United States Patent

[11] **3,546,366**

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[54] **COMPRESSIBLE ELECTRICAL CONNECTORS**
5 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **174/94,** 174/71
[51] **Int. Cl.** **H02g 15/08**
[50] **Field of Search** ..... 174/71, 72, 84.1, 90, 94; 339/276; 287/109; 29/628, 630(F)

[56] **References Cited**

UNITED STATES PATENTS

2,884,478	4/1959	Becker et al.	174/94
3,134,844	5/1964	Myers	174/94
3,235,654	2/1966	Eldridge, Jr.	174/94
3,236,938	2/1966	Toedtman	174/94
3,275,738	9/1966	Flynn et al.	174/94

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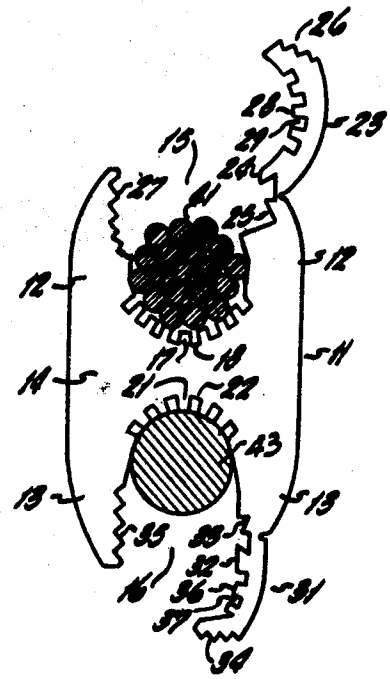
ABSTRACT: Compressible electrical connecters have integral enclosure tabs which lock in place and provide electrically and mechanically secure joints.



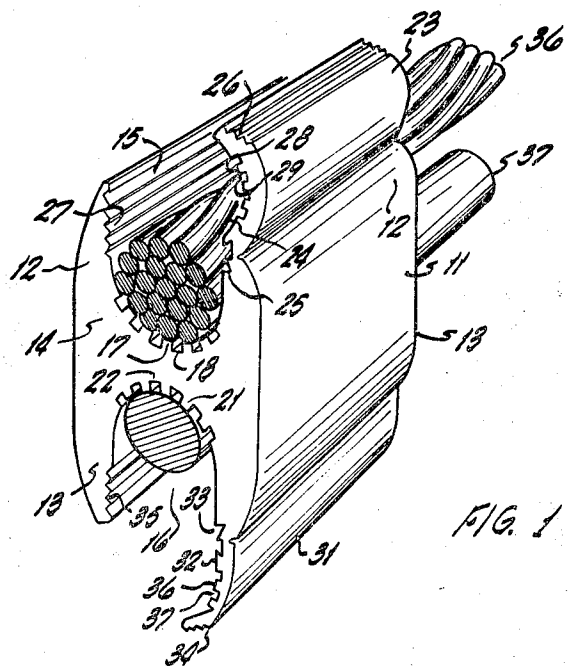


FIG. 1

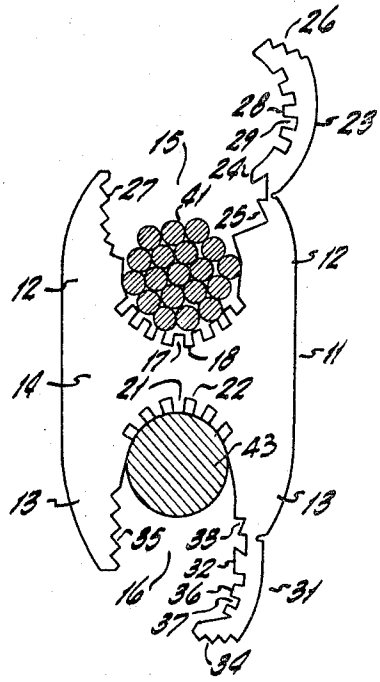


FIG. 2

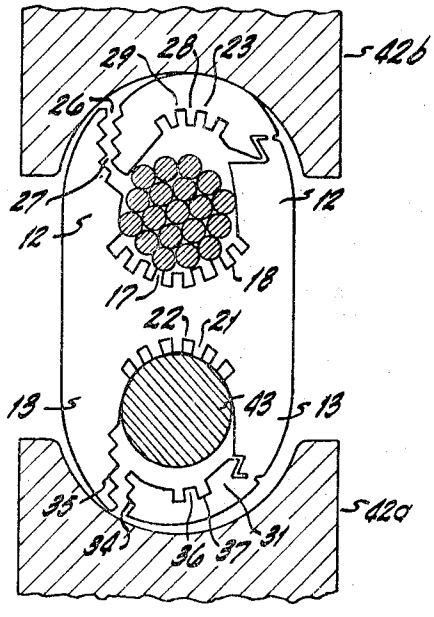


FIG. 3

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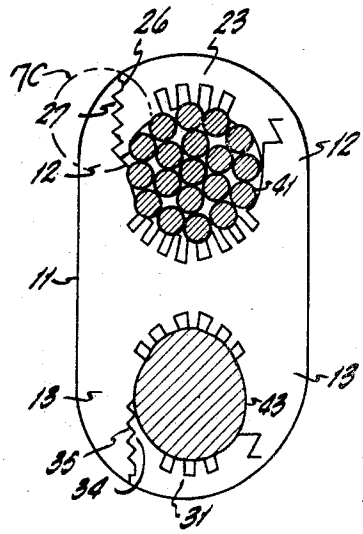

FIG. 4

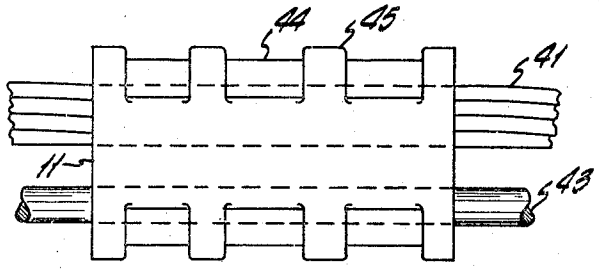

FIG. 5

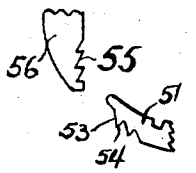

FIG 7A

FIG 7B

FIG 7C

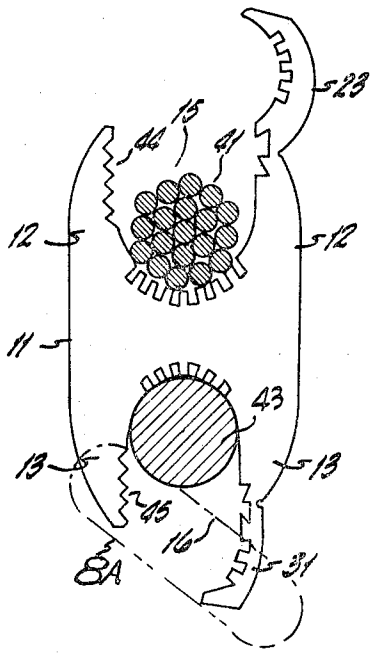

FIG. 6

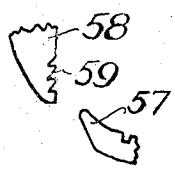

FIG. 8A

FIG 8B

FIG. 8C

COMPRESSIBLE ELECTRICAL CONNECTORS

This invention relates to new and improved electrical connectors. More particularly, it relates to compressible connectors for large diameter conductors.

Connectors of the described type are general—although not always—used on electrical conductors in the power distribution industry. Generally, a designer of these devices faces several problems. The connectors must be adaptable for connecting a range of differing diameter and shaped conductors. Additionally, the connector should be of a construction such that, when the connector is compressed around the surface of the conductor, the conductor is tightly sealed so as to prevent entry of foreign elements and contaminants, such as moisture and the like. Once the connector is sealed, it must stay sealed. For example, the connector should be of a construction such that when pressure is applied at points along the body of the connector to seal it tightly, this local squeezing or crimping does not cause an adjacent section of the connector which has already been sealed to pop open. Moreover, if the conductor cables are wound in a helical configuration, the connector must be constructed so that it will not be forced open if the cables exert an inherent outward pressure resulting from the helical memory.

An object of this invention is to provide compressible electrical connectors having an integral enclosure tab which locks in place and provides an electrically and mechanically secure joint.

Another object is to provide connectors which can be sealed tightly with good contact pressure on the conductor and which will not pop open at a previously sealed point when pressure is exerted at an adjacent point to seal the connector.

Still another object is to provide connectors which will resist internal pressures exerted by the conductors and will retain their locked condition after they are sealed.

An additional object is to provide connectors for a wide variety of large diameter conductors.

In keeping with one aspect of the invention, these and other objects are accomplished by a connector having a substantially H-shaped cross section with two pairs of arms spaced to provide a recess adapted to receive a conductor. One of the arms of each pair includes an integral enclosure tab. The inventive connector includes means for establishing mechanical interference between the enclosure tab and the oppositely disposed, overlapping arm when the connector is in a closed and compressed state enfolding and gripping and conductor disposed in the body recess. Thus, the enclosure tab locks in place, providing an electrically and mechanically secure joint.

More particularly, the mechanical interference between the tab and the arm may be established by a variety of means such as interlocking ridges or serrations on the inside of the arm and on the tab surface. Or, on compression of the connector, an interference fit may occur responsive to a cold flow of metal from a smooth tab surface into a ridged or serrated surface on the inside of the arm and vice versa. An interlocking cam like surface on the inside of the arm may lock into teeth on the tab surface and vice versa, and the like. It is by virtue of this mechanical interference that the connector overcomes any propensity to pop open when pressure is applied at adjacent points along the axis of the connector to seal it or as a result of internal pressure created by the inherent mechanical characteristics of the particular conductor being sealed.

The integral enclosure tabs which are affixed to the arms of the body are easily bendable over the recesses formed in the body of the connector to hold the conductors. The tabs are pivoted over their associated recesses by a hinging action occuring at the inside interface of each tab and the arm to which the tab is affixed in order to provide exact and uniform alignment of the tab so that it interlocks properly with the corresponding, oppositely disposed arm.

The above mentioned and other features and objects of this invention will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of the connector before compression;

FIG. 2 is an end elevational view of the connector before compression;

FIG. 3 is an end elevational view of the connector illustrating the action of the compression tool in bending the tabs inwardly of their associated recesses and the oppositely disposed arms and, also, illustrating the hinging action at the interface of the tab and the arm to which it is affixed;

FIG. 4 is an end elevational view of the connector body fully compressed with the tabs locked into position;

FIG. 5 is a side elevational view of the connector after compression;

FIG. 6 is a perspective view of a second embodiment of the invention;

FIGS. 7A, 7B and 7C (which corresponds to the fragment of FIG. 4 which is enclosed within a dot-dashed circle 7C) are fragmentary, end views illustrating a modified construction of the tab and the mating portion of an arm utilized on the connector; and

FIGS. 8A (which corresponds to the fragment of FIG. 6 which is enclosed by dot-dashed lines 8A), 8B and 8C are fragmentary, end views illustrating another modified construction of the tab and the mating portion of an arm utilized on the connector.

An electrical connector is shown in FIG. 1 and FIG. 2 to illustrate a preferred embodiment exemplifying the principles of the invention. In general, this embodiment includes a substantially H-shaped body, generally indicated as 11, made of a malleable metal. The body 11 includes two pair of arms 12 and 13 extending outwardly from an intervening partition 14. The arms 12 are spaced-apart to provide a recess 15. Similarly, the arms 13 are spaced to provide a corresponding recess 16, usually of slightly smaller dimensions.

The body 11 is provided with a plurality of longitudinal alternately arranged series of deformable ribs 17 and grooves 18. Specifically, the ribs 17 extend along the recess between projecting into the recess 15 and along the inside surface of each arm 12.

The plurality of deformable ribs 17 and alternately arranged grooves 18 provided along the inside surface of each arm 12 and along the recess bottom form a generally arcuate cross-sectional outline. This configuration of ribs 17 and grooves 18 assures bending of the arm 12 in a desired manner as subsequently described and enables the arms 12 to wrap or enfold the conductor very closely.

The body 11 is provided with a plurality of alternating deformable ribs 21 and grooves 22 extending along the bottom of the other recess 16 and along the inside surface of each arm 13. The ribs 21 extend into the interior of recess 16.

Correspondingly, the ribs 21 and grooves 22 constitute a generally arcuate cross-sectional configuration. It will be noted that because the recess 16 is slightly smaller to accommodate a smaller conductor, there are fewer ribs 21 extending along the recess bottom and up the inside of the arm 13 than there are along the bottom of the slightly larger recess 15 and along arms 12.

The ribs 17 in recess 15 and the ribs 21 in recess 16 constitute a yieldably deformable means under pressure to accommodate the conductor size and to conform to the configuration of said conductor.

Attached integrally with one of the arms 12 is a camlike tab 23 extending beyond the end of the other opposite arm 12. Tab 23 has a generally arcuate cross-sectional outline on its inside and outside surfaces. On the inside surface of tab 23 is a plurality of longitudinal, alternately arranged series of deformable ribs 28 and grooves 29, such ribs 28 deforming under pressure against the conductor to conform to the conductor configuration. At the inside interface of arm 12 and tab 23 and extending longitudinally the length of the interface, there is a locking rib or ratchet 24 and a groove 25 to receive such rib or ratchet.

According to the invention, a means is provided for establishing mechanical interference between tab 23 and the oppositely disposed arm 12 when the tab 23 is in a closed and compressed state enfolding and gripping the conductor disposed in the recess 15.

Ridges or serrations 26 are formed on the outside, top surface or mating edge of tab 23 and extend longitudinally the length of such tab between its ends. Corresponding, interlocking ridges or serrations 27 are provided on the inside surface or mating portion of the opposed arm 12 and extend longitudinally the length of such arm. As will become apparent, a conductor is inserted into groove 15 with the tab 23 in the "open" position then upon compression as shown in FIG. 3, the groove 25 engages the locking rib 24 and the tab 23 is pivoted on this interlocking hinge closing over the conductor. This interlocking hinge means insures proper alignment of tab 23 as it is bent inwardly of its associated recess 15 and inwardly of the opposed arm 12 before the arms 12 are compressively overlapped and the opposed arm 12 is interlocked with tab 23 by means of mechanical interference created between the ridges or serrations 26 on the mating edge of tab 23 and the interlocking, complementary ridges or serrations 27 on the mating portion of arm 12. The conductor is, thus, enfolded and locked in place within the recess 15.

The length of tab 23, or in other words, the distance of the tab 23 extending outwardly from its associated arm 12, is less than the width of the recess 15 between the arms 12. This structural arrangement assures that the tab 23 will enter the recess 15 when the tab 23 is bent over. Also, upon compression, a mechanical interference is established between the ridges or serrations 26 on the tab 23 and the complementary, interlocking ridges or serrations 27 on the inside surface of the opposed arm 12.

A similar tab 31 is attached integrally to one of the arms 13 at the same side of the connector as the other corresponding tab 23. Tab 31 extends outwardly beyond the end of the other arm 13. Again, tab 31 has a generally arcuate cross-sectional outline on its inside and outside surfaces and a plurality of longitudinal, alternately arranged series of deformable ribs 36 and grooves 37 are formed on the inside surface. Also, tab 31 is provided with a locking rib or ratchet 32 at its connection to its associated arm 13 and there is a groove 33 in the associated arm 13 to receive such rib or ratchet so that the tab 31 can be pivoted on this interlocking hinge into a closed position over a conductor inserted laterally into groove 16. As a result of the interlocking hinging action between the rib 32 and the groove 33, the tab can be easily bent inwardly toward the other arm 13 in proper alignment. Ridges or serrations 34 are formed on the outside, top surface or mating edge of tab 31 and extend the length of the tab between its ends. These ridges or serrations 34 are adapted to engage complementary, interlocking ridges or serrations 35 provided on the inside surface or mating portion of the opposite arm 13 when the tab is bent inwardly of the opposite arm 13 and the conductor is enfolded and gripped in the recess 16 under compressive action. Thus, this tab 31 is also of a slightly lesser length than the width of the recess 16 between the arms 13 to assure that the bendable tab 26 will enter the recess 16.

To install the connector, a conductor 41 is inserted into recess 15 and the tab 23 is pivoted into position over the conductor 41 by compressive action of a compression tool 42 as shown in FIG. 3. As suggested above, the tab 23 enters the recess 15 inside of the opposite arm 12 and the mating edge of tab 23 interlocks with the mating portion of arm 12.

A smaller conductor 43 is disposed in the recess 16 and the tab 31 is pivoted into position over the conductor under pressure as is shown in FIG. 3. Similarly, the tab 31 enters and closes the recess 16 inside of the opposite arm 13 by the interlocking action of the mating edge of tab 31 and the mating portion of arm 13.

The compression tool 42 may be of any suitable type. The jaws 42*a*, 42*b* are fitted over the connector body 11 and manipulated to exert a compressive pressure, thereby squeezing the body 11 to the condition illustrated in FIGS. 4 and 5.

Specifically, the action of tool 42 is to engage the tabs 23 and 31 and bend them inwardly of the associated recesses 15 and 16 and inwardly of the oppositely disposed arms 12 and 13, respectively. Upon bending of tabs 23 and 31, locking ribs 24 and 32 are engaged by their corresponding grooves 25 and 33 respectively, in an interlocking, hinging action which causes the tabs 23 and 31 to bend in exact alignment with the oppositely disposed arms 12 and 13. This initial action of tool 42 and the bending and hinging of tabs 23 and 31 is best shown in FIG. 3.

Upon continued compressive action of tool 42, the arms 12 and 13 are bent toward each other enough so that the mating edges on tabs 23 and 31 and the mating portions on arms 12 and 13 come into contact. This provides interlocking, overlapping connections that enfold and grip the conductors 41 and 43 as is shown in FIG. 4. The tabs 23 and 31 and the arms 12 and 13 are disposed around their associated conductors 41 and 43 in close contiguous relation. The tabs 23 and 31 are compressively interlocked with arms 12 and 13 by means of mechanical interference created between the ridges or serrations 26 and 34 on the mating edges of tabs 23 and 31 and the complementary ridges or serrations 27 and 35 on the mating portions of arms 12 and 13 respectively. Thus, the connector is interlocked in a manner such that crimping at an adjacent point along the connector will not cause the seal to pop open. Also, the internal pressure exerted by the conductor cables will not cause the seal to be forced open.

Upon compression of the connector, the ribs 17 and 28 are deformed and yield under pressure by the conductor 41 to accommodate the particular size of the conductor 41. As the ribs 17 and 28 are deformed, the ribs 17 and 28 wipe the contact surfaces with a cleaning action and yieldably conform precisely to the conductor configuration to provide an optimum contact.

As a result of the provision of grooves 18 along the bottom of recess 15 and along the inner surface of arms 12, the arms 12 bend toward each other at the bottom of the recess 15 and thereby preclude any bulging in this area of the recess bottom.

If a compound or paste (not shown) is utilized in the connector, the compound will be retained in the grooves 18 and 29 by the ribs 17 and 28. Moreover, such compound will be forced into the stranding of the conductor 41 for more effective action.

It will be realized that as the ribs 17 and 28 yieldably deform under pressure by the conductor 41 upon compression of the connector, the ribs 17 and 28 accommodate the conductor 41 and thereby prevent excessive pressure from developing on the conductor. Of course, it will be readily apparent that this deformation feature of the ribs 17 and 28 enables the insertion and effective connection of any conductor 41 within a wide range of sizes.

In a similar manner, the conductor 43 deforms the ribs 21 and 36 under pressure so that the ribs 21 and 36 accommodate the particular size of the conductor 43. Again, the ribs 21 and 36 conform to the particular shape and contour of the conductor 43, and particularly the ribs 21 and 36 wipe the surface of the conductor 43 with a cleaning action and conform precisely with the conductor to provide an effective contact. The yielding or deformation of the ribs 21 and 36 precludes any excessive pressure developing on the conductor 43.

The same advantageous result is obtained in that the deformation of the ribs 21 and 36 in the recess 16 and on the tab 31 enables the effective connection of any conductor 43 within a wide range of sizes.

Because grooves are placed along the bottom of recess 16 and up each of the arms 13, the arms 13 bend toward each other at the bottom of recess 16 and thereby preclude any bulging in this area.

If a compound or paste (not shown) is utilized in this portion of the connector body 11, such compound would be retained in the grooves 22 and 37 by the ribs 21 and 36 even upon endwise insertion of the conductor 43. Upon compressive action, the compound would be forced against the conductor 43 for more effective usage.

With the particular construction of tabs 23 and 31 and their structural relationship with the width of recess 15 and 16 respectively, the tabs 23 and 31 will enter the recesses 15 and 16 within the oppositely related arms 12 and 13 in an alignment such that the ridges or serrations on the mating portion of the arms 12 and 13 will interlock with the complementary ridges or serrations on the mating edge of the tabs 23 and 31 respectively as the connector 11 is compressed with the conductors 41 and 43 in place.

A second embodiment of the compressible electrical connector is illustrated in FIG. 6. In this embodiment, the mating portion of arm 12 is provided with ridges or serrations 44. The mating edge of tab 23 is flat initially. Under compression, when a conductor is in place in groove 15, the ridges or serrations 44 on the mating portion of arm 12 will interlock with the flat mating edge of tab 23 by means of cold flow of metal into the ridges or serrations 44. The compressive force of the compression tool will cause a mechanical interference to be created as the smooth metal surface of tab 23 is deformed into the ridged or serrated mating portion of arm 12. This interlocking action will be very effective for connectors constructed of a soft, malleable metal which will accommodate the above mentioned cold flow of metal.

Similarly, in FIG. 6, the mating portion of arm 13 is provided with ridges or serrations 45 and the mating edge of tab 31 is flat. The compressive force of the compression tool when the mating edge of tab 31 is brought into contact with the mating portion of arm 13 will cause a cold flow of metal into the ridges or serrations 45. The mechanical interference thus created will cause the connector to be interlocked.

FIGS. 7A, 7B, and 7C illustrate a modified construction of a tab 51 and a mating portion of an arm 52 that can be utilized to advantage in any one of the embodiments of FIGS. 1—6. To orient the reader, a dot-dashed circle has been drawn in FIG. 4 to identify the part where the fragment of FIG. 7C may be located. The mating edge of tab 51 is provided with camlike inclined surfaces 53 terminated by locking teeth 54. Correspondingly shaped ratchet-like locking teeth 55 are provided on the mating portion of arm 56. These inclined surfaces guide each other as the connector is closed and the tip ends of the teeth engage each other to lock the tab in the closed position.

In FIG. 7A, the tab 51 is shown in the "open" position. Upon compression, (FIGS. 7B and 7C), when a conductor (not shown) is in place in the connector, the surfaces 53 and 55 easily slide over each other. Thus, a positive interlocking is achieved between the teeth 54 at the end of the camlike inclined surfaces 53 and the ratchetlike locking teeth 55. This embodiment has the advantage of preventing premature binding or locking responsive to interference between the interlocking edges of the tab and the mating portion of the arm. This feature tends to preclude any possibility that the sidewalls will either collapse after a conductor has been compressively interlocked in the connector, or fail to make a completely tight, low resistance electrical connection.

FIGS. 8A, 8B and 8C illustrate another modified construction of a tab 57 and a mating portion of an arm 58. Again, to orient the reader, a dot-dashed line 8A has been drawn in FIG. 6 to identify where the fragment of FIG. 8A may be located. This modified embodiment can be utilized advantageously in any of the embodiments of FIGS. 1, 6 and 7. As shown in FIG. 8A, the mating edge of the tab 57 is initially flat. The mating portion of arm 58 is provided with ratchetlike teeth 59. Again, the inclined surfaces of the teeth guide the tab to a closed position, and the tip ends of the teeth hook into the arm to keep the connector from opening. Under compression (FIGS. 8B and 8C), when a conductor (not shown) is in place within the connector, the teeth 59 interlock into the flat mating edge of the tab 57. This interlocking is achieved by means of a cold flow of sidewall metal into the teeth 59 in the manner previously described with respect to the embodiment of FIG. 6. Again, the camlike operation insures a smooth sliding action free of binding at the interfacing surfaces.

For convenience in description, the term "interlocking teeth" will hereinafter be employed in the claims to generically denote all of the aforementioned means for establishing mechanical interference.

While the principles of the invention have been described above in connection with specific apparatus and applications, it is to be understood that this description is made only by way of example and not as a limitation on the scope of the invention.

We claim:

1. A compressible electrical connector having integral enclosure tabs which lock in place comprising: a connector body of malleable metal having a substantially H-shape in cross section to provide two pairs of upstanding arms, the arms of each pair being spaced-apart to provide a recess for receiving a conductor, the recesses being open along their lengths at opposed portions of the body, one of the arms of each pair including an integral tab bendable over the associated recess, the length of each tab being less than the width of the associated recess between the pair of arms to assure entry of the tab into the recess, and wherein the means for establishing mechanical interference interlocking teeth on a mating portion of the arm which interlock with a mating edge of the tab as the connector is compressed, said interlock providing an electrically and mechanically secure joinder of said tab with said arm when the tab is in a closed and compressed state enfolding and gripping the conductor disposed in the recess.

2. The connector of claim 1 including complementary interlocking teeth on said mating portion of said arm and on said mating edge of said tab.

3. The connector of claim 1 including a flat mating edge on said tab and interlocking teeth on said mating portion of said arm.

4. A compressible electrical connector having integral enclosure tabs which lock in place comprising: a connector body of malleable metal having a substantially H-shape in cross section to provide two pairs of upstanding arms, the arms of each pair being spaced-apart to provide a recess for receiving a conductor, the recesses being open along their lengths at opposed portions of the body, one of the arms of each pair including an integral tab bendable over the associated recess, the length of each tab being less than the width of the associated recess between the pair of arms to assure entry of the tab into the recess, and interlocking teeth on a mating edge of the tab which interlock with a mating portion of the arm as the connector is compressed, said interlock providing an electrically and mechanically secure joinder of said tab with said arm when the tab is in a closed and compressed state enfolding and gripping the conductor disposed in the recess.

5. The connector of claim 4 including a flat mating portion on said arm and interlocking teeth on said mating edge of said tab.