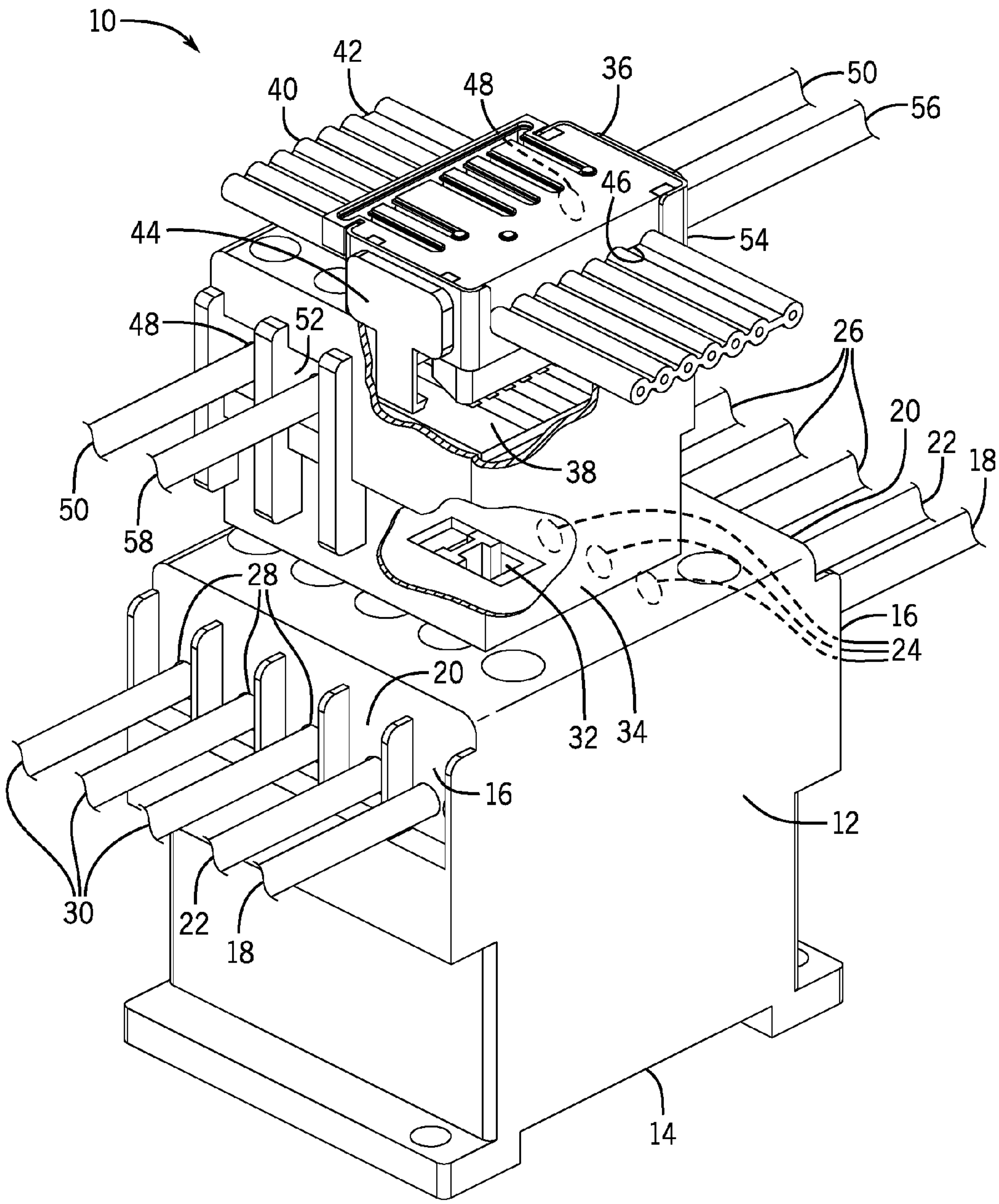
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42
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52
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14

FIG. 1

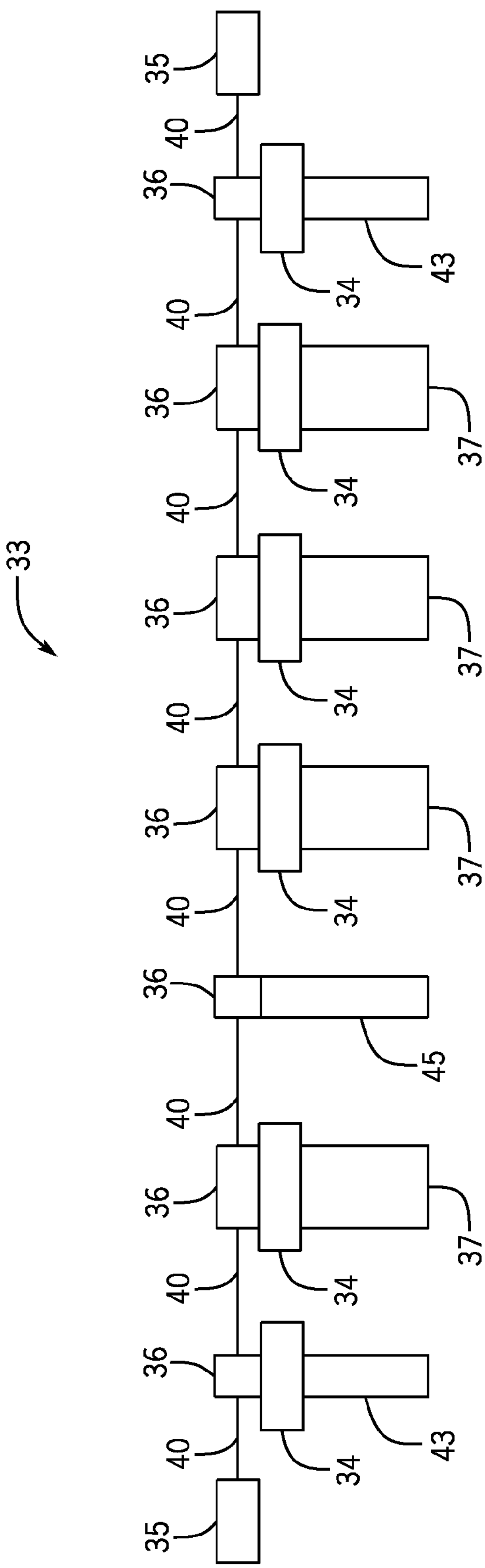
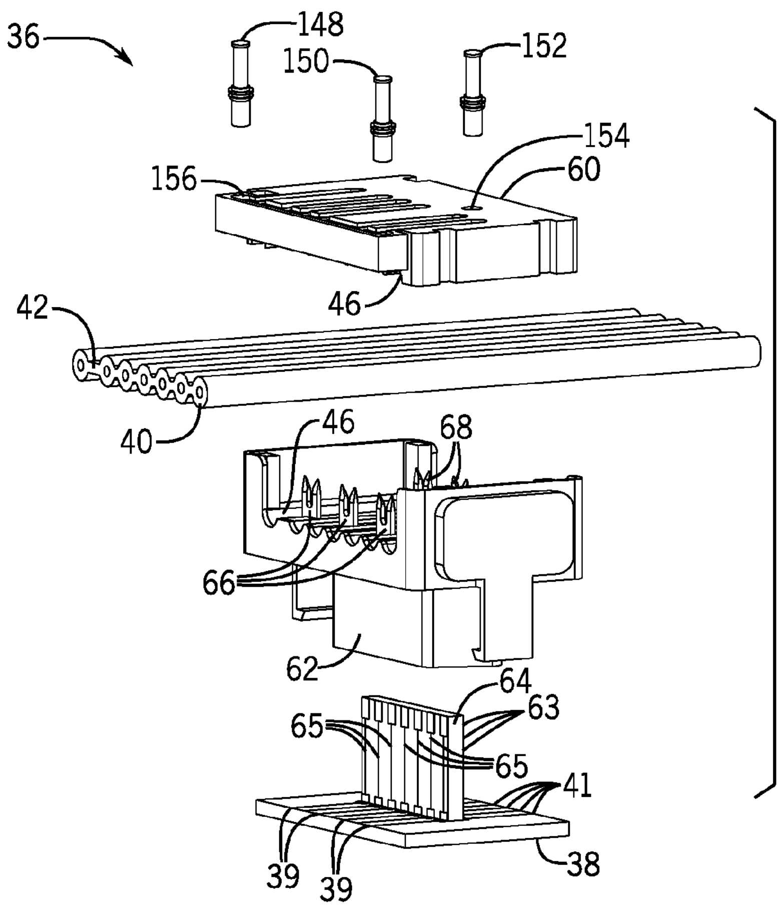


FIG. 1A


36
148
150
152
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60
156
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68
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39
39
38

FIG. 2

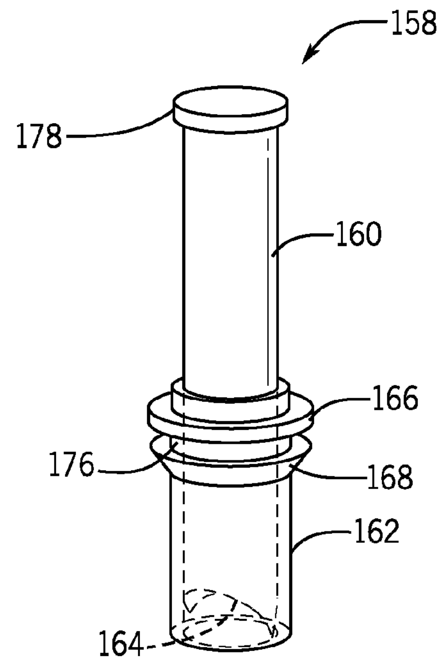

158
178
160
166
176
168
162
164

FIG. 3

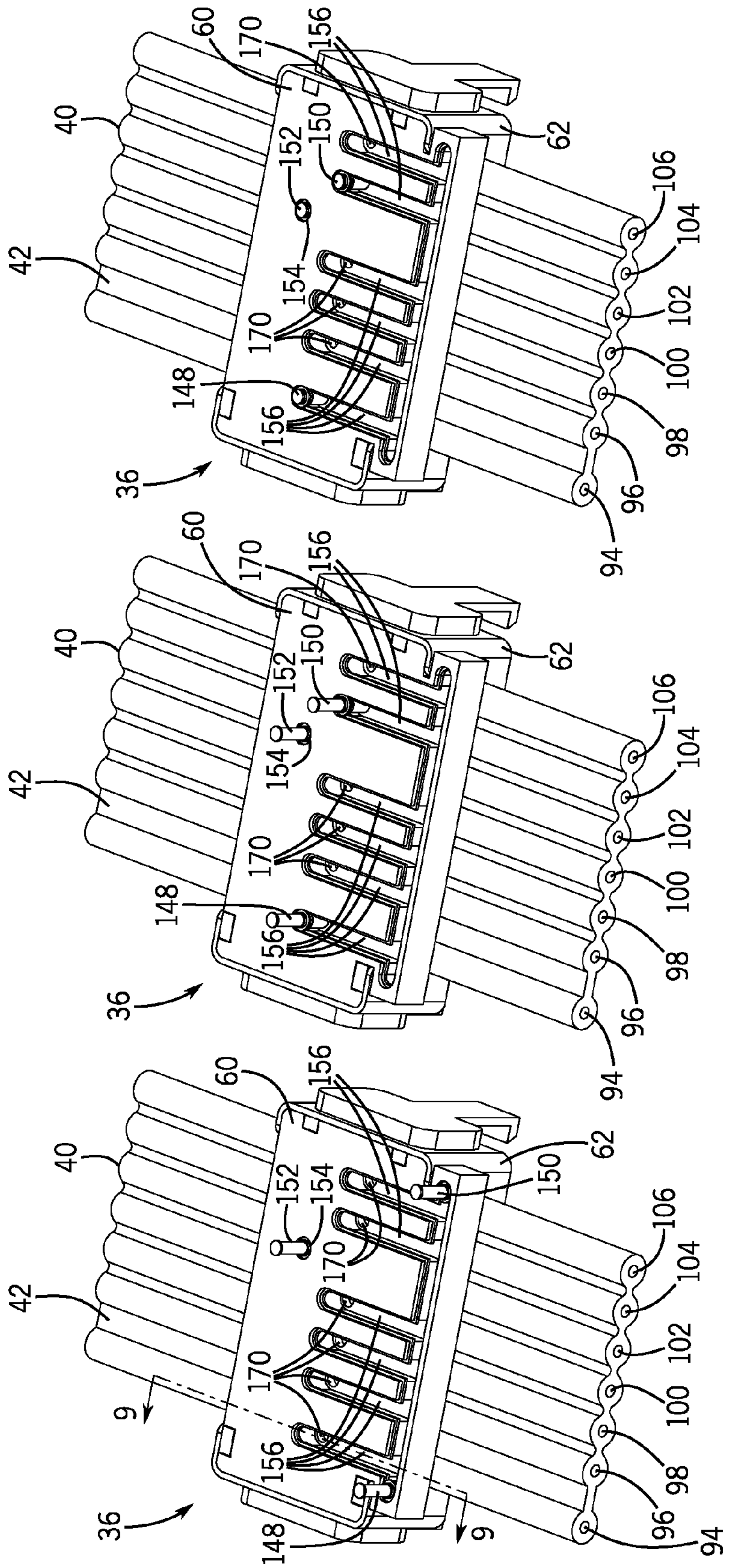


FIG. 4C

FIG. 4B

FIG. 4A

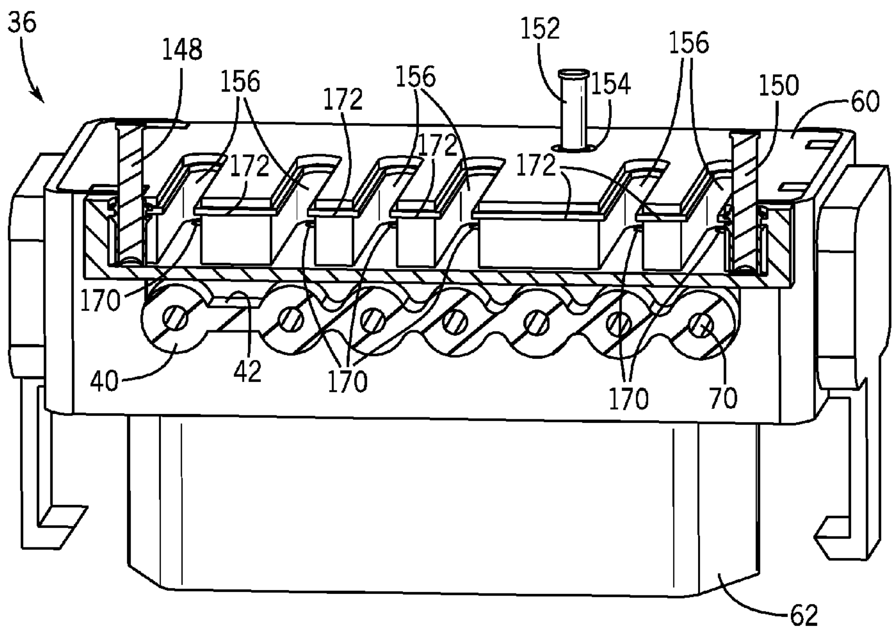
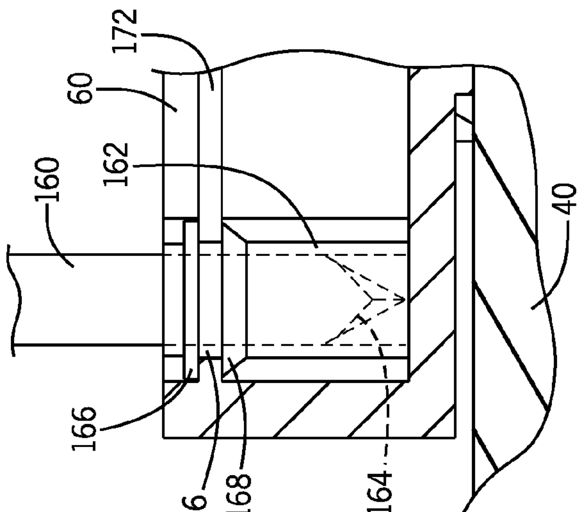
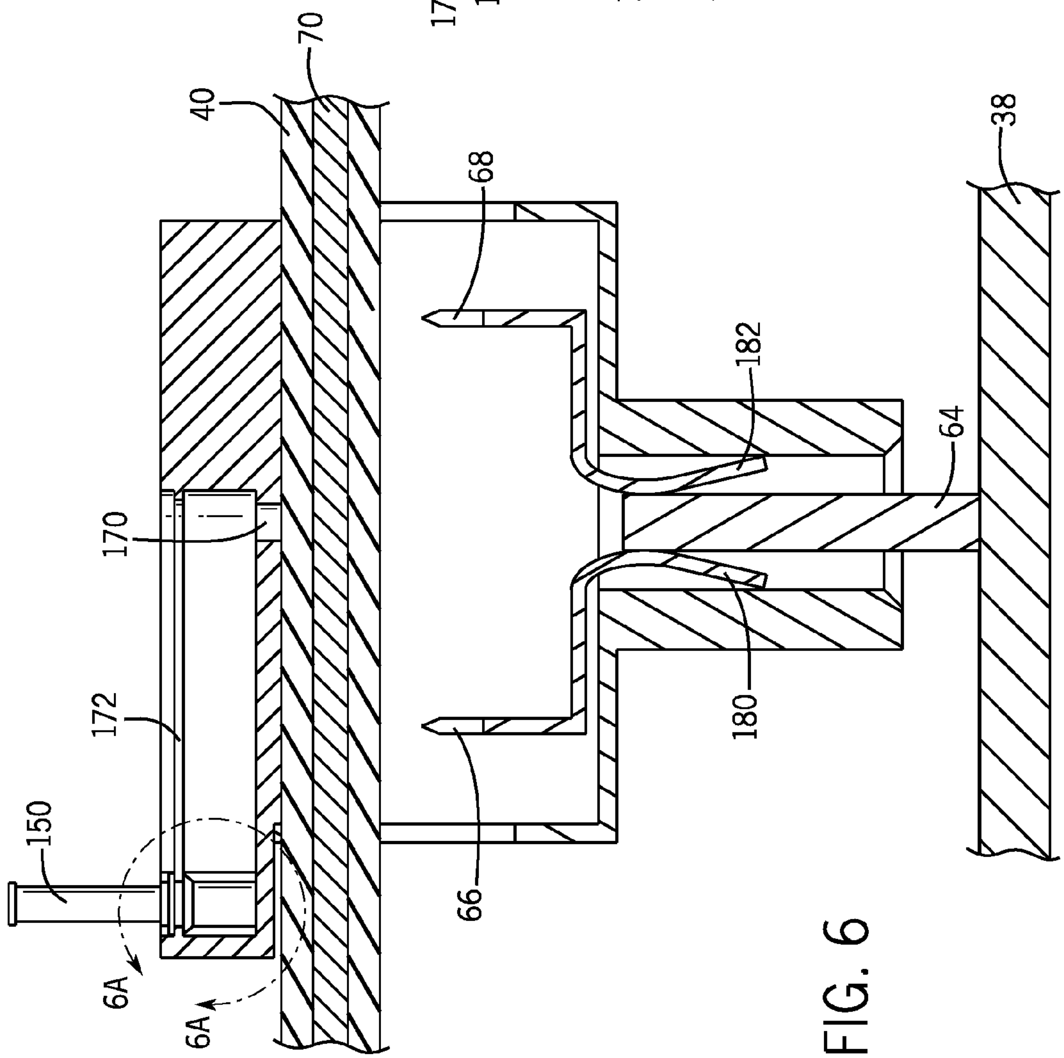

36
148
156
172
156
172
152
154
172
156
150
60
170
40
42
170
170
70
62

FIG. 5



172
60
162
160
40
166
176
168
164

FIG. 6A



70
40
68
38
182
64
170
172
180
150
66
6A
6A

FIG. 6

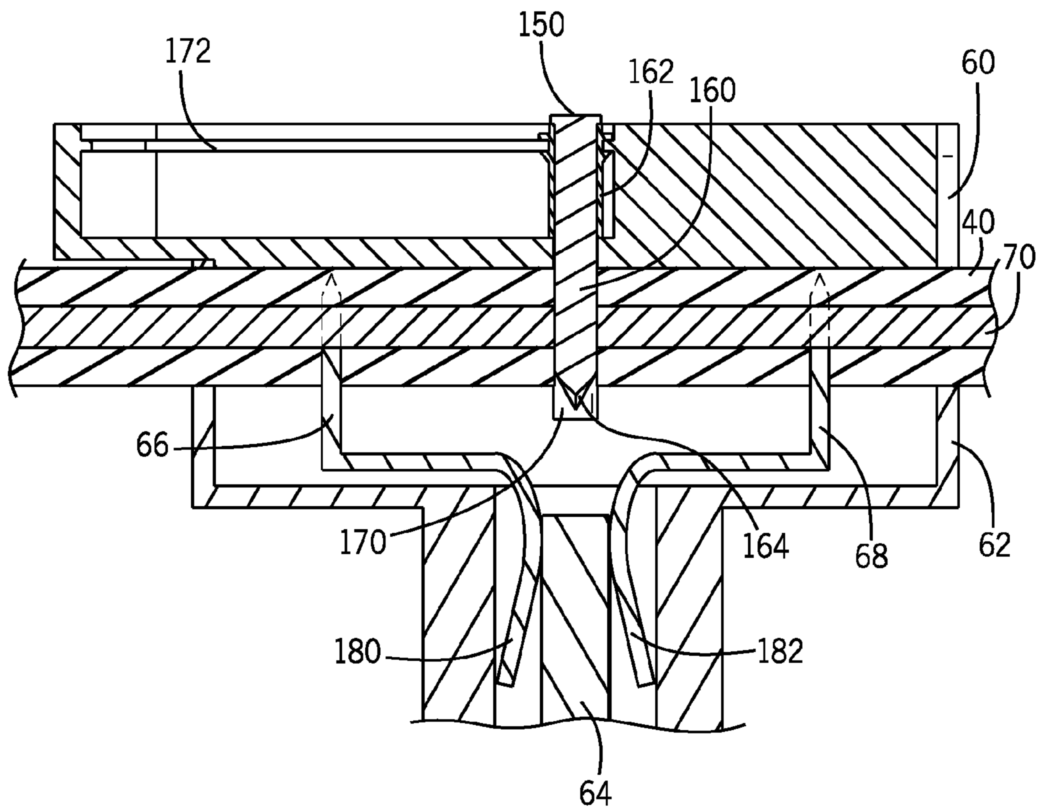


FIG. 7

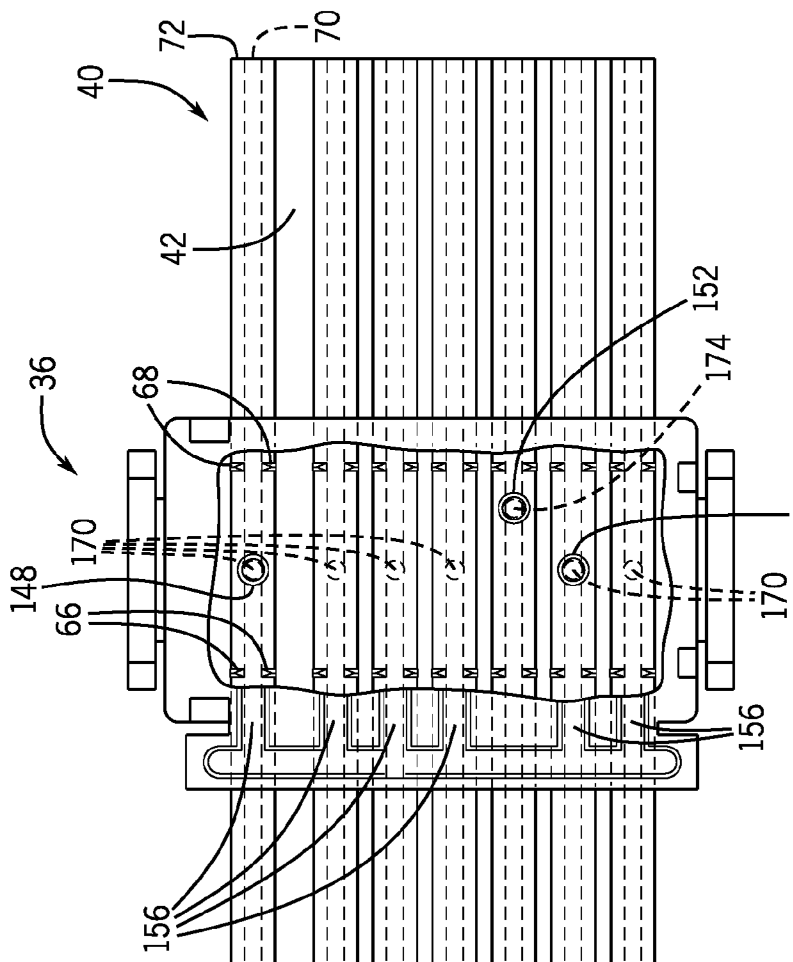
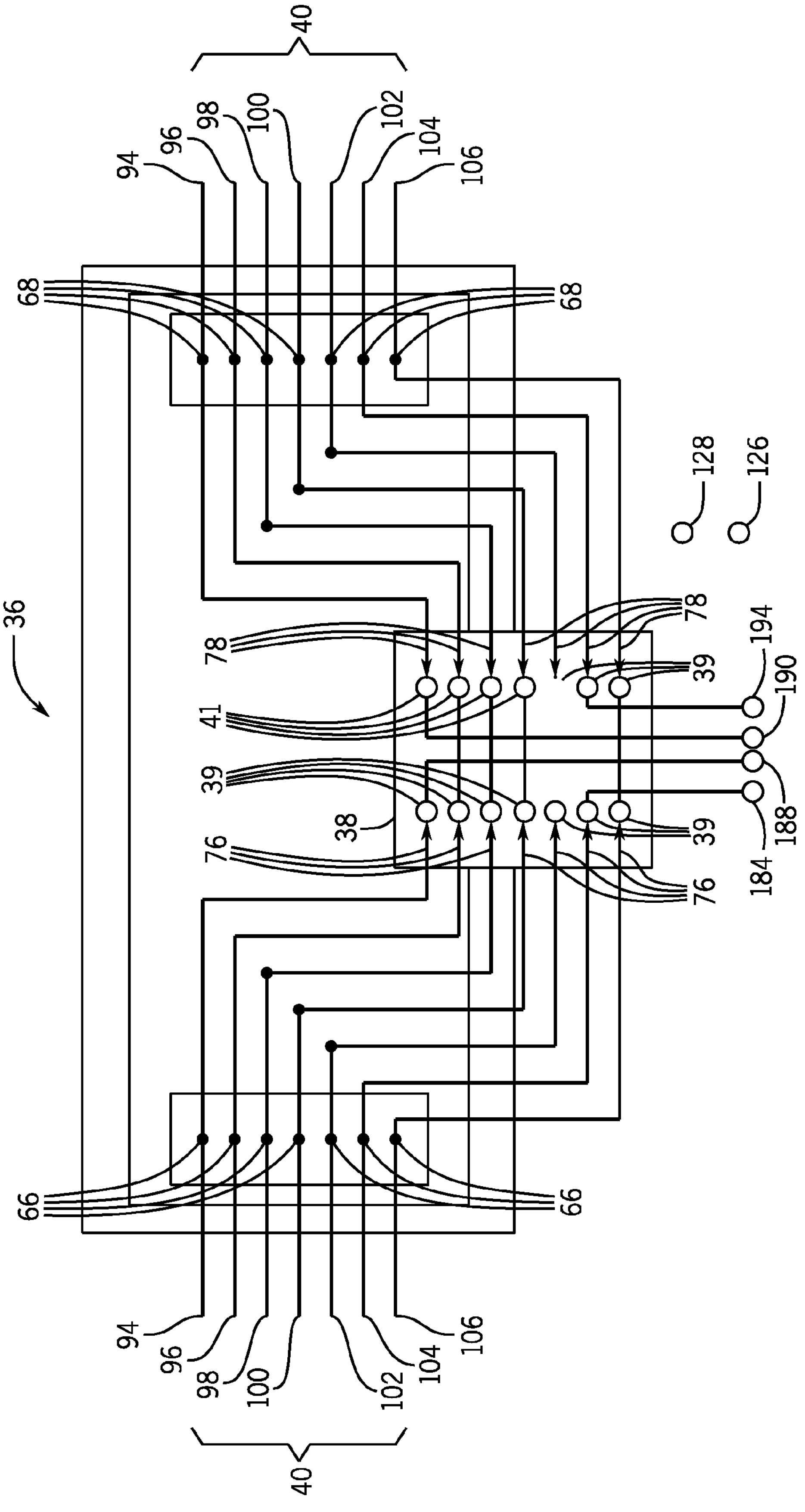


FIG. 8


40
94
96
98
100
102
104
106
68
68
128
126
36
78
78
39
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194
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188
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66
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94
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100
102
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106
40

FIG. 9

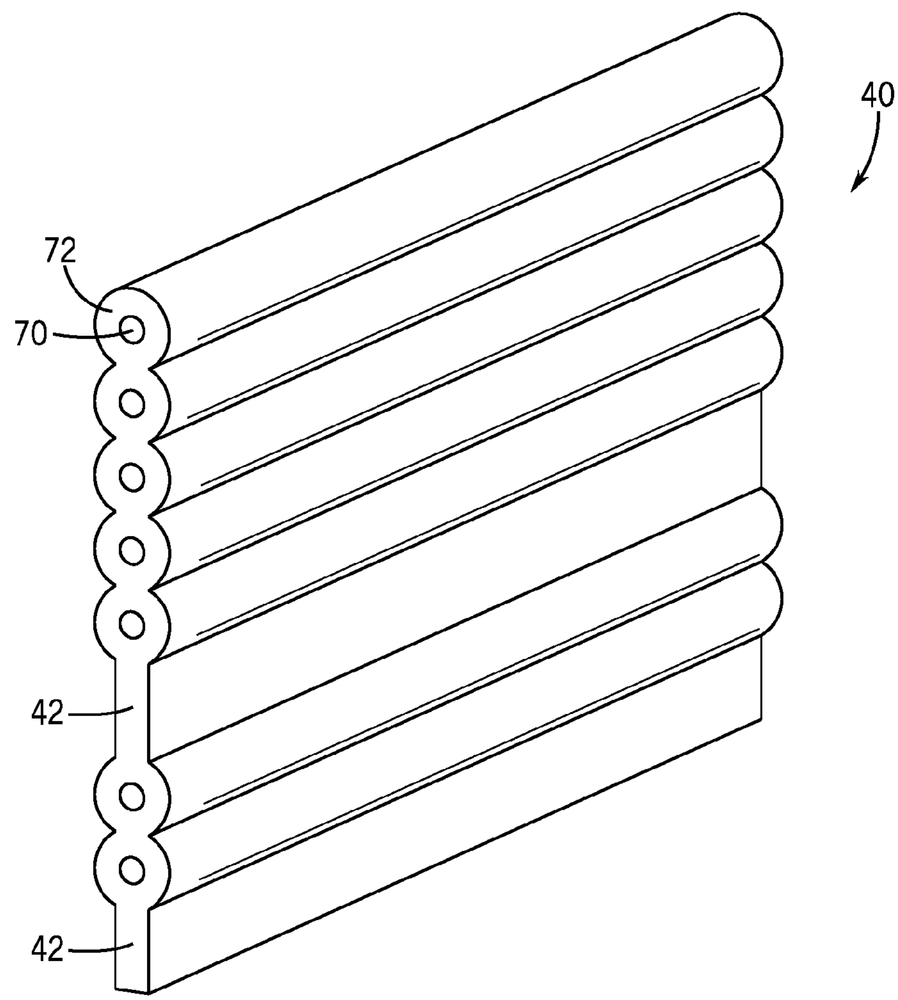
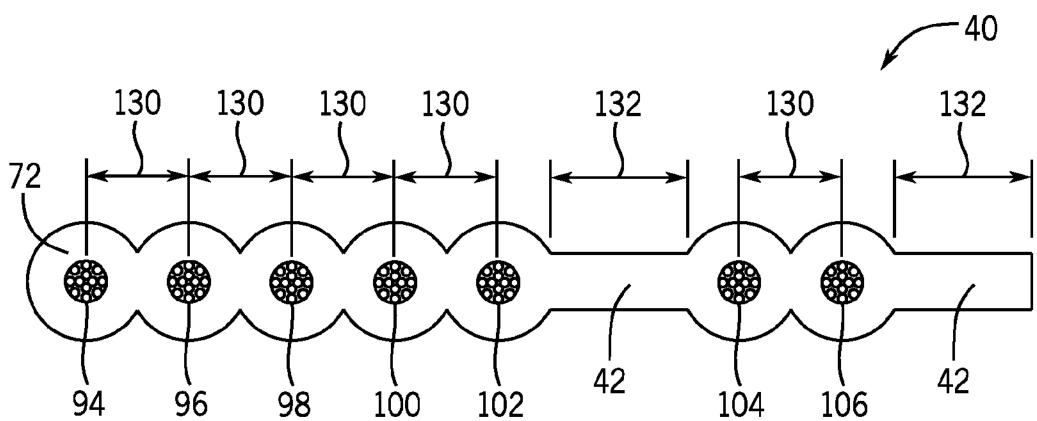

40
72
70
42
42

FIG. 10


40
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130
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130
132
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72
94
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102
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104
106
42

FIG. 11

CONNECTOR WITH SLIDING TAP

BACKGROUND

The disclosed embodiments relate generally to cables and connectors used in conjunction with network transmission media of the type used in industrial control, monitoring, and similar power and data network systems. More particularly, the disclosed embodiments relate to a novel modular connector for use with such a cable and associated network. The modular connector and cable are designed for use in an industrial-type control and monitoring system in which a number of device nodes receive various forms of power and data via the conductors in the cable via the conductor and associated interface.

Such power and data network systems typically include a number of device nodes coupled to a set of common conductors for transmitting power and data. The node devices often include both sensors and actuators of various types, as well as microprocessor-based controllers or other command circuitry. Power supplies coupled to the network furnish electrical energy via the network media to power interface devices and operate actuators, sensors, and other devices. In operation, devices on the network process the transmitted parameter data and command operation of networked devices as push-button switches, motor starters, proximity sensors, flow sensors, speed sensors, actuating solenoids, electrical relays, electrical contactors, and so forth.

The transmission of both power and data on the same cable presents several challenges, some of these being; reliably establishing a connection to the network, maintaining network continuity when de-coupling devices from the network, supplying additional power to an installed network, and mitigation of noise induced on the data conductors by the power conductors. Due to the nature of an industrial network as described, devices may be located at various points on the network for a given application. This necessitates the ability to quickly and reliably place connectors on a multi-conductor cable anywhere along its length. Additionally, it is desirable to maintain the electrical continuity of both the power and data transmitted on the network when a device is removed from a network. Given the fact that various forms of electrical power are provided to devices via the network cable, power will vary by application and changes made to existing applications it is desirable to have means by which to provide additional power to the network and its devices. And finally, unlike unpowered data networks, in the case of a network transmission media conveying various forms of electrical energy and data there is the increased potential for unwanted noise or interference between conductors due to the nature of energizing and de-energizing coils, the opening and closing of contacts of devices on the network, and the general environment in which the network may be located.

There is a need, therefore, for an improved network media connector and associated cable for use in industrial control networks and the like. More particularly, there is a need for a connector and associated cable that quickly and effectively establishes a connection and provides the ability to inject additional power onto the network, and includes separate power and signal conductors positioned to mitigate electrical noise.

BRIEF DESCRIPTION

The embodiments in the present disclosure describe a novel modular connector for power and data network systems. The connector comprises a lower body having at least one orientation key, where the lower body encloses a cavity containing a plurality of connectors where each connector corresponds and is electrically connected to two of an insulation displacement member of a plurality of insulation displacement members aligned in two rows along the top surface of the lower body. The connector also has an upper body, upper body having at least one fixed conductor severing device and one or more movable conductor severing devices acting upon selected conductors of the multi-conductor ribbon cable, upper body also having at least one orientation key, each orientation key positioned to receive a corresponding set of keying voids in a multi-conductor ribbon cable. When mated to an interface circuit board, the conductive path is through traces on the interface board to the connected device and other devices on the network.

DRAWINGS

These and other features, aspects, and advantages of the disclosed embodiments will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

FIG. **1** is a perspective drawing of an electromagnetic switching device with network interface;

FIG. **1***a* is a diagrammatical illustration of a device network including a number of nodes;

FIG. **2** is an exploded perspective view of a connector, ribbon cable, header board, and a network interface printed circuit board;

FIG. **3** is a detail view of a punch pin;

FIG. **4***a* is a perspective view of an embodiment of a connector in the pre-crimped state;

FIG. **4***b* is a perspective view of an alternate embodiment of a connector in the pre-crimped state;

FIG. **4***c* is a perspective view of an alternate embodiment of a connector in the crimped state;

FIG. **5** is a cutaway side view of an embodiment of a connector in the pre-crimped state;

FIG. **6** is a cutaway end view of an embodiment of a connector in the pre-crimped state;

FIG. **6***a* is a detail view of a portion of FIG. **6** illustrating the engagement of the punch in the connector in the pre-crimped state;

FIG. **7** is a cutaway end view of an embodiment of a connector in the crimped state;

FIG. **8** is a cutaway top view of connector and ribbon cable in the crimped state;

FIG. **9** is a schematic diagram of a connector in the plugged state;

FIG. **10** is a perspective view of a multi-conductor ribbon cable with keying voids; and

FIG. **11** is an end view of a multi-conductor ribbon cable with keying voids.

DETAILED DESCRIPTION

Turning now to the drawings, and referring to FIG. **1**, a circuit interrupting device is illustrated in the form of an electromagnetic contactor with network interface **10** for controlling electrical current on multiple current carrying paths. The electromagnetic contactor with network interface **10** comprises an electromagnetic contactor **12** having a generally rectangular body providing a slot **14** therein for receiving a standard DIN rail along the transverse axis generally within the plane of the base. Electromagnetic contactor **12** has a number of electrically isolated contact sections each configured to receive electrical inputs via power input conductors **26** connected to power terminal blocks **24** and deliver electrical outputs to a load via load output conductors **30** connected to load terminal blocks **28** when the electromagnetic contactor **12** is placed in a state resulting in a completed electrical circuit. This state is controlled by passing an electric current through the electromagnetic coil contained within the device whose electrical connections are made accessible via the coil terminal blocks **16**, the current being conveyed to the device via coil wires **18**. Additionally, electromagnetic contactor **12** may include auxiliary contacts which are contained within the device, whose state changes in concert with that of the electromagnetic contactor **12**. Electrical connections to these auxiliary contacts are made via auxiliary contact terminal blocks **20** with current conducted via auxiliary contact terminal wires **22**.

Continuing with FIG. **1**, in addition to an electromagnetic contactor **12**, electromagnetic contactor with network interface **10** includes a network interface **34**. Network interface **34** is coupled to electromagnetic contactor **12** and is actuated in unison via a mechanical interface **32** that mechanically couples the device to the network interface such that when the state of electromagnetic contactor **12** changes that of network interface **34** changes as well. Connector **36** is attached to printed circuit board **38** contained within network interface **34**. In this particular embodiment connector **36** is secured to network interface **34** via a pair of latches **44** placed on each side of the connector and mating with a slot on network interface **34**. It is conceivable that for some applications alternate embodiments of securing the attachment may include captive screws in place of the latches. In this particular embodiment, connector **36** is attached to ribbon cable **40** which provides power and data transmission to network interface **34** and similarly to associated devices on the network. Ribbon cable **40** contains a void **42** in the cable which matches an orientation key **46** on connector **36** in order facilitate the correct orientation of connector **36** when connecting to ribbon cable **40**. It is important to note that the number of voids, their width, and position in the cable may vary depending upon the application without diverging from the intent of the disclosed embodiments.

In the embodiment illustrated in FIG. **1**, network interface **34** provides electrical current to positive output terminal **52** and negative output terminal **54** where electrical current is obtained from conductors on ribbon cable **40** and provided via positive output terminal wire **56** and negative output terminal wire **58** to corresponding coil wires **18**. This allows network interface **34** to control the state of electromagnetic contactor **12** via network signals on ribbon cable **40**. Additionally, network interface **34** may include an auxiliary contact whose electrical interface is provided via network interface auxiliary contact terminal blocks **48** and associated electrical connections via network interface auxiliary contact terminal wires **50**.

In FIG. **1***a* a data and power network is illustrated diagrammatically and designated generally by the reference numeral **33**. The network includes a plurality of device nodes **37** coupled to one another via a network interface **34** and a network ribbon cable **40**. One embodiment of a device node **37** is an electromagnetic contactor **12** and network interface **34** attached to ribbon cable **40** with connector **36** which is illustrated in FIG. **1** as electromagnetic contactor with network interface **10**. Each device node **37** receives power and data signals from cable **40** via a modular connector **36** attached to network interface **34**. At ends of cable **40** terminators **35** are provided for capping the cable ends and electrically terminating the signal conductors of the cable. Intelligent power taps **43** are connected to network **33** with connector **36** on network interface **34** via ribbon cable **40** for the purpose of providing electrical power to network **33** typically in the form of 24 volts DC. As illustrated, intelligent power taps **43** are intelligent devices having the ability to interact with the control and data signals of the network in addition to providing various forms of power. An alternate embodiment of a power tap could be a non-intelligent power tap **45**. Non-intelligent power tap **45** only provides power to the network and thus connector **36** couples directly to non-intelligent power tap **45** with no need for network interface **34**. Various embodiments of device node **37** may include devices such as push-button switches, motor starters, proximity sensors, flow sensors, speed sensors, actuating solenoids, electrical relays, electrical contactors, and so forth each adapted to receive an embodiment of network interface **34**. As will be appreciated by those skilled in the art, each device node **37** may transmit and receive control and data signals via ribbon cable **40** in accordance with various standard protocols in addition to receiving various forms of electrical power.

Considering FIG. **2**, an exploded perspective view of connector **36**, ribbon cable **40**, and interface printed circuit board **38** is illustrated. Connector **36** comprises an upper portion **60** and lower portion **62**. Upper portion **60** contains configuration channel **156** adapted to receive one or more moveable punches of which two are illustrated in this embodiment, moveable punch A **148** and moveable punch B **150**. Moveable punch A **148** and moveable punch B **150** move within configuration channel **156** to various configuration positions that will be explained further on in this specification. Additionally, upper portion **60** contains fixed punch aperture **154** which is adapted to receive fixed punch **152**. Ribbon cable **40** is located transversely between upper portion **60** and lower portion **62** such that when upper portion **60** and lower portion **62** are compressed together by a crimping tool a connection to each conductor contained within ribbon cable **40** is made via left insulation displacement members **66** and right insulation displacement members **68** which are typically configured such that there are two connections per conductor in the ribbon cable, one on the left and one on the right which is further illustrated in FIG. **7**. Upper portion **60** and lower portion **62** of connector **36** have an orientation key **46** which aligns with cable void **42** of ribbon cable **40** in order to facilitate the correct orientation of connector **36** on ribbon cable **40**. Orientation keys **46** provide a mechanism such that connector **36** is properly aligned with multi-conductor ribbon cable **40** during the crimping process. This ensures that the correct power and data signals of the conductors contained within multi-conductor ribbon cable **40** are electrically connected to the corresponding power and data signals of network interface **34**. Connector **36** is attached to interface circuit board **38** via header board **64**. Interface circuit board **38** includes a number of right interface circuit board traces **39** and left interface circuit board traces **41** that are electrically connected to right header circuit board traces **63** and left header circuit board traces **65** on header circuit board **64**. It is easily conceivable by one skilled in the art that the both the number and configuration of the fixed and moveable punches as represented by fixed punch **152**, moveable punch A **148**, and moveable punch B **150** could vary by application.

FIG. **3** is a detail view of the punch assembly **158**. Punch assembly **158** represents the punches of upper portion **60** including fixed punch **152**, moveable punch A **148**, and moveable punch B **150**. Punch assembly **158** comprises punch barrel **162** which is adapted to receive with a friction fit punch pin **160**. Punch pin **160** is able to move vertically within the constraint of punch barrel **162** with punch top **178** preventing punch pin **160** from being pushed completely through punch barrel **162**. The bottom of punch pin **160** comprises a punch blade **164** which severs conductors **70** in ribbon cable **40** and will be explained further on in this specification. Top engagement ring **166** and bottom engagement ring **168** are circumferentially adapted around punch barrel **162** forming punch engagement slot **176**. The circumference of bottom engagement ring **168** is chamfered such that it can be snapped into configuration channel **156**. Punch assembly **158** is held captive within configuration channel **156** by the operative engagement of the bottom edge of top engagement ring **166** and the top edge of bottom engagement ring **168**. Punch assembly **158** is able to move in constrained lateral motion within configuration channel **156**. It is important to note that FIG. **3** illustrates merely one potential embodiment of punch assembly **158**. Other embodiments are conceivable by one skilled in the art without diverging from the intent of the disclosed embodiments.

Considering FIG. **4***a*, FIG. **4***b*, and FIG. **4***c* as a group the relationship of connector **36** and the parts of which it is comprised in relation to ribbon cable **40** are illustrated. Beginning with FIG. **4***a*, a perspective view of connector **36** just prior to the completion of the crimping operation is illustrated. Connector top **60** and connector bottom **62** have been joined but it is important to note that fixed punch **152**, moveable punch A **148**, and moveable punch B **150** are each in the uncrimped state. Portions of configuration channel **156** run in lateral relation to conductors **70** in ribbon cable **40**. At the end of each lateral channel a punch receiving aperture **170** is located. Punch receiving aperture **170** is adapted to receive punch pin **160** of moveable punch A **148** and moveable punch B **150**. Punch receiving apertures **170** are entirely through upper portion **60** such that punch blade **164** of punch pin **160** of moveable punch A **148** and moveable punch B **150** are allowed to contact conductors **70** of ribbon cable **40**. Fixed punch aperture **154** is adapted to receive punch barrel **162** of fixed punch **152** allowing punch blade **164** of punch pin **160** of fixed punch **152** to move within punch barrel **162** and come into contact with conductor **70** of ribbon cable **40**. As further illustrated in FIG. **4***b*, moveable punch A **148** and moveable punch B **150** have been placed into position in configuration channel **156** over punch receiving apertures **170**. FIG. **4***b* and FIG. **4***c* illustrate possible configurations for moveable punch A **148** and moveable punch B **150**. FIG. **4***c* illustrates fixed punch **152**, moveable punch A **148**, and moveable punch B **150** at the completion of the crimping operation. If moveable punch A **148** and moveable punch B **150** are not required for the application they can remain in the outer position as shown in FIG. **4***a* and will not be crimped during the crimping operation.

Turning to FIG. **5**, a side perspective view with a partial cutaway of connector **36** is shown in the state just prior to the completion of the crimping operation as indicated by the fact that upper portion **60** and lower portion **62** are coupled and fixed punch **152**, moveable punch A **148**, and moveable punch B **150** remain in the uncrimped state. This view illustrates rail **172** which encompasses the entire perimeter of configuration channel **156** and is the mechanism used to retain moveable punch A **148** and moveable punch B **150** and define their movement within configuration channel **156**. Additional detail is provided in FIG. **6** and FIG. **6***a*.

Continuing with FIG. **6** with additional detail provided in FIG. **6***a*, a cutaway end view of connector **36** is illustrated. In this view upper portion **60** and lower portion **62** are in the uncrimped state and ribbon cable **40** is located transversely between upper portion **60** and lower portion **62**. In this view connector **36** is coupled to header board **64**. As depicted in FIG. **2** header board **64** makes electrical contact with interface circuit board **38** via right header board traces **63** connected to right interface board traces **41** and left header board traces **65** connected to left interface board traces **39**. Left connector contact **180** makes contact with left header board traces **65** and right connector contact **182** makes contact with right header board traces **63** and in turn interface circuit board **38** as part of network interface **34** as described. In the illustrated embodiment the flow of power and data signals on multi-conductor ribbon cable **40** is interrupted when connector **36** is removed from network interface **34**. It is easily conceivable by one skilled in the art that some applications may require that the flow of power and data signals on multi-conductor ribbon cable **40** not be interrupted when connector **36** is removed from network interface **34**. In this alternate embodiment, each of right connector contact **182** and left connector contact **180** may be replaced by corresponding pairs of spring contacts that maintain a conductive path when connector **36** is de-coupled from network interface **34**.

In FIG. **7** a cutaway end view of connector **36** is shown with upper portion **60** and lower portion **62** in the fully crimped state. In this particular illustration moveable punch B **150** is shown in the fully crimped state as well. In this state punch pin **160** has traveled through punch barrel **162** with punch blade **164** severing conductor **70** of ribbon cable **40**. A similar sequence occurs with moveable punch A **148** and fixed punch **152** as illustrated in FIG. **4***c*. Additionally, in the fully crimped state each conductor **70** of ribbon cable **40** is pierced by a set of left insulation displacement members **66** and right insulation displacement members **68**. A cutaway top view of connector **36** in the fully crimped state is further illustrated in FIG. **8**. As described, each conductor **70** of ribbon cable **40** is pierced by a corresponding pair of left insulation displacement members **66** and right insulation displacement members **68**. The fully crimped connector **36** coupled with header board **64** and interface circuit board **38** is further illustrated in FIG. **8**.

Referring to FIG. **9**, a schematic illustration of connector **36** engaged with ribbon cable **40** is shown. In this particular embodiment the electrical signals passing through connector **36** may be assigned as shown in the following table, table **1**:

Conductor element number	Electrical Signal
94	Switched Power Positive 140
96	Switched Power Negative 142
98	Network Signal Positive 144
100	Network Signal Negative 146
102	Discovery 134
104	Network Power Positive 136
106	Network Power Negative 138

For the purpose of further explanation, the signal assignment embodiment of table **1** corresponds to that of FIG. **4***c*.

The number of conductors **70** in ribbon cable **40** is seven for the exemplary network embodiment. It is conceivable that the number, types, and ordering of electrical power and signals carried by conductors **70** in ribbon cable **40** could vary widely for a given application without diverging from the intent of the disclosed embodiments. For instance, the choice of assigning signals to particular conductors **70** in ribbon cable **40** may be done so as to increase noise immunity, minimizing electromagnetic interference (EMI) between the conductors and the signals that they carry. Conceivable embodiments include separating power signals from network signals using one or more keying voids **42** between corresponding conductors or placing switched power conductors in distal relation to other conductors. For a given embodiment it is desirable to allow some of the electrical signals contained on each conductor **70** of ribbon cable **40** to pass unaltered or bypassed through the combination of connector **36**, header board **64**, and interface circuit board **38** while other signals may be altered or suspended.

As illustrated, the signal Discovery **134** is assigned to conductor **102** of ribbon cable **40** and is passed to interface circuit board **38** via associated left insulation displacement member **66** with the signal returned on the associated right insulation displacement member **68**. Network Power Negative **138**, Switched Power Negative **142**, Network Signal Positive **144**, and Network Signal Negative **146** are assigned to the conductor indicated in table **1** and are passed through connector **36** unaltered. In some embodiments it is conceivable that left insulation displacement member **66** and right insulation displacement member **68** associated with the assigned conductor **70** for each of Network Power Negative **138**, Switched Power Negative **142**, Network Signal Positive **144**, and Network Signal Negative **146** may be removed from connector lower portion **62** of connector **36** as the associated power and signals are passed through connector **36** unaltered.

Continuing with FIG. **9** and referring to FIG. **4***c*, Switched Power Positive **140** is assigned to conductor **94** of ribbon cable **40**. As a consequence of the completed crimping operation, conductor **94** has been operatively engaged by associated left insulation displacement member **66** and right insulation displacement member **68** and moveable punch A **148** has severed conductor **94**. This provides the ability to inject additional Switched Power Positive **140** onto data and power network **33** via connections **188** and **190** on interface circuit board **38** as required for a given application. Discovery signal **134** has been assigned to conductor **102** which has been operatively engaged by associated left insulation displacement member **66** and right insulation displacement member **68** and fixed punch **152** has severed conductor **102** connecting Discovery signal **134** to interface circuit board **38**. Network Power Positive **136** has been assigned to conductor **104** which has been operatively engaged by associated left insulation displacement member **66** and right insulation displacement member **68** and moveable punch B **150** has severed conductor **104**. This provides the ability to inject additional Network Power Positive **136** onto data and power network **33** via connections **184** and **194** on interface circuit board **38** as required for a given application.

Electrical connections to connection points **184**, **188**, **190**, and **194** may be established by any number of means including but not limited to jumpers on pin headers, Dual In-Line Package (DIP) switches, relays, or semiconductor switching devices. Additionally, it is conceivable that configuration information may be written to network interface **34** via network **33** through the use of a computer running a configuration software program. Any number of combinations of signals being passed through, altered, enhanced, or suspended is conceivable for any device on network **33** whether that is a device node **37** or an intelligent power tap **43**. Generally stated the method of signal selection would include the following steps of determining the number and type of devices **37** required for an application, calculating the network power requirements, calculating the switched power requirements, selecting the number of intelligent power taps **43** and non-intelligent power taps **45** required to meet network and switched power requirements, determining the distribution of intelligent power taps **43** and non-intelligent power taps **45** on network **33**, positioning a plurality of devices **37**, intelligent power taps **43**, and non-intelligent power taps **45** on network **33**, setting configurable circuit completing devices in network interface **34**, mechanically coupling a network interface **34** to a plurality of devices **37** and intelligent power taps **43**, configuring positions of moveable punch A **148** and moveable punch B **150**, on a plurality of connectors **36**, mechanically coupling a connector **36** to each of a plurality of network interface **34** on devices **37** and intelligent power taps **43**, and non-intelligent power taps **45**. It is important to note that various combinations of the presence or absence of one or more orientation keys **46** and their position in connector **36** in relation to multi-conductor ribbon cable **40**, in combination with the number of fixed punch **152**, moveable punch A **148**, and moveable punch B **150** could be used to meet the requirements of an application. In addition to the various embodiment choices of the ribbon cable, orientation keys, and both fixed and moveable punches, additional embodiments may result from the combination of intelligent and non-intelligent taps and the combination of choices with regard to signals being passed through, altered, enhanced, or suspended in order to meet the requirements of a given application. The described embodiments are just some of a number of possible embodiments that could be conceived by a person skilled in the art.

Finally, FIG. **10** illustrates ribbon cable **40** with additional detail provided in FIG. **11**. As previously described, ribbon cable **40** includes network signal conductors and power conductors disposed generally parallel to one another in a common plane. In reference to the signal assignments in table **1** above, FIG. **11** illustrates Switched Power Positive **140** on conductor **94**, Switched Power Negative **142** on conductor **96**, Network Signal Positive **144** on conductor **98**, Network Signal Negative **146** on conductor **100**, Discovery **134** on conductor **102**, Network Power Positive **136** on conductor **104**, and Network Power Negative **138** on conductor **106**. Discovery **134**, Network Signal Positive **144**, and Network Signal Negative **146** are network signal conductors. Network Power Positive **136**, Network Power Negative **138**, Switched Power Positive **140**, and Switched Power Negative **142** are power signals. The preferred structure of ribbon cable **40** and the advantages flowing from the preferred structure include an insulative cover or jacket **72** encapsulating the signal and power conductors, insulator **72** narrows to form a reduced thickness physical key or void **42** which corresponds to the placement of orientation key **46** on connector **36**, thereby ensuring that each network connector **36** is properly and uniformly positioned with respect to the conductors carried within ribbon cable **40** during installation. The number, width **132**, and position of physical key or void **42** on ribbon cable **40** could vary without deviating from the intent of the disclosed embodiments. Additionally, as previously described, within ribbon cable **40**, conductors **94-106** and the network signals or power that they conduct in any given embodiment may be assigned or ordered in such a way so as to minimize electromagnetic interference (EMI.) It could also be conceived by a person skilled in the art to vary the spacing **130** between conductors **94-106** so as to provide further immunity to noise especially between signal conductors and power conductors.

While only certain features of the disclosed embodiments have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the disclosed embodiments.

The invention claimed is:

1. A connector for a multi-conductor power and data transmission network ribbon cable for use with a network, the network including a plurality of devices configured to be coupled to one another via the cable, the connector comprising: a lower body enclosing a cavity containing a plurality of connectors, each connector corresponding and electrically connected to two insulation displacement members of a plurality of insulation displacement members forming first and second rows; an upper body having a fixed severing device positioned within the upper body in alignment with a conductor of the multi-conductor ribbon cable, a plurality of configuration channels supporting and horizontally constraining one or more moveable severing devices where each configuration channel is aligned with some of the conductors of the multi-conductor cable, wherein all severing devices are movable from an initial uncrimped state to a final crimped state, the upper body adapted to engage the multi-conductor ribbon cable between the upper body and lower body.

2. The connector of claim **1**, wherein the upper body and the lower body have at least one orientation key, the orientation keys defining a space configured to receive the multi-conductor ribbon cable in corresponding keyed orientation.

3. The connector of claim **1**, wherein a multi-conductor cable is adapted to receive at least one orientation key on opposing sides.

4. The connector of claim **1**, wherein each conductor of the multi-conductor ribbon cable is brought into electrical contact with conductor engaging portions of two opposing insulation displacement members.

5. The connector of claim **4**, wherein the insulating jacket of the multi-conductor ribbon cable is sufficiently resilient to permit piercing by insulation displacement members.

6. The connector of claim **4**, wherein the insulating jacket of the multi-conductor ribbon cable has a first thickness surrounding conductors, a second thickness between adjacent conductors, and a third thickness for receiving orientation keys.

7. The connector of claim **4**, wherein the conductors of the multi-conductor ribbon cable are disposed parallel to one another in a common plane with signal conductors at a first distance and power conductors at a second distance.

8. The connector of claim **4**, wherein the conductors of the multi-conductor ribbon cable are disposed parallel to one another in a common plane ordered such that power conductors do not electrically couple with signal conductors.

9. The connector of claim **1**, wherein the connector is configured to receive an edge connector on a printed circuit board.

10. A connector for a power and data transmission network cable, a network including a plurality of nodes configured to be coupled to one another via the cable, the connector comprising:

an upper body and a lower body each having at least one orientation key adapted to receive a multi-conductor ribbon cable, the lower body having a receiving cavity;

a multi-conductor ribbon cable adapted to receive orientation keys transversely positioned between the upper body and the lower body whose conductors are electrically coupled to insulation displacement members on the lower body;

a plurality of configuration channels in the upper body aligned in correspondence with some of the conductors of the multi-conductor ribbon cable, supporting and horizontally constraining one or more moveable severing devices;

at least one severing device positioned within the upper body aligned with one conductor of the multi-conductor ribbon cable;

wherein all severing devices are movable from an initial uncrimped state to a final crimped state.

11. The connector of claim **10**, wherein conductors may have additional electrical power injected.

12. The connector of claim **10**, wherein conductors may be altered or suspended.

13. The connector of claim **10**, wherein conductors may be passed unaltered.

14. The connector of claim **10**, wherein the connector is configured to receive an edge connector on a printed circuit board.

15. The connector of claim **11**, wherein the printed circuit board contains one or more connectors for electrical power.

16. An industrial control network connector system comprising:

an upper body having at least one orientation key adapted to receive a multi-conductor cable, a severing device within the upper body in alignment with a conductor of the multi-conductor cable, a plurality of configuration channels supporting and horizontally constraining one or more moveable severing devices where each configuration channel is aligned with some of the conductors of the multi-conductor cable, wherein all severing devices are movable from an initial uncrimped state to a final crimped state, and a lower body having at least one orientation key adapted to receive the multi-conductor cable, the lower body having a receiving cavity adapted to receive an interface circuit board;

a plurality of connectors arrayed in opposing pairs in the receiving cavity each electrically connected to one of a plurality of insulation displacement members;

a multi-conductor cable adapted to receive orientation keys transversely positioned between the upper body and the lower body whose conductors are electrically coupled to insulation displacement members on lower body when upper body and lower body are operatively engaged;

an interface circuit board having conductive traces on opposing sides in corresponding relation to connectors wherein upon coupling with lower body opposing connectors are placed in contact with conductive traces;

a network interface coupled to an industrial control device having a surface adapted to receive the network device in operative engagement.

17. The connector system of claim **16**, wherein the industrial control device is selected from the group consisting of push-button switches, motor starters, proximity sensors, flow sensors, speed sensors, actuating solenoids, electrical relays, and electrical contactors.

18. The connector system of claim **16**, wherein network interface and industrial control device are mechanically coupled for operative engagement.

19. The connector system of claim **16**, wherein the network interface controls the state of the industrial control device by network signals.

20. The connector system of claim **16**, wherein the network interface obtains network power and system power from the multi-conductor cable.

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