

T&B 1107

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PATENT

ELECTRICAL CONNECTOR STRAIN RELIEF1 FIELD OF THE INVENTION:

The present invention relates generally to improvements in electrical data connectors. More particularly the present invention relates to a shielded compact data connector which permits the transmission of signals at high data rates.

5 BACKGROUND OF THE INVENTION:

In the field of data/communications technology, information in the form of electrical signals is being transmitted at ever increasing speeds. Along with the desire to transmit information at faster data rates, the industry has also seen the need to reduce the size of hardware employed so as to increase portability and ease of use. In order to keep pace with these improvements, the interconnection technology, which includes electrical cables and electrical connectors designed to connect such hardware, has also undergone significant changes. Electrical connectors and cables are now available which are much smaller in size and capable of transmitting data at higher rates.

Continued improvement in connection technology is not without problems. When decreasing the size of electrical connectors while requiring the connectors to transmit data at higher rates, cross-talk between adjacent conductive components of the connector becomes a factor which must be addressed. Additionally, as these components are normally used in close proximity to other electronic components, the individual connector components must be shielded from electro-magnetic interferences and radio-frequency interferences. These interferences can adversely affect the performance levels of the connectors especially at higher data rates.

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1 An additional demand on connector technology is
that the connector components must be "user friendly". That
is, the components must be easy to assemble as well as easy
to connect and disconnect. Further, the portability of many
5 electronic components requires that these connections and
disconnections be repeated many times. A connector must be
able to withstand the rigors of repeated interconnection
without degradation of mechanical or electrical performance.

 It can be appreciated that merely "downsizing" a
10 connector will be insufficient to meet the current
requirements of the industry. Smaller connectors must be
designed to meet increased signal transmission requirements,
and provide for internal and external shielding as well as
long term reliable mechanical performance.

15

SUMMARY OF THE INVENTION:

 It is an object of the present invention to
provide a electrical connector for terminating jacketed
multi-conductor electrical cable.

20

 It is a further object of the present invention to
provide strain relief for securely terminating jacketed
multi-conductor cable in a connector housing.

 It is a still further object of the present
invention to provide an electrical connector strain relief
25 device having hermaphroditic components which secure the
cable to the connector housing.

 In the efficient attainment of these and other
objects, the present invention provides an electrical
connector for terminating jacketed multi-conductor
30 electrical cable. The connector includes a connector
housing for accommodating the cable. The housing defines a
first bounded opening which permits passage of the cable
therethrough. The cable strain relief device is positioned
adjacent the first bounded opening of the housing and
35 includes first and second interengageable strain relief
members. The first strain relief member is fixedly
positioned within the housing and the second strain relief



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1 member is movably supported by the first strain relief
member. The first and second strain relief members define
a second bounded opening substantially concentric with the
first bounded opening surrounding the cable. The second
5 strain relief member is moveable with respect to the first
strain relief member so as to reduce the size of the second
bounded opening for frictionally securing the cable therein.

As more particularly described by way of the
preferred embodiment herein the first and second strain
10 relief members are hermaphroditic and include
interengageable teeth permitting ratchet type movement
between the first and second strain relief members. The
ratchet teeth permit multiple positional alignment between
the hermaphroditic strain relief members to permit
15 securement of different size cables therebetween.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 shows an exploded perspective view of the
compact data connector of the present invention and a
20 shielded multi-conductor electrical cable positioned for
termination therewith.

Figure 2 is a perspective showing of the internal
shield of the connector of Figure 1.

Figure 3 is an exploded perspective view of a
25 connector sub-assembly of the connector of Figure 1.

Figures 4 and 5 show in front plan and perspective
views respectively, a conductor holding block used in the
connector sub-assembly of Figure 3.

Figure 6 is a perspective view a strain relief
30 device used to secure the multi-conductor cable to the
connector shown in Figure 1.

Figure 7 is a perspective showing of a ground clip
employed in the connector shown in Figure 1.

Figure 8 is a perspective view the connector of
35 Figure 1 including a latch for attachment to a mating
connector.



1 Figure 9 shows the connector of Figure 8 in
connected position with the mating connector.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT:

5 Referring to Figure 1 a compact electrical data
connector 10 is shown. Connector 10 may be employed to
terminate electrical cable 12 having an insulative outer
jacket 14, an inner conductive cable shield 16 and a
plurality of individually insulated electrical conductors 18
10 extending therethrough. In order to prepare cable 12 for
termination in connector 10, jacket 14 is cut away exposing
a portion of cable shield 16 and a length of conductors 18
suitable for termination.

 In the present illustrated embodiment cable 12 is
15 an eight conductor cable. However, it may be appreciated
that the invention may be employed with cables having
greater or fewer conductors. Also, cable shield 16 is shown
to be a metallic foil shield, however cables having other
types of conductive shields, such as metallic braiding, may
20 also be employed in accordance with the present invention.
Connector 10 includes an outer connector housing 20 formed
in two parts, a housing base 22 and a housing cover 24.
Housing cover 24 includes a plurality of depending
deflectable locking arms 26 which engage protrusions 28 on
25 base 22 to provide for snap fit engagement of cover 24 on
base 22. Other similar snap fitting elements may also be
employed to secure cover 24 to base 22. Housing 20 may be
formed of a suitably electrically insulative plastic such as
polyester. In order to provide external electrical
30 shielding which shields the connector 10 from external
interferences such as radio-frequency interferences and
electro-magnetic interferences, both base 22 and cover 24
may be internally and externally electrolessly plated with
a metallic plating such as nickel/copper. The process of
35 metallurgically plating a plastic member may be accomplished in
a manner which is conventional in the art.



1 Housing 20 is generally an elongate rectangular
member having a connection end 30 and an opposed cable
receiving end 32. Housing 20 shown in Figure 1 is a plug
type electrical connector where connection end 30 is
5 insertable into a jack type electrical connector for mating
engagement therewith (Fig. 8). While a plug connector 10 is
shown, the concepts of the present invention may also be
employed in a jack connector configuration.

10 Cable receiving end 32 of connector 10 defines a
rearwardly opening circular passage 34, more clearly shown
in Figures 8 and 9, which permits entry of cable 12 into
connector 10.

 Housing base 22 supports therein a termination
sub-assembly 40. Referring additionally to Figure 3
15 termination sub-assembly 40 is shown. Termination sub-
assembly 40 includes a termination support member 42 formed
of a suitably insulative plastic such as polyester, which
supports a plurality of electrical contacts 44. Each of
contacts 44 are elongate electrically conductive metallic
20 members formed of beryllium-copper having a connection end
46 and a termination end 48. Connection end 46 includes a
cantilevered element 50 for making mating resilient
electrical engagement with similar contacts in the mating
jack connector. Termination end 48 includes blade type
25 insulation displacing contact (IDC) portions 52 which, as
will be described in further detail hereinbelow, are
constructed for insulation displacing termination with
conductors 18 of cable 12.

 In the present illustrative embodiment contacts 44
30 are positioned in two longitudinally aligned transversely
spaced rows. Insulation displacing contact portions 52 of
the lower row extend in a direction opposite of the
insulation displacing contact portions 52 of the upper row.
Contacts 44 further include a matable shunting mechanism 54
35 along a central extent 56 thereof. Shunting mechanism 54
permits the shunting engagement of the upper row of contacts



1 44 to the lower row of contacts 44. The operation of a
shunting mechanism 54 of this type is shown and described in
copending patent application Serial No. 08/013,452 filed on
February 4, 1993 entitled "Vertically Aligned Electrical
5 Connector Components" which is assigned to the assignee of
the present invention.

Support member 42 of termination sub-assembly 40
includes a forward interconnection end 58 and a rear
termination support end 60. Support member 42 supports
10 contacts 44 in individual electrical isolation providing
upper and lower forward platforms 62 and 64 which support
the connection end 46 of contacts 44.

As contacts 44 are maintained in close proximity
in support member 42, it becomes necessary to shield
15 individual contact pairs from adjacent contact pairs. Shown
in Figure 2 is an internal contact shield 66. Shield 66 is
a die cast metallic member formed of zinc which is
insertable over support member 42 from the interconnector
end 58 thereof. Contact shield 66 serves to shield pairs of
20 contacts 44 from one another both laterally and vertically.
Contact shield 66 includes upper and lower shield platforms
68 and 70 which provide effective vertical shielding as
between the connection ends 46 of contacts 44. Further,
contact shield 66 includes a transverse wall 72 separating
25 lateral pairs of contacts 44. Transverse wall 72 is
especially effective in shielding the central portion 56 of
contacts 44 including shunting mechanism 54 which extends to
shunt vertically spaced contacts 44. Contact shield 66
further includes a plurality of extending contact bumps 74.
30 As will be described in further detail hereinbelow, contact
bumps 74 extend for engagement with metallically plated
housing 20 of connector 10. This establishes electrical
path continuity between housing 20 and contact shield 66.
Contact shield 66 further includes an extending ground
35 element 76 which extends for grounding electrical engagement
with cable shield 16, as will be described in further detail



1 hereinbelow, to maintain electrical ground continuity
between cable shield 16 and contact shield 66.

 Cable 12 is terminated to termination sub-assembly
40 prior to the insertion of termination sub-assembly 40
5 into base 22 of housing 20. Extending insulated conductors
18 of cable 12 are positioned for insulation displacing
connection with IDC portions 52 of contacts 44. In order to
accurately align conductors 18 with insulation displacing
portion 52, the present invention provides a pair of
10 polycarbonate conductor holding blocks 80 which are
removably positionable with respect to support member 42.
Each holding block 80 is sized to be accommodated within a
recess 61 and 63 at the termination end 60 of support member
42. Further each holding block 80 is designed for
15 positionable receipt over the upper and lower rows of
contacts 44.

 Referring additionally to Figures 4 and 5, each
holding block 80 includes plural elongate contact slots 82
which are designed for accommodating insulation displacing
20 contact portions 52 of contacts 44 upon attachment of
holding block 80 to support member 42. Each holding block
80 includes individual slots 82 for uniquely accommodating
each insulation displacing contact portion 52. Holding
block 80 further includes plural elongate conductor
25 passageways 84 which are in individual communication with
slots 82. Each passageway 84 accommodates one conductor 18
of cable 12. In order to support conductor 18 for accurate
alignment adjacent insulation displacing contact portion 52
for proper insulation displacing connection therewith,
30 holding block 80 includes plural alignment fingers 86
extending into passageway 84. Fingers 86 help support
conductors 18 adjacent an upper extent of passageway 84.
The walls of holding block 80 defining passageway 84 include
an upper V-shaped flattened surface 88. Fingers 86 extend
35 toward the apex 88a of V-shaped surface 88 so as to permit
the location of conductor 18 within the apex 88a of V-shaped
surface 88.



1 As shown particularly with respect to Figure 4,
the arrangement of fingers 86 and V-shaped surface 88 serves
to locate conductor 18 at a position off-centered with
respect to passageway 84. The fingers 86 engage the
5 insulation of conductor 18. As the insulation of conductor
18 is deformable, the fingers 86 hold conductor 18 securely
in passageway 84. Fingers 86 may also be resiliently
deformable to further frictionally secure the conductor 18
in position for electrical termination with IDC portions 52
10 of contacts 44. The interaction between fingers 86 and
conductor 18 permits proper location of conductor 18 and
also accommodates various sizes of conductors.

 Additionally, in order to facilitate entry of the
individual conductors 18 into the individual passageways 84
15 holding block 80 includes a tapered funnel entry surface 85
surrounding two adjacent passageways 84. Funnel entry
surface 85 is generally oval and tapers inwardly toward
passageway 84 to provide a smooth inwardly directed surface
against which conductors 18 may be inserted. Funnel entry
20 surface 85 serves to lead conductors 18 into proper position
within passageway 84.

 In order to properly position holding block 80
with respect to support member 42, a ratcheting inter-lock
system is employed. Holding block 80 includes a projecting
25 detent element 90 on each longitudinal side thereof.
Support member 42 includes inwardly directed ladder-type
detent receiving elements 92. Detent receiving elements 92
are positioned on opposed internal side surfaces 42a of
support member 42 within recesses 61 and 63. Each detent
30 receiving element 92 includes a tapered lead-in surface 94
and plural positioning elements 96 which permit the holding
block 80 to be supported in multiple positions within
support member 42. Initially, holding block 80 is supported
below lead-in surface 94. In this position, conductors 18
35 may be inserted into passageways 84 to align the conductors
over insulation displacing contact portions 52. The holding



1 block 80 may be snapped down to either of the next two
positions to secure the conductors 18 against, but not in
electrical connection with, IDC portions 52. Two
5 intermediate positions are provided so as to properly
position various sizes of conductors which are contemplated
to be terminated by the connector of the present invention.
Holding block 80 may be snapped down to a final position
forcing IDC portions 52 fully through slots 82 and past
10 passageway 84 to make insulation displacing connection with
conductors 18. In this final position holding block 80
securely supports conductors 18 in insulation displacing
electrical connection with contacts 44.

It is contemplated that both holding blocks 80 may
be simultaneously moved from an initial position to a final
15 terminated position under the actuation of a suitable tool
such as pliers (not shown). Movement in this manner will
provide for the mass termination of all eight conductors 18
with the associated insulation displacing contact portions
52.

20 With termination sub-assembly fully assembled and
terminated to conductors 18 of cable 12, the termination
sub-assembly 40 and cable 12 may be inserted into base 22 of
housing 20. Termination sub-assembly 40 is inserted into
base 22 adjacent connection end 30 thereof. Upon insertion
25 of termination sub-assembly 40 into base 22, cable 12 is
inserted into cable receiving end 32 of housing 20 and
extends through passage 34 at the rear end thereof.

The cable receiving end 32 of housing 20 includes
a two-component strain relief device 100 which helps secure
30 cable 12 in housing 20. Strain relief device 100 which is
shown in more detail in Figure 6 includes a pair of mating
generally hermaphroditic strain relief components 102 and
104. Strain relief component 102 is referred to as a
stationary component and is fixedly positioned in a channel
35 106 (Fig. 8) in base 22 adjacent cable receiving end 32.
Strain relief component 104 is movably positioned within a



1 similarly disposed slot in cover 24. Strain relief
components 102 and 104 are generally U-shaped members having
a bottom wall 102a and 104a respectively and upwardly
extending sidewalls or legs 102b, 102c and 104b, 104c. Legs
5 102c, 104c are deflectable and include inwardly directed
ratchet teeth 102d and 104d respectively. Legs 102c and
104c include outwardly directed ratchet teeth 102e, 104e
respectively. The hermaphroditic strain relief components
102 and 104 are positioned so that leg 102b of component 102
10 engages leg 104c of component 104 and similarly leg 102c of
component 102 engages leg 104b of component 104. The
positioning of ratchet teeth 102d, 104d and 102e, 104e
permit the movable one-way ratchet engagement of component
102 with respect to component 104. The deflectability of
15 legs 102c and 104c permits such ratchet movement of
components 102 and 104. The internal surfaces of legs 102c,
104c as well as the internal surfaces of bottom walls 102a
and 104a are generally curved so as to form a circular
opening 108 which is generally concentric with passage 34 of
20 housing 20.

As component 104 moves with respect component 102,
opening 108 defined therebetween will be reduced in size in
order to frictionally secure jacket 14 of cable 12
therebetween. In order to assist in this frictional
25 securement, ribs 110 are provided on the internal surface of
each bottom wall 102a and 104a. These ribs provide
increased localized friction against the cable jacket 14.

Component 104 may also include a frangibly
removable cap 112 which is attached to component 104 by a
flexible web 114. Cap 112 includes inwardly directed
30 protrusions 116 which are insertable into recesses 118
adjacent bottom wall 104a of component 104 for snap fit
engagement therewithin.

Strain relief device 100 operates in the following
35 manner. Strain relief component 102 is fixedly positioned
within base 22 of housing 20. Strain relief component 104



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1 is inserted into the slot in cover 24. Cover 24 is then
positioned over an snap fitted onto base 22. In this
position legs 102b, 104b and 102c and 104c are only in
initial engagement. In order to provide strain relief for
5 cable 12 within connector 10, strain relief component 104 is
manually pushed down into housing 10 through cover 24 to
provide for ratchet engagement of the respective teeth of
legs 102b, 104b and 102c, 104c. Component 104 is pushed
downward toward component 102 until the cable is secured
10 within opening 108 which is continually decreasing in size
by the movement of component 104 with respect to component
102. If cable 12 is of relatively small diameter, cap 112
may be attached to component 104 and be used as a pressing
surface. With such relatively small cables, cap 112 will
15 also function as a stop preventing over-insertion of
component 104 and the possible of crushing of cable 12. In
terminating larger cables, cap 112 may extend above the
surface of cover 24 as component 104 need not be inserted as
deeply into base 20. In this situation in order to maintain
20 a flat profile of cover 24, cap 112 may be frangibly removed
from component 104 and discarded.

Prior to installation of cable 12, cable shield 16
is folded back over an extent of jacket 14. Thus the cable
shield will also be secured between strain relief components
25 102 and 104. As the connector 10 is metallized, conductive
continuity may be established between cable shield 16 and
housing 20. Additionally, as contact shield 66 is in
electrical engagement with metallized housing 20 through
extending bumps 74 thereon, conductive continuity is
30 maintained between cable shield 16 and contact shield 66
through metallized housing 20. However, in order to provide
further redundant direct conductive continuity between cable
shield 16 and contact shield 66, a ground clip 120 is
employed.

35 Ground clip 120 which is shown in more detail in
Figure 7 is positioned adjacent strain relief device 100 for



1 engagement with cable shield 16 upon strain relief
termination of cable 12 in housing 20. Ground clip 120 is
an elongate member formed of conductive metal such as plated
copper. Ground clip 120 includes a cable engagement extent
5 122, an opposed contact shield engaging extent 124 and a
central mounting surface 126. Cable engagement extent 122
includes a transversely arcuate cable engaging surface 128
for positioning of cable 12 thereon. Shield engagement
10 extent 124 includes a deflectable cantilevered arm 130 for
engagement with extending ground element 76 of contact
shield 66. Ground clip 120 is positioned within housing
base 22 so that cable engagement extent 122 overlies fixed
strain relief component 102. Ground clip 120 is secured
15 within base 22 employing a pair of inwardly directed
deflectable locking barbs 132 at central mounting surface
126. An appropriate post (not shown) extends from a wall of
base 22 to be received between locking barbs 132 to secure
ground clip 120 thereat. Shield engagement extent 124
20 extends toward connection end 30 of housing 20 for
engagement with ground element 76 of contact shield 66 upon
insertion of contact shield 66 into base 22. Cantilevered
arm 130 is deflectable so as to resiliently engage an end
76a (Fig. 2) of contact shield 66 upon termination of cable
12 in housing 20. Ground clip 120 establishes electrical
25 continuity between cable shield 16 and contact shield 66
directly without need to employ the metallic plating of
housing 20 to establish such continuity.

Referring now to Figures 8 and 9 the latching of
connector 10 to a mating connector is shown. Connector 10,
30 which as above mentioned is a plug connector, may be
mechanically and electrically mated with a complementary
jack connector shown schematically as jack connector 150.
Connector 10 is designed for repeated connection and
disconnection with jack connector 150. In order to provide
35 for such repeated connections and disconnections, connector
10 includes a deflectable latch 140 extending therefrom.
Connector 10 which is shown in a position rotated 180° from



1 that shown in Figure 1, includes latch 140 extending from a
side wall of housing base 22. Latch 140 is generally a
deflectable cantilevered member having a distal latching
surface 142, a proximal manual actuating surface 144 and a
5 central transition surface 146. Latching surface 142 and
manual actuating surface 144 extend generally longitudinal
to connector housing 20. Latching surface 142 and manual
actuation surface 144 are vertically spaced apart being
connected by transversely extending transition surface 146.
10 The particular shape of latch 140 provides for a low profile
configuration of the latch. Connector 10 generally has a
rectangular body profile defined by base 22 and cover 24.
Employing an extending simple cantilevered arm which would
extend from housing 20, would require the distal end of the
15 latch to be substantially outward of the rectangular body
profile of connector 10. This would result in the
presentation of a wider body profile which would be
generally unacceptable for use with compact components.
Also in order to appropriately latch such an extending arm
20 a greater degree of deflection would be required. The latch
140 of the present invention overcomes these disadvantages
by providing a latching surface 142 which is within the body
profile of housing 20 upon latching engagement with
connector 150.

25 Connector 10 is connected to jack connector 150 in
the following manner. The connection end 30 of connector 10
is inserted into jack connector 150, latch 140 which is
designed to downwardly deflect upon insertion into connector
150, engages a downwardly ramped latch element 152 of
30 connector 150. This engagement forces latching surface 142
under ramped latch element 152. An opening 148 in latching
surface 142 rides over ramped latch element 152 and into
locked position therewith.

35 Referring to Figure 9 the latched position of
connector 10 with respect to connector 150 is shown.
Latching surface 142 is secured within connector 150 with



1 opening 148 in latching surface 142 surrounding latch
element 152 to secure connectors 10 and 150 in latching
engagement. In order to release the latch 150 and
5 disconnect connector 10 from connector 150 manual actuation
surface 144 is depressed. Since manual actuation surface
144 is positioned in the plane above the plane of latching
surface 142, the manual actuation surface 144 may be easily
manipulated by the user. By depressing manual actuation
10 surface 144 latching surface 142 is moved away from ramped
latch element 152 permitting disconnection of connector 10
from connector 150.

The present invention thus provides a low profile
latch almost entirely within the body profile of connector
10 with only manual actuation surface 144 slightly extending
15 above the body profile of connector 10 to facilitate manual
actuation and release of connector 10 from connector 150.

Various changes to the foregoing described and
shown structures would now be evident to those skilled in
the art. Accordingly the particularly disclosed scope of
20 the invention is set forth in the following claims.

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CLAIMS

1. An electrical connector for terminating jacketed multi-conductor cable comprising:

a connector housing for accommodating said cable, said housing defining a first bounded opening for permitting passage of said cable therethrough;

a cable strain relief device positioned adjacent said first bounded opening of said housing for securing said cable thereat, said cable strain relief device including first and second interengageable strain relief members, said first strain relief member fixedly positioned within said housing adjacent said first bounded opening and said second strain relief member movably supported by said first strain relief member adjacent said first bounded opening, said first and second strain relief members each comprising a pair of spaced legs, one leg having outwardly directed engagement elements and the opposing leg having inwardly directed engagement elements, the outwardly directed engagement elements on a leg of one strain relief member engaging the inwardly directed engagement elements on a leg of the other strain relief member, said first and second strain relief members defining a second bounded opening adjacent to said first bounded opening, said second strain relief member being movable with respect to said first strain relief member to reduce the size of said second opening and for frictionally securing said cable thereat.

2. An electrical connector of claim 1, wherein said first and second strain relief members are generally hermaphroditic.

3. An electrical connector of claim 1 or claim 2, wherein said first and second strain relief members each comprise cable engagement surfaces including raised ribs for engagement with said cable.

4. An electrical connector of any one of claims 1 to 3, wherein said engagement elements on said first and second strain relief members include interengageable teeth for permitting ratchet-type movement between said first and second strain relief members.





5. An electrical connector of any one of claims 1 to 4, wherein said second strain relief member include a stop element for limiting movement of said second strain relief member with respect to said first strain relief member.
6. An electrical connector of any one of claims 1 to 5, wherein said first and second strain relief members each comprise a generally U-shaped member including a bottom wall and a pair of upstanding sidewalls, said pair of spaced legs on each strain relief member defining said respective sidewalls.
7. An electrical connector of claim 6, wherein a leg of both of said first and second strain relief members has a curved internal surface opposite said outwardly directed engagement elements.
8. An electrical connector of claim 7, wherein said bottom wall of both of said first and second strain relief has a curved internal surface.
9. An electrical connector of claim 8, wherein said legs on both said first and second strain relief members are deflectable, and wherein said engagement elements on said first and second relief members comprise ratchet teeth.
10. An electrical connector of any one of claims 1 to 9, wherein said second strain relief member comprises a cap having an extent projecting exteriorly of said housing for pressing said second strain relief member, said cap being removably attached to said second strain relief member.

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