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Damon

[11] **3,907,397**

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[54] **HIGH DENSITY CONNECTOR PLUG ASSEMBLY**

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[73] Assignee: **Augat, Inc.**, Attleboro,, Mass.

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[21] Appl. No.: **510,230**

[52] **U.S. Cl.**..... **339/107**; 339/196 M; 339/DIG. 1

[51] **Int. Cl.**[2]..... **H01R 13/58**; H01R 33/04

[58] **Field of Search** 339/107, 196, 206, 208, 339/DIG. 1

[56] **References Cited**

UNITED STATES PATENTS

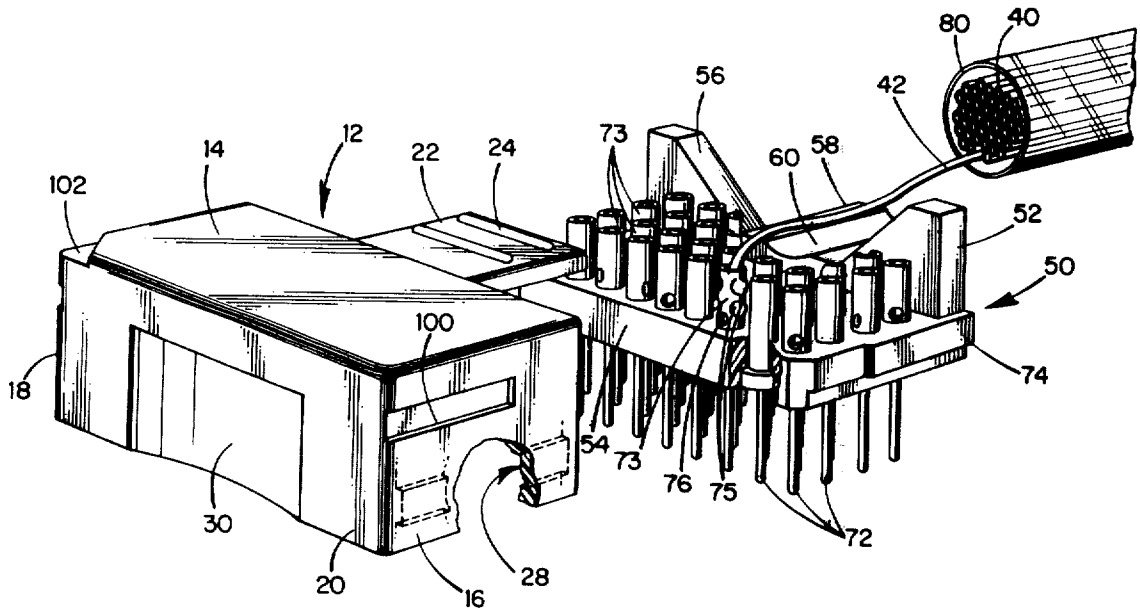
3,335,395	8/1967	Smith	339/196 M
3,375,481	3/1968	Parnell	339/107
3,506,945	4/1970	Appleton et al.	339/107

Primary Examiner—Roy Lake
Assistant Examiner—Neil Abrams
Attorney, Agent, or Firm—Weingarten, Maxham & Schurgin

[57] **ABSTRACT**

A high density connector plug assembly for connecting a multi-wire cable bundle to a panel board. The plug assembly includes a two-element housing for enclosing the end of the wire bundle, flanges to form clamping apparatus extending from one side of the housing and abutting the wire bundle, a heat shrinkable collar disposed around the wire bundle and the clamping apparatus for securing the housing elements and wire bundle securely together, and a multiplicity of connector pins. The individual wires of the cable bundle are connected to the connector pins which are arranged in a modified dual-in-line array, which pins may be mounted to a panel board or to an adaptor element for making external connections to circuitry.

9 Claims, 5 Drawing Figures



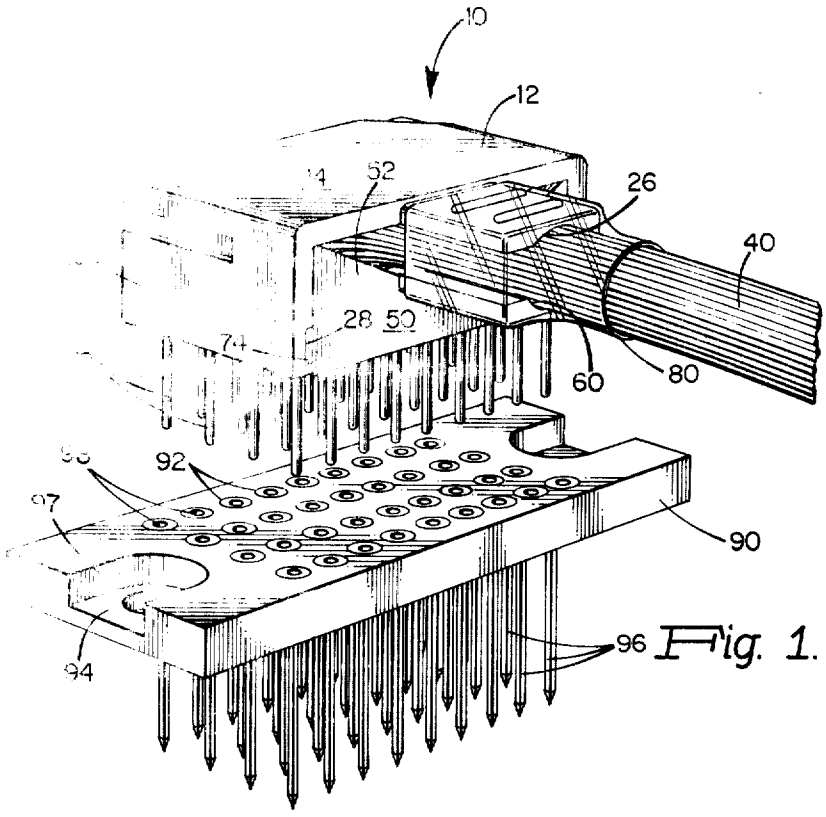

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Fig. 1.

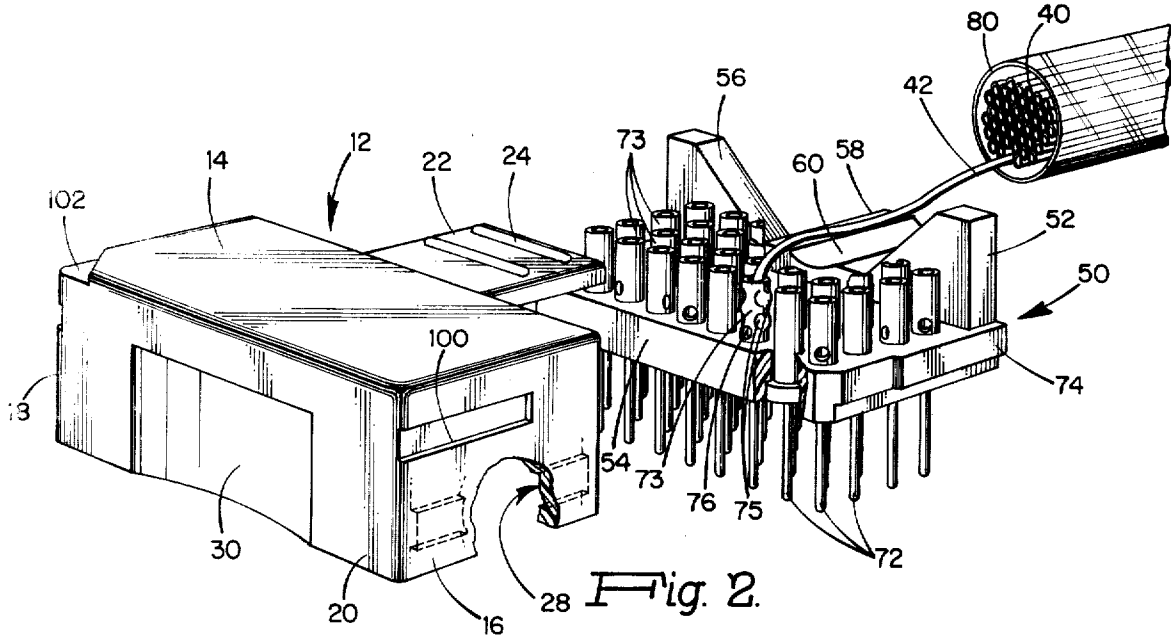

80
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Fig. 2.

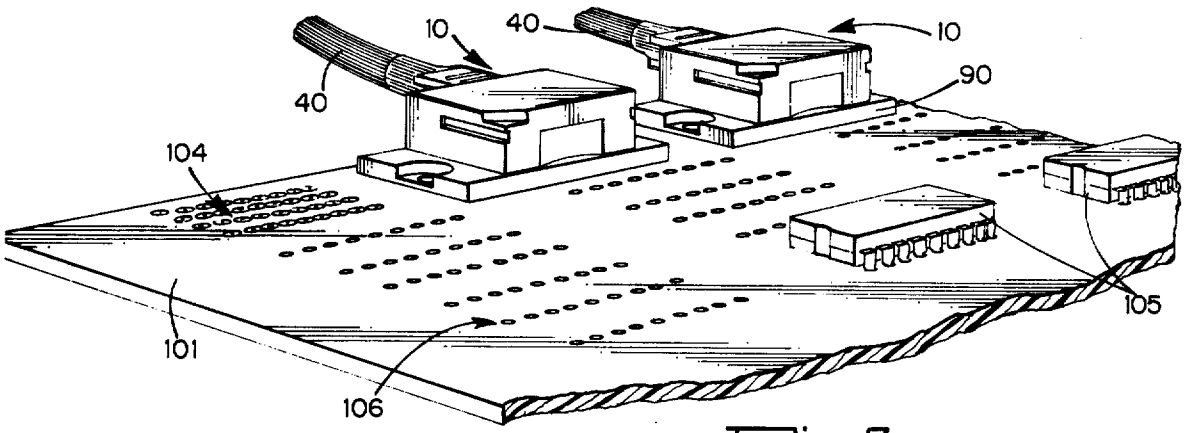


Fig. 3.

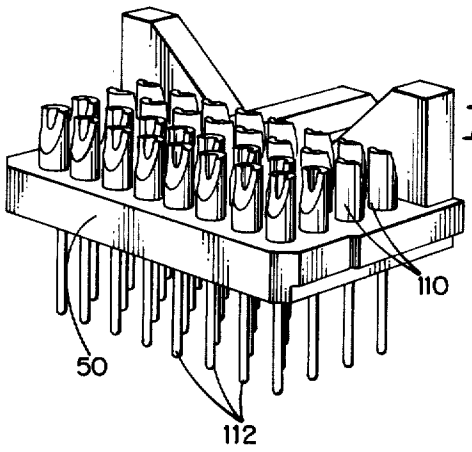


Fig. 4.

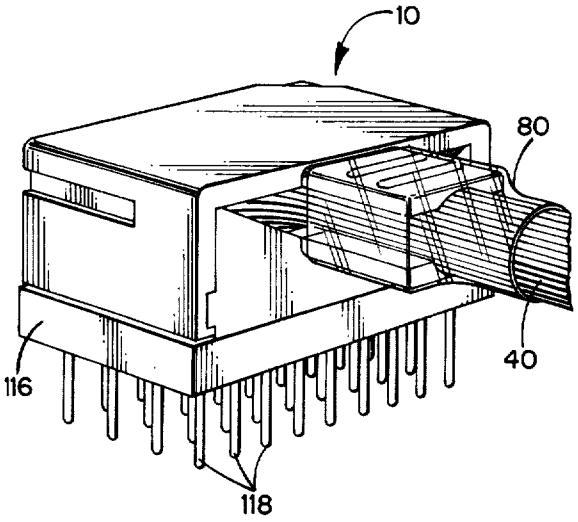


Fig. 5.

HIGH DENSITY CONNECTOR PLUG ASSEMBLY

FIELD OF THE INVENTION

This invention relates to electrical connection apparatus and more particularly concerns a connector for adapting a high density multi-wire cable bundle in a modified dual-in-line configuration for a high density connection to a printed circuit or panel board.

DISCUSSION OF THE PRIOR ART

Multiple wire cable has been developed for use in the electronics industry, generally for purposes of making high density external electrical connections to printed circuit boards for mounting panels of the type designed to receive dual-in-line (DIL) electronic circuit packages. Some connecting plugs of the prior art feed a multi-wire twisted cable bundle vertically through an opening in a cover which is bolted to a connector having two parallel rows of holes to receive electrical connection pins, which pins are in turn mated to a similar array of holes or socket pins on panel board or intermediate connectors. The cable bundle can also enter the connector plug through an opening in its side or end. An example of the prior art is shown in U.S. Pat. No. **3,506,945.** The individual wires of the bundle are inserted in each of the sockets of contacts mounted in the plug. The connector plugs of the prior art have definite density limitations in DIL configurations due to pin spacing, modularity strictures, even with the emphasis presently placed on miniaturized modular integrated circuit units. Optimum density otherwise available cannot be realized. It has become the current practice to design modular printed circuit boards so that when an electronic element mounted thereto fails, the board itself may be simply removed and thrown away. The conventional DIL configuration is not ideal for multi-wire cable connection because the DIL connector plug assembly uses significant panel board surface space. Since panel boards are often stacked closely adjcacent one another in modular construction, it is important that the cable bundle not add to the total height of the connector plug. Because of the inherent width of flat ribbon cables, their use has not been widely accepted for high density panel board purposes.

SUMMARY OF THE INVENTION

The present invention provides a novel high density low profile modified DIL connector plug assembly for connecting a high density multi-wire cable bundle to a printed circuit board, panel board, or other type mounting media. The adaptor plug is generally comprised of a hood, a base and a plurality of contact pins. The generally rectangular hood having a top, two sides and one end is adapted to slidably engage an L-shaped base having an end and a bottom. An opening in the end of the L-shaped base provides a transverse entry way for the cable bundle into the housing. Upper and lower flanges horizontally disposed on the hood and base, respectively, provide a low profile cable clamp. A heat shrinkable collar is placed around the cable and over the flanges of the clamping apparatus. When heat is applied to the collar, the collar shrinks and tightly binds the cable bundle and clamp flanges of the hood and base together so that the connector plug assembly is captivated as a relatively rigid structure.

The bottom of the L-shaped base has an orthogonal matrix of countersunk bores in which metal connector pins are disposed to which are electrically and physically connected the individual wires of the cable bundle. The modified DIL configuration employed by this invention is essentially a double dual-in-line array wherein the normal space between the two rows of a DIL is filled with two more DIL rows so that there are four rows of holes or pins in parallel. The unitary connector plug formed of the hood, base, cable bundle and collar may be mounted directly to an appropriate array of holes in a printed circuit board, through an insulative adaptor to a similar board. The adaptor may have different types of contact pins extending therefrom. The high density low profile configuration of the instant invention facilitates low cost miniaturization of integrated circuit modular components.

BRIEF DESCRIPTION OF THE DRAWING

The objects, advantages and features of this invention will become more readily apparent from the following detailed description when taken in conjunction with the accompanying drawing in which:

FIG. **1** is a perspective view of the high density, low profile connector plug of the instant invention in position to be inserted through an intermediate wire wrapping adaptor element;

FIG. **2** is an exploded partially broken-away perspective view showing the connection of an individual wire of the multi-wire cable bundle to a contact pin within the plug of the invention;

FIG. **3** is a perspective view of a panel board showing the connector plug of this invention together with integrated circuit packages mounted to the board;

FIG. **4** is a perspective view of an alternative base element of this connector plug; and

FIG. **5** is a modified embodiment of the invention similar to the view of FIG. **1** with the elements fitted together.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides a high density, low profile connector plug assembly for connecting a multi-wire cable bundle to a printed circuit or panel board or into an adaptor element which in turn can be mounted onto a panel board or other mounting assembly. Referring now to FIGS. **1** and **2** of the drawing, there is shown a generally rectangular connector plug assembly **10** comprising a generally rectangular hood **12** having a top **14,** sides **16** and **18** and a forward end **20,** and a generally L-shaped base **50** having a rearward end **52** and a bottom plate **54** slidably engaging hood **12** to form a housing. A longitudinal laterally disposed slot **28** is disposed in the inside surface of side **16** of the hood and extends throughout the length of the inside surface thereof. A similar slot (not shown) is disposed in the inside surface of side **18** of the hood. Generally longitudinal laterally disposed shoulders **74** are formed on the side edges of the bottom plate **54** of base **50.** The slots **28** and shoulders **74** are mutually engaged when hood **12** is slid rearwardly in alignment with base **50.**

The end **52** of L-shaped base **50** has a generally V-shaped opening **56** therein through which the wires of cable bundle **40** extend into the inside of assembly **10.**

A horizontally disposed upper flange **22** extends rearwardly from the top **14** of hood **12** and has a series of

ridges **24** disposed on its top and a concave arcuate downwardly facing surface **26.** The arcuate surface **26** extends the full distance across hood **12** from flange **22** across the underside of top **14.** Horizontally disposed lower flange **58** extends rearwardly from the bottom of V-shaped opening **56** on base **50** and has a plurality of ridges (not shown) on its underside similar to ridges **24** on the upper flange **22** and a concave arcuate upwardly facing surface **60.** The upper and lower flanges **22, 58** are disposed in cooperative relationship to form a clamping apparatus abutting the cable bundle **40** which passes between them.

An orthogonal matrix of countersunk holes are disposed through the bottom plate **54** of base **50** and metal contact pins **72** are pressed into the holes of the matrix. The individual wire **42** of multi-wire cable bundle **40** are connected to each of the contact pins, preferably by soldering, crimping or by other suitable means. FIG. **2,** for purposes of simplicity, shows only a single wire **42** crimped to socket **73** of pin **72.** The wire is stripped a short distance and inserted into the socket opening in each pin, and crimped in place, as indicated by dimples **75.** An inspection hole **76** is provided in each pin socket to be sure that the bare strands of each wire **42** are visible at that depth in the socket.

A heat shrinkable collar **80** is disposed around the cable bundle **40** and around upper and lower flanges **22** and **58.** Under the application of heat, the collar contracts in conventional manner around the flanges **22** and **58** and around the cable bundle and engages ridges **24** to firmly secure the abutting flanges around the periphery of the cable bundle to prevent the cable from being easily removed from the housing. This securely connects the cable, base and hood of the assembly together. Because of the engagement of shoulder **74** with slot **28,** vertical relative motion between hood and base is prevented, and collar **80** prevents any sliding or horizontal relative motion. The collar not only secures the elements together, it also provides effective strain relief for the cable bundle as it enters the housing. It may be appreciated that this type of connection and strain relief is much simpler than conventional screw-type clamps.

The assembly of the major elements of the invention is preferably accomplished by loosely sliding collar **80** onto the multi-wire cable bundle, electrically and physically connecting the conductors of each individual wire **42** to each of the connector pins **72** in base **50,** sliding hood **12** onto the base, sliding collar **80** around flanges **22** and **58,** and applying heat to the collar with a suitable heat applicator of conventional design so that it shrinks tightly around the flanges **22** and **58** and the cable.

In FIG. **1** there is shown a flat, generally rectangular insulator element **90** having an orthogonal matrix of countersunk holes **92** therethrough equivalent to the corresponding orthogonal matrix of holes in base **50.** Electrical contact pins **96** are disposed through the holes **92** and are adapted to accept the contact pins **72** in base **50** into the sockets **98** in the top of each pin **96.** The pins **96** may be wire wrapping, solder cup, printed circuit or other type terminals. Mounting ears **94** are provided on opposite ends of insulator **90** with mounting holes **97** therethrough for mounting the insulator to a suitable base if desired. In other instances the contact pins will sufficiently frictionally engage the board to which it is mounted or the pins will be soldered thereto.

The housing **10** and insulator element **90** are preferably made of a thermoplastic, a thermosetting plastic or other suitable material. However, it will be appreciated that any suitable moldable electrically insulative material may be used.

Depression **30** on the forward end **20** of hood **12** is provided for easy thumb grip handling of the assembled connector plug. To remove the assembly from its mounting, the fingers may engage the clamping apparatus and the thumb will then engage depression **30.** Horizontally disposed, generally rectangular slots **100** located on the outside of sides **16** and **18** of housing **12** are provided for engagement by the jaws of a typical removal tool for an alternate means of removal. Corner slot **102** is provided on the top **14** of hood **12** for visual polarization for connector orientation.

With reference now to FIG. **3,** there is shown a panel board **101** to which are mounted two connector plug assemblies **10** of this invention. An unused array **104** of quadruple-in-line holes in the board is also shown. Integrated circuit packages (IC's) **105** are shown mounted directly to the board via conventional dual-in-line hole arrays **106.** As an alternative the entire board may be drilled with quadruple-in-line arrays so that either IC's or the instant connector plugs may be mounted wherever desired on the board surface. It may be appreciated that use of this invention as an input/output connector as shown in this Figure, makes very efficient use of space. While the two connector plug assemblies shown in FIG. **3** appear to be a significant distance apart, they can be much more densely packed. They are shown with wide spacing in FIG. **3** only for purposes of clarity.

An alternative embodiment of the connector pins of base **50** is shown in FIG. **4.** Solder cups **110** may be used in place of the crimp sockets **73** shown in FIG. **2.** Each wire of the cable bundle would be stripped a short distance and the bare strands soldered to one of solder cups **110.** That portion of pins **112** projecting downwardly from base **50** are substantially the same as those shown in FIGS. **1** and **2** identified by reference numeral **72.**

FIG. **5** is similar to FIG. **1** but the connector plug assembly **10** has been mounted to a modified adaptor element **116.** This adapter has printed circuit board pins **118** and is adapted to be soldered to a printed circuit or panel board. Because of this modified type of mounting, the mounting ears **94** shown in the FIG. **1** embodiment are not necessary. In this case, these connector plug assemblies may be mounted even closer together to increase density and make more efficient use of board surface area.

It will be appreciated that the present invention provides a low profile connector plug adapted to receive a high density, multi-wire cable bundle for connection either directly to panel board or to a multi-contact insulator element. The modified DIL configuration of the cable connector pins results in space saving with higher space efficiency which can be usefully employed particularly with low cost high density circuit modules.

It may be appreciated that the type of connector pin employed by either the connector plug assembly or the adaptor is not important with respect to this invention. The mounting ears could be used to mount the adaptors to a frame rather than to panel boards if desired. With wire wrapping pins extending from the adaptors,

a group of them mounted to a frame effectively forms a wire wrapping pin board.

In view of the above description, it is likely that modifications and improvements will occur to those skilled in the art which are within the scope of this invention.

What is claimed is:

1. A high density connector plug assembly for connecting a multi-wire cable bundle to a panel board comprising:

a generally rectangular housing for enclosing the end of said multi-wire cable bundle, said housing comprising:

a generally rectangular hood having two sides, a top and a forward end, the rearward end and bottom of said hood being open;

a generally L-shaped base having a bottom plate and an end, said end fitting the open rearward end of said hood and said bottom plate fitting the open bottom of said hood, said base having a generally V-shaped opening in said end and an orthogonal matrix of countersunk bores through said bottom plate; and

means for coupling said base and said hood together;

a plurality of electrical connector pins disposed in said bores of said base and projecting outwardly from one side thereof, the wires of said cable bundle being individually connected electrically and physically to said connector pins;

clamping apparatus disposed at said V-shaped opening comprising:

an upper flange integral with and extending rearwardly from said hood top; and

a lower flange integral with and extending rearwardly from the base of said V-shaped opening in said rearward end of said base, said lower flange cooperatively with said upper flange abutting the top and bottom of said cable bundle.

2. The connector plug assembly according to claim 1 and further comprising a heat shrinkable collar disposed around said upper and lower flanges and said cable, said collar engaging said flanges and said cable when shrunk pursuant to the application of heat.

3. The connector plug assembly according to claim 1 wherein said means for coupling said base and said hood comprises:

a generally lateral longitudinal slot in the inside surface of each side of said hood coextensive with the length of said inside surface; and

a generally lateral, longitudinal shoulder on each side of said bottom plate of said base cooperative with said slots in said hood sides.

4. The connector plug assembly according to claim 1 and further comprising an arcuate depression on said forward end of said hood extending from the bottom throughout a major portion of the height of said hood, said depression facilitating easy handling of the assembled connector plug.

5. The connector plug assembly according to claim 2 wherein each of said upper and lower flanges is formed with at least one lateral ridge on its outer surface for engagement by said collar.

6. The connector plug assembly according to claim 5 wherein each of said upper and lower flanges is formed with a concave arcuate surface facing said cable bundle.

7. The connector plug assembly according to claim 3 and further comprising a heat shrinkable collar disposed around said upper and lower flanges and said cable, said collar engaging said flanges and said cable when shrunk pursuant to the application of heat, said collar and said coupling means combining to securely couple said hood to said base and captivate said flanges and said cable bundle as a unitary connector plug assembly.

8. A connector plug assembly according to claim 1 and further comprising:

a generally flat rectangular adaptor having:

an orthogonal matrix of countersunk bores;

a plurality of metal contact pins disposed in said bores of said matrix, each having a socket in one end to receive said connector pins in said base;

a bore at each end for mounting purposes.

9. A connector plug assembly insulator element for use with the connector plug assembly according to claim 1 comprising:

a generally flat rectangular body having:

an orthogonal matrix of countersunk bores;

a plurality of metal connector pins disposed in said bores of said matrix; and

a bore at each end through a support ear for accepting a support mounting.

* * * * *