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Provinsky

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[45] **Dec. 17, 1974**

[54] **ELECTRICAL CONNECTOR ASSEMBLY**

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[73] Assignee: **Bunker Ramo Corporation,** Oak Brook, Ill.

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[21] Appl. No.: **397,994**

[52] **U.S. Cl.** ..... **339/198 GA,** 339/208, 339/210 R, 339/17

[51] **Int. Cl.** **H01r 9/00**

[58] **Field of Search** ..... 339/198, 206, 207, 208, 339/210, 215, 176 R, 176 M, 176 MF, 258 P, 339/217 R, 17

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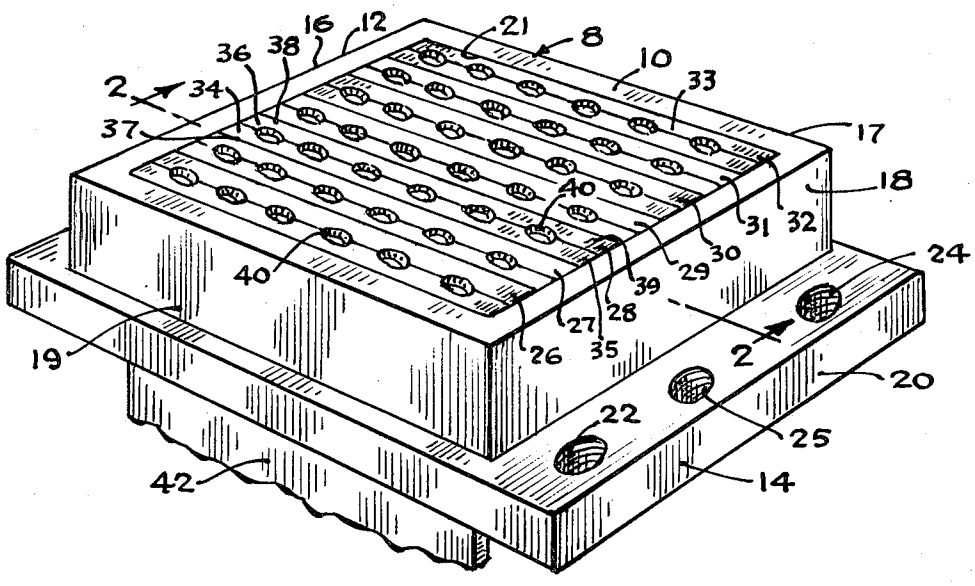
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Primary Examiner—Roy D. Frazier
Assistant Examiner—Robert A. Hafer
Attorney, Agent, or Firm—William Lohff; Frederick M. Arbuckle

[57] **ABSTRACT**

An electrical connector assembly including a box-like housing with open ends and a plurality of flat cable electrical connectors retained in the housing and individually releasable therefrom, by releasable latching elements, with each of the connectors being adapted to electrically receive a multi-conductor flat cable wherein the individual conductors are accessible through apertures in the cable and each connector includes a two piece dielectric insert housing a plurality of contacts with hook-like tails facing a common lateral direction and insertable through the apertures for electrical access to the conductors in the cable.

16 Claims, 10 Drawing Figures



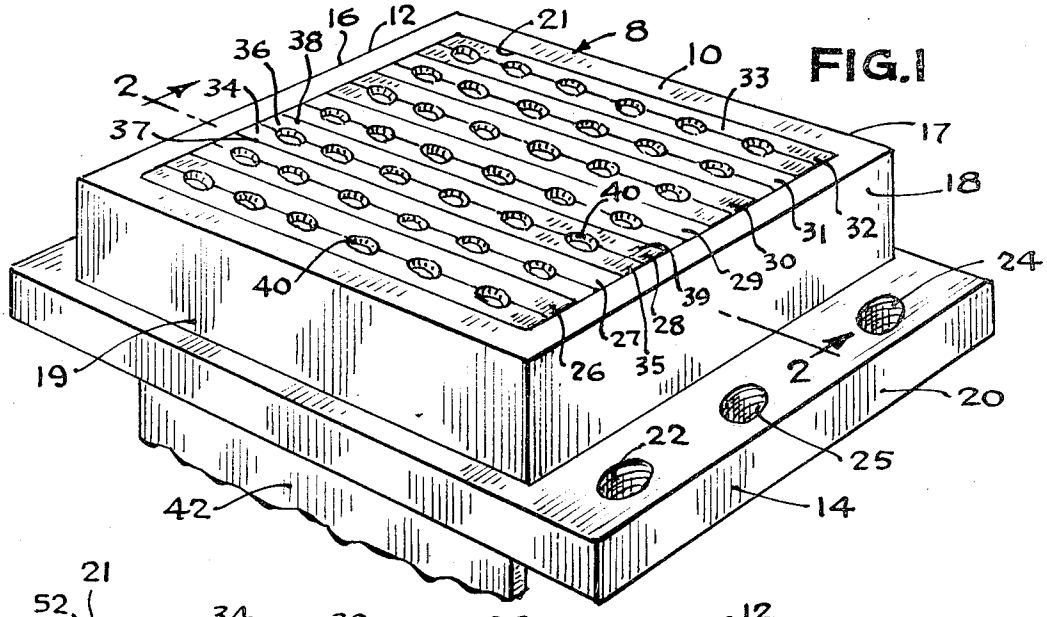


FIG. 1

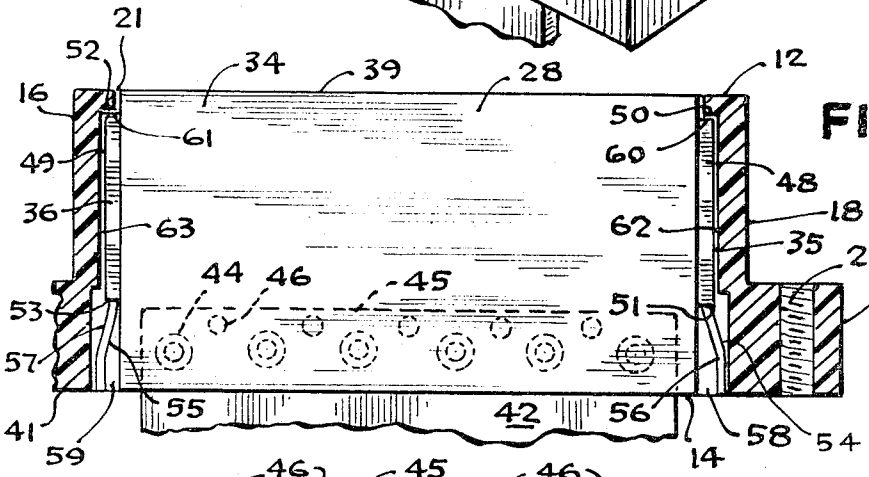


FIG. 2

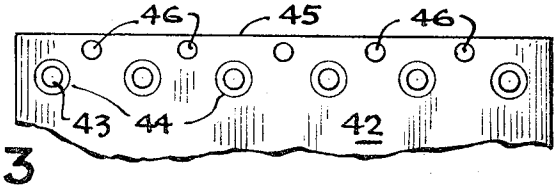


FIG. 3

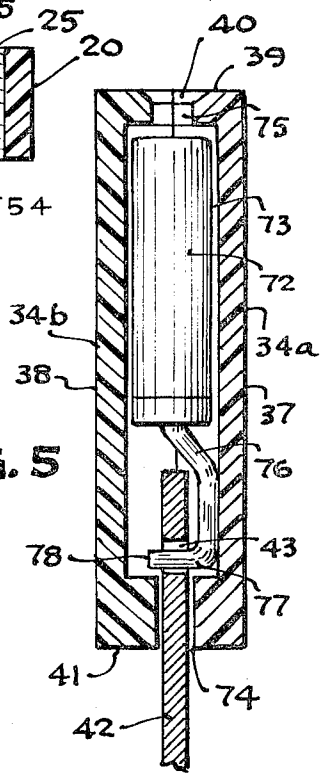


FIG. 5

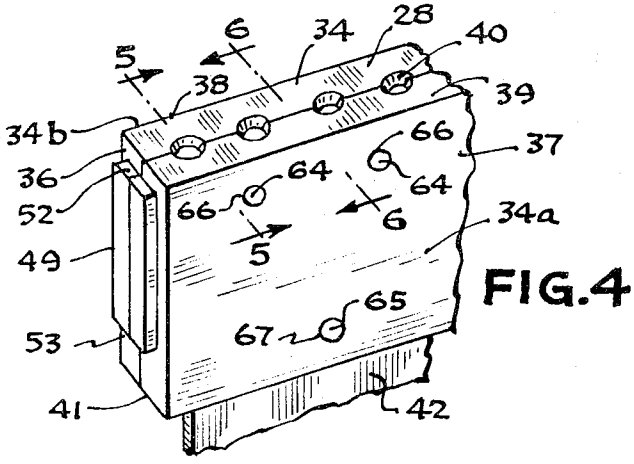


FIG. 4

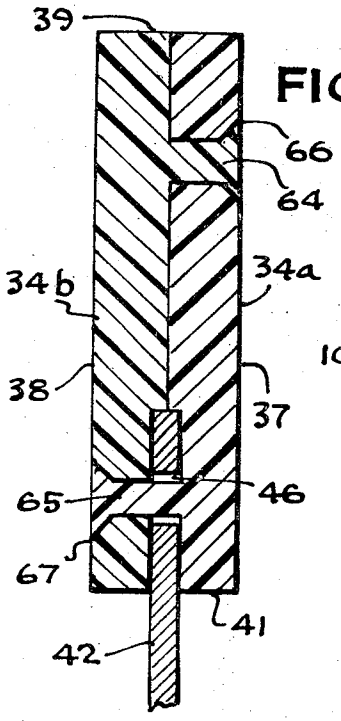


FIG.6

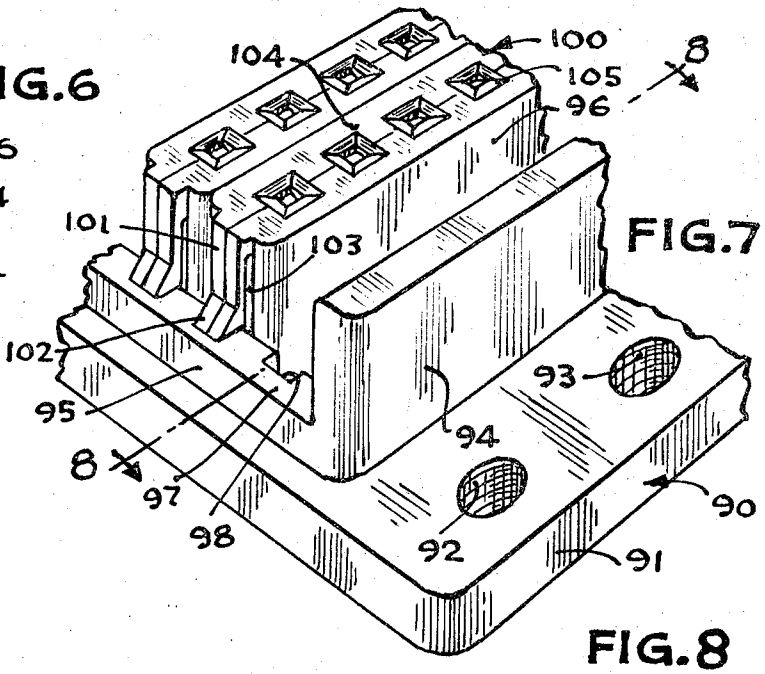
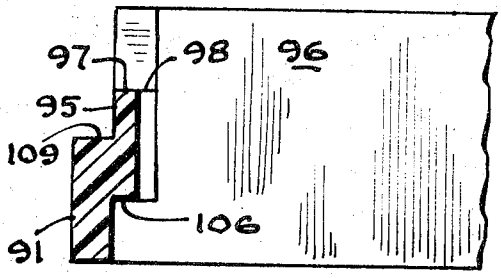


FIG.7

FIG.8



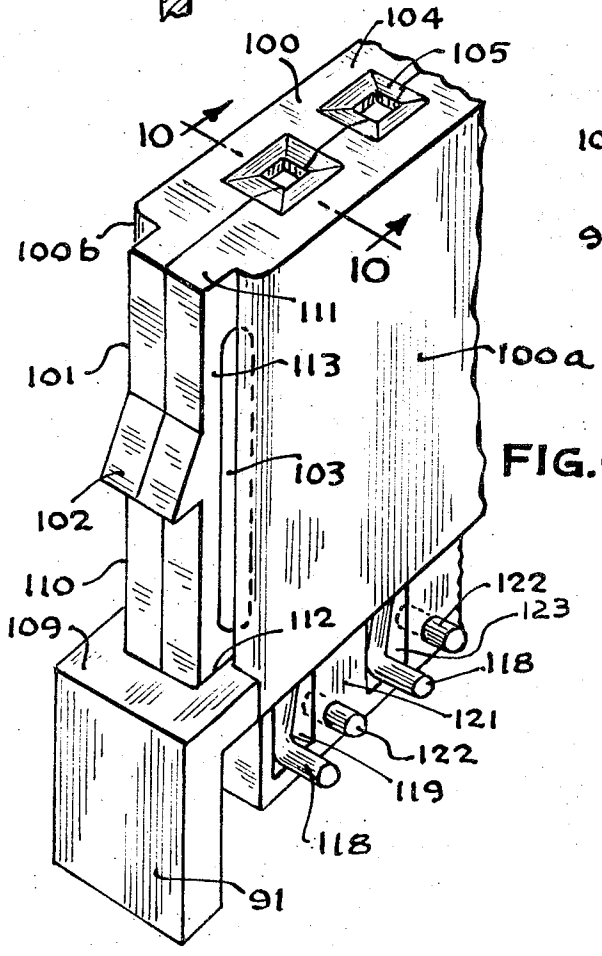


FIG.9

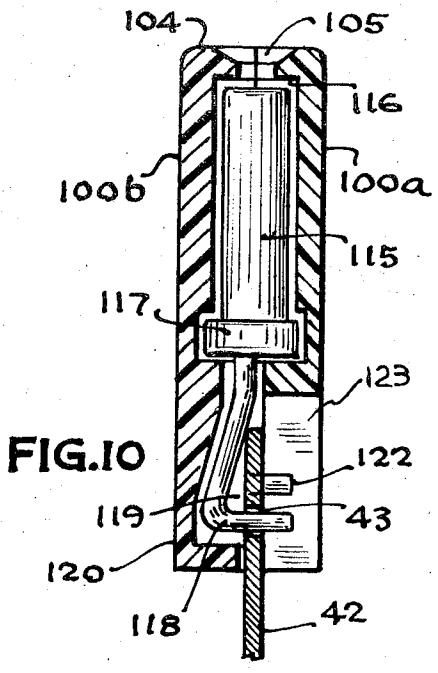


FIG.10

ELECTRICAL CONNECTOR ASSEMBLY

This invention relates to an electrical connector assembly and electrical connectors therefor adapted for connection to flat cables with apertures providing electrical access to the individual conductors of each cable. The invention herein described was made in the course of or under a contract or subcontract thereunder with the United States Government.

BACKGROUND OF THE INVENTION

In connecting a plurality of conductors in a flat cable to existing electrical connectors adapted for such cables, the individual conductors are commonly soldered or otherwise applied to the individual contacts in the connector. Often the contacts are closely spaced in a row in the connector to generally match the spacing of the conductors.

When two or more of these connectors are closely spaced together in a side-by-side relation, one of the problems that can occur concerns the difficulty in providing reliable solder connections to the individual contacts within the limited spacing available. In some instances, the metallic surfaces of the individual conductors are not completely soldered electrically to the adjacent contact tail or excess solder may be used which can cause electrical shorts.

Another problem associated with mounted assemblies of two or more connectors affixed to a plurality of flat cables is that it can be difficult to remove one connector from the assembly without initially removing all of the connectors. Since it often becomes desirable for replacement or maintenance purposes to remove individual connectors from the assembly, improvements are desirable in mounting two or more connectors together in an assembly which will permit removal or release of individual connectors.

SUMMARY

Briefly, the invention is directed to electrical connector assemblies in which a plurality of electrical connectors are connected to a plurality of flat cables and individually releasable from the assembly. The invention is further directed to individual connectors with retention means on opposite extremities which cooperate with a portion or portions of the assembly to permit the release of an individual connector. Also, the invention is directed to electrical connectors constructed of two-part inserts in which one part serves as support for internally interconnecting the contacts to conductors in a flat cable, after which the second part is installed to complete the connector.

In the inventive assembly, a plurality of connectors are retained within the hollow interior of a box-like housing with each connector and adjacent portions of the housing provided with retention means including inwardly yieldable latching elements and adjacent shoulder means over which the latching elements are snapped to permit release of individual connectors. The insulating inserts of individual connectors are of two part construction with each part advantageously forming one side and portions of the opposite ends and front and rear faces of the insert. A plurality of contacts are arranged in at least one row along the internal surface of one part of the insert and include hook-like tails spaced inwardly from the rear face of the insert and oriented laterally in a common direction towards the other insert point. Prior to the connector being inserted in the assembly housing, a flat cable with apertures and adjoining exposed solder pads electrically connected to the conductors in the cable is placed over hook-like tails of the contacts for electrical engagement as by soldering between the tails and solder pads. The insert parts further include posts on at least one part and aligned apertures on at least the other part through which the posts are inserted for retention of the two parts together following installation and interconnection of the cable.

Among the several advantages provided by the invention, one is that each connector with an installed cable can be individually inserted in a compact arrangement in the assembly housing and subsequently removed individually.

Another advantage is that removal of the individual connectors can be accomplished manually or by simple tools.

A further advantage is that the individual connectors have two part inserts and a plurality of contacts which are supported and rearwardly protected in one of the insert parts during the installation of the cable and subsequent use of the assembled connector.

Still another advantage is that a flat cable can be installed in the individual connector before the connector is inserted in the assembly housing.

Other advantages will be apparent from the detailed description below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an electrical connector assembly of the invention.

FIG. 2 is an internal side view partially in cross section along line 2—2 of FIG. 1.

FIG. 3 is a partial plan view of one end of a flat cable.

FIG. 4 is a partial perspective view of one connector utilized in the assembly of FIG. 1.

FIG. 5 is an end sectional view along line 5—5 of FIG. 4.

FIG. 6 is an end sectional view along line 6—6 of FIG. 4.

FIG. 7 is a partial perspective view of a second embodiment of the invention.

FIG. 8 is a partial side view along line 8—8 of FIG. 7.

FIG. 9 is a partial perspective view of one end of a connector of FIG. 7.

FIG. 10 is an end sectional view along line 10—10 of FIG. 9.

DETAILED DESCRIPTION

In FIGS. 1–2, the connector assembly 8 of the invention is represented as including a box-like housing 10 with upper and lower open ends 12 and 14, respectively, and four raised sides 16–19 protruding from base 20. Each pair of sides are opposite and form a rectangular-shaped hollow interior 21 within housing 10. Apertures 22 and 24 visible in FIG. 1 serve for mounting the assembly to a panel or other external support (not shown) while aperture 25 serves to receive a jack screw. A plurality of electrical connectors 26–32 are arranged in hollow interior 21 in a side-by-side relation so that collectively they form a rectangular shape 33 sized to fit within hollow interior 21. As illustrated, representative connector 28 includes a dielectric insert 34

with ends 35–36 adjacent opposite sides 16–18 of housing 10 and with sides 37–38 adjoining connectors 27 and 29, respectively. Connector 28 includes an upper face 39 with a plurality of upper openings 40 arranged in a row between ends 35–36 for engagement with a mating connector (not shown). Each of the connectors also includes a lower portion with rear face 41 to receive flat cable 42.

As illustrated in FIG. 3, cable 42 includes a plurality of apertures 43 with solder pads 44 at end 45 of the cable to provide electrical access to the individual conductors (not shown) arranged in a parallel pattern between the sides of the cable. Apertures 46 are provided to retain the cable in the connector as illustrated in FIG. 6.

In the sectional view of FIG. 2, the side 37 of connector 28 is shown mounted in housing 10 but releasable rearwardly from the housing. As illustrated, representative connector 28 includes projections 48–49 on ends 35–36, respectively, providing opposite shoulders 50–51 and 52–53 to form one of the two retention members for retaining the connector in the housing. Housing 10 further includes an integrally-formed, individually-yieldable, vertically-oriented pair of latching elements represented by opposite tines 54–55 with upper free ends 56–57 inclined inwardly to bear against the lower shoulders of projections 48–49. Tines 54–55 are individual members of a plurality of tines arranged in two rows at the bottom of the hollow interior 21 of housing 10 along sides 16 and 18. Free ends 56–57 of tines 54–55 are spaced apart from sidewalls 16 and 18 to permit outward deflection during the insertion of the individual connectors and rear openings 58–59 are provided rearwardly as access means to permit insertion of a probe (not shown) for outward deflection of the tine and release of the individual connector. Frontwardly disposed from and spaced apart from tines 54–55 are shoulders 60–61 which in combination with the tines form grooves 62–63 to receive projections 48–49. During the insertion of the connector, projections 48–49 ride over the tines 54–55 and snap into grooves 62–63 thereby retaining the connector in the housing but permitting its rear release therefrom.

FIG. 4 is illustrative of the general shape of connector 28 with its front openings 40 and multi-piece construction of insert 34 with the individual insert members 34*a* and 34*b* forming portions of openings 40. In assembling each insert member to form the completed insert, each connector member is fastened to the other by means of aligned pins and apertures represented by pins or posts 64–65 and apertures 66–67. As illustrated in FIG. 6, the ends of the pins are enlarged to permanently affix the insert members together.

In FIG. 5, contact 72 is representative of a plurality of contacts arranged in a row between ends 35–36 and retained in insert 34. Contact 72 is positioned in enlarged cavity 73 which extends between opening 40 and lower opening 74, the latter being sized to receive cable 42 and being therefore generally an elongated opening. Upper opening 40 is of a closed entry construction and frontwardly chamfered for guiding the pin of a mating contact (not shown) into the upper active portion of contact 72 represented by contact socket 75 aligned below opening 40 and in close relation to sides 37–38. Contact 72 includes a rear tail 76 adapted to be inserted into aperture 43 of cable 42 and electrically engage solder pads 44. Tail 76 includes hook 77 with end 78 extending laterally within the side-to-side confines of cavity 73. The purpose of apertures 46 in cable 42 is demonstrated in FIG. 6 wherein pin 65 is inserted through apertures 46 and 67 and thereafter flattened to permanently affix the lower portions of insert members 34*a* and 34*b* together. Front pin 64 is inserted through aperture 66 and thereafter flattened to affix the upper portions of the insert 34 together.

By constructing each of the connectors 26–32 of two-piece construction, contacts 72 can be easily inserted in cavities 73 of insert 34*a* with hooks 77 all extending in a common lateral direction. Flat cable 42 can then be inserted over hooks 77 and pins 65 in one step after which solder pads 44 are soldered to tails 76. The second half 34*b* of insert 34 can then be mounted to complete the assembly. In the resultant assembly, contact tails 76 are held within the confines of insert 34 and rearwardly protected against accidental shorting or other engagement by metallic members. Advantageously, each of the molded side members 34*a* and 34*b* include pins 64–65 as well as apertures 66–67 arranged in an alternating pattern by upper and lower pins and apertures and include opposite portions of openings 40 and 74 and cavities 73 so that both side members can be formed in the same mold. Each of the pins 64–65 of one member are positioned for alignment within apertures 66–67 of the other member which facilitates easy mounting of the two members together.

A second embodiment of the invention is illustrated in FIGS. 7–10. Housing 90 in FIG. 7 includes base 91 with apertures 92–93, sidewalls 94–95 and hollow interior 96. Sidewall 95 is recessed to form ledge 97 with keyways 98 for lateral alignment of connectors 100. As illustrated, each connector includes a hex or projection 101 with latch element or extension 102 shaped to abut against ledge 97 for retention of the connector in the housing. Slot 103, as partially illustrated in FIG. 7, permits the inward flexing of latch element 102 to release the connector from the housing. Similar to connector 28, connector 100 includes a front face 104 with a plurality of upper openings 105 to receive a mating connector. Connectors 100 are arranged in a side-by-side relation in a similar manner to connectors 26–32. In the sectional view of FIG. 8, the shape of hollow interior 96 is further illustrated including keyways 98 and recessed ledges 97. Rearwardly disposed in hollow interior 96 is shoulder 106 which collectively with sidewall 95 and ledge 97 forms a projection for retaining connectors 100 in housing 90. The projection forms abutment surfaces for engagement with latch element 102 and lower shoulder 109 which collectively form groove 110 as illustrated in FIG. 9. Projection 101 includes ends 111–112 integrally formed on the connector insert with latch element 102 generally positioned about halfway between the ends so that upper portion 113 provides an exposed area which can be manually deflected inwardly carrying tine 102 for release of the connector.

As illustrated in FIGS. 9–10, contacts 115 are positioned in cavities 116 below opening 105 to receive mating contact members. Contact 115 includes collar 117 for retention purposes and a lower hook 118 extending through aperture 43 on cable 42 for electrical connection of one of the individual conductors. Connector member 100*b* extends below connector member 100*a* and is provided with individual narrow pockets 119 open laterally towards member 100*a* and formed

by barrier walls **123**. Hooks **118** in pockets **119** are oriented towards side member **100***a* and extend below side member **100***a* beyond pockets **119** to receive flat cable **42**. In this manner, contacts **115** are restricted in rotational movement and provide hooks **118** over which cable **42** can be inserted in one step.

A lower portion **120** with barrier walls **123** is further provided with support **121** to limit the lateral positioning of cable **42** prior to the formation of the solder connection with hook **118**. Strain relief pin **122** is positioned to pass through aperture **46** on cable **42** and provide strain relief for the cable. After termination of cable **42** to connector **100** cavity below connector member **100***a* can be potted or otherwise enclosed in a manner known to the art after which the individual connectors are inserted into housing **90**. Following installation of flat cables **42** individually in connectors **26–32** or **100**, the connectors are rearwardly inserted in housing **10** or **90** and snapped into position. In the resultant arrangement, the connectors are in a side-by-side relation and can be individually released for maintenance or other purposes.

While the invention has been particularly shown and described above with reference to a preferred embodiment thereof, it will be recognized by those skilled in the art that the principals of this invention may be applied in other similar devices and that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. An electrical connector assembly comprising a box-like housing with upper and lower open ends and at least one pair of opposite outer sides,

a plurality of electrical connectors including a plurality of multi-piece dielectric inserts with opposite ends disposed adjacent said pair of opposite sides of said housing to form two sets of retention members, and a plurality of electrical contacts arranged in a row between said ends and retained in each of said inserts, said connectors being disposed in side-by-side relation within said sides, facing said upper end for engagement with mating connectors and including lower portions for electrical engagement with electrical conductors, each of said connectors being capable of rearwardly receiving a flat multi-conductor cable with an end having a plurality of apertures, a portion thereof providing electrical access to the conductors, each of said inserts including a lower portion with an elongated opening sized for entry of said cable into said insert, and each of said contacts including a lower tail formed as a hook to engage one of said apertures and thereby provide electrical engagement with one of said conductors, and

means for releasably retaining said connectors individually in said housing including a row of integrally-formed, individually yieldable latching elements and spaced apart shoulder means to form grooves therebetween on one of said retention members in each of said two sets, projection means with upper and lower shoulders on the other of said retention members to ride over the latching elements and snap into said grooves, and access means in at least one of said retention members for release of said latching elements.

2. The connector assembly of claim **1** wherein the opposite sides of said one pair include upwardly facing recessed ledges and each of said insert ends includes an outwardly projecting, inwardly yieldable latching element having one end integrally joined to said insert and an arm portion extending above said ledge and externally exposed for movement inwardly for release of said latching element.

3. The connector assembly of claim **2** wherein each of said insertion ends includes a vertical key including said latching element, and said adjacent side includes a vertical keyway extending upwardly to said ledge for insertion of said key, the vertical keys and vertical keyways of the inserts and housing providing lateral alignment of the inserts in the housing.

4. The connector assembly of claim **3** wherein each insert includes a pair of individually molded side members, each having portions of said keys.

5. The connector assembly of claim **1** wherein said contacts include rear tails with laterally extending hooks, the extension of said hooks being within the side-to-side confines of said insert.

6. The electrical connector assembly of claim **1** wherein each of said dielectric inserts includes a pair of side members with oppositely aligned apertures and posts, the posts extending inwardly across said insert for entry into said apertures to secure said members together with at least one of said posts being positioned for insertion through one of said apertures in said cable for retention of said cable in said insert.

7. The electrical connector assembly of claim **1** wherein said housing includes an outer flange with means for mounting said housing to an external support.

8. An electrical connector for rearwardly receiving a flat multi-conductor cable having an end with apertures affording electrical access to individual conductors, said connector comprising

a dielectric insert with front and rear faces, a plurality of upper openings in a row along said front face, an elongated lower opening along said rear face for entry of said cable, a plurality of internal cavities extending between said upper openings and said lower opening, and a plurality of electrical contacts disposed in said cavities with upper active portions facing said upper openings and lower tail portions with laterally extending hooks shaped to be inserted into at least a portion of said apertures of said cable and electrically engage said conductors in said cable,

said insert further including a pair of individually molded side members each providing an opposite portion of said upper openings and cavities, the side members including a plurality of side apertures and inwardly extending side posts with at least one of said posts on one side member being aligned with one of said apertures on the other side member for entry into said aperture for retention of the side members,

said hooks all facing one of said members and over which the apertured end of the cable can be inserted, and

one of said side members extending below the other side member and including narrow pockets open laterally towards the other member to receive at least a portion of the contact tail portions and thereby restrict the contacts from rotation with the

ends of the hooks being exposed laterally beyond the pockets to receive said cable.

9. The electrical connector of claim **8** wherein the insert includes a lower portion with said elongated lower opening which when the cable is inserted into the opening prevents accidental electrical access to the conductors through the apertures.

10. The electrical connector of claim **8** wherein said insert includes opposite ends with inwardly yieldable latching elements for releasable retention of said insert housing.

11. The electrical connector of claim **10** wherein said one side member includes barrier walls forming said pockets and providing side support for said cable.

12. The electrical connector of claim **9** wherein said insert includes opposite ends with projection means providing front and rear facing shoulders for retention of said connector in a housing.

13. The electrical connector of claim **12** wherein said posts and apertures in each side member are disposed in upper and lower rows with the posts and apertures being in an alternating arrangement in each of said rows.

14. An electrical connector for rearwardly receiving a flat multi-conductor cable having an end with apertures affording electrical access to individual conductors, said connector comprising

a dielectric insert with front and rear faces, a plurality of upper openings in a row along said front face, an elongated lower opening along said rear face for entry of said cable, a plurality of internal cavities extending between said upper openings and said lower opening, and a plurality of electrical contacts disposed in said cavities with upper active portions facing said upper openings and lower tail portions with hooks shaped to be inserted into at least a portion of said apertures of said cable and electrically engage said conductors in said cable,

said insert further including a pair of individually molded side members each providing an opposite portion of said upper openings and cavities, one of the side members including narrow pockets open laterally towards the other member to receive at least a portion of the contact tail portions and thereby restrict the contacts from rotation with the ends of the hooks being exposed laterally beyond the pocket to receive said cable.

15. The electrical connector assembly of claim **14** wherein said one side member includes barrier walls forming said pockets and providing side support for said cable.

16. The electrical connector of claim **15** wherein said insert includes opposite ends with means for latching said connector to an external housing.

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