United States Patent [19]

Peek

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[54] **COMPRESSION CONNECTOR FOR ELECTRICAL CONDUCTORS WITH TABS IN SERIES**

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[52] **U.S. Cl.** ..... **174/94 R,** 29/628, 174/71 R, 339/276 R

[51] **Int. Cl.** **H02g 15/08**

[58] **Field of Search** ..... 174/71 R, 84 C, 90, 174/94 R; 339/276 T, 276 R; 287/108, 109; 29/628

[56] **References Cited**

UNITED STATES PATENTS

3,354,517	11/1967	Levinsky	174/94 R X
3,408,855	10/1968	Dannes	174/94 R

Primary Examiner—Darrell L. Clay
Attorney—John H. Leonard et al.

[57] **ABSTRACT**

The compression connector has a metal body with a conductor-receiving recess opening outwardly laterally of the body and defined by spaced side walls extending endwise of the body. The outer edge of one of the side walls carries a plurality of tabs which can be folded into stacked face to face relation to each other, and, in the stacked relation, can be swung into the recess through the open side of the recess so as to close its open side and provide a filler partially filling the recess around a conductor disposed therein. The side walls and tabs can be distorted into tight embracing relation to the conductor by die crimping forces applied toward the base of the recess. The tabs can be detached from the body, selectively, so as to change the overall size of the filler in an inverse relation to the cross section of the conductor to be connected.

8 Claims, 6 Drawing Figures

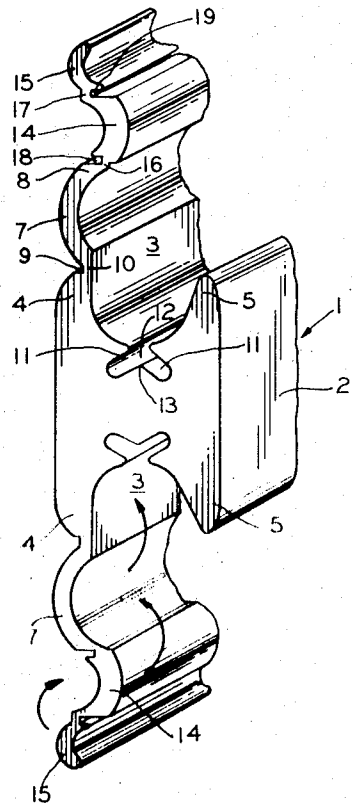
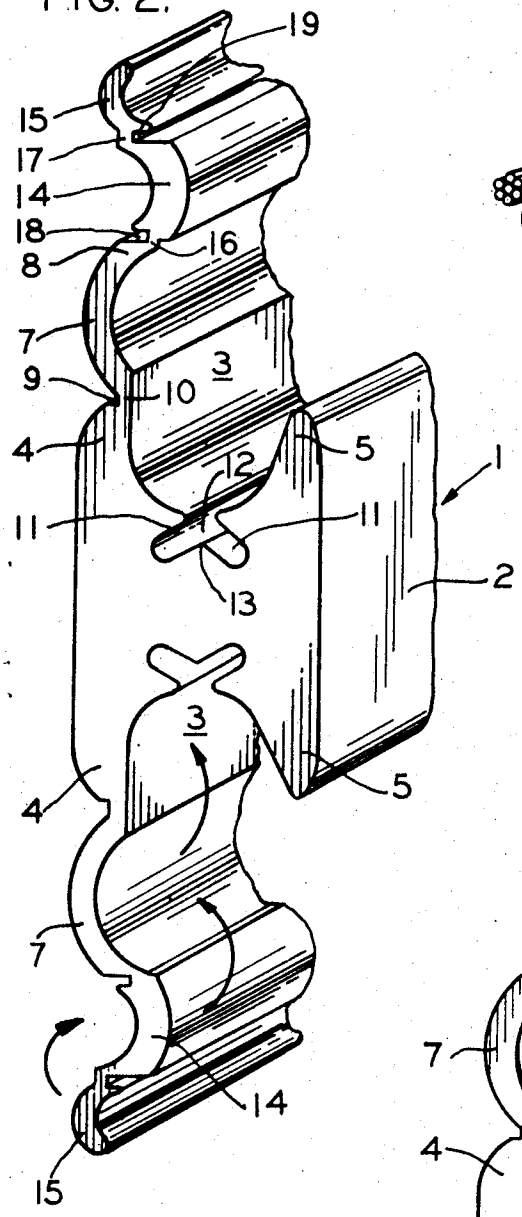


FIG. 2.



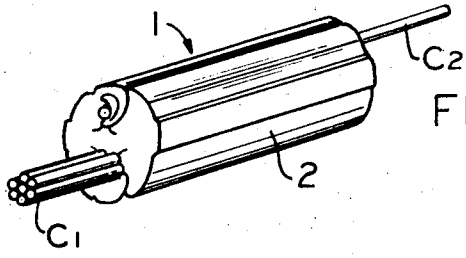


FIG. 1.

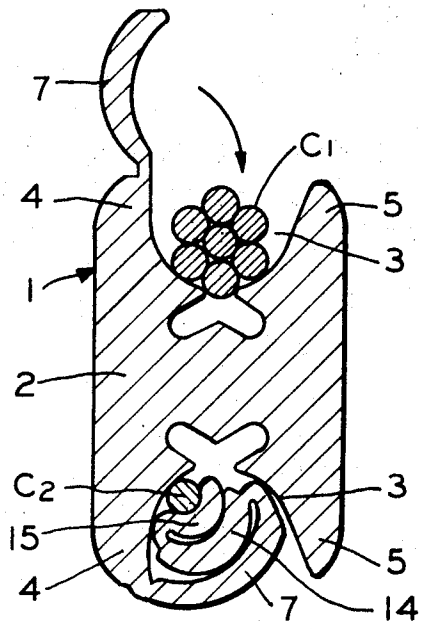


FIG. 3.

FIG. 4.

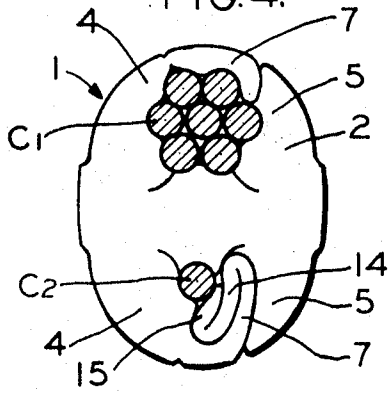
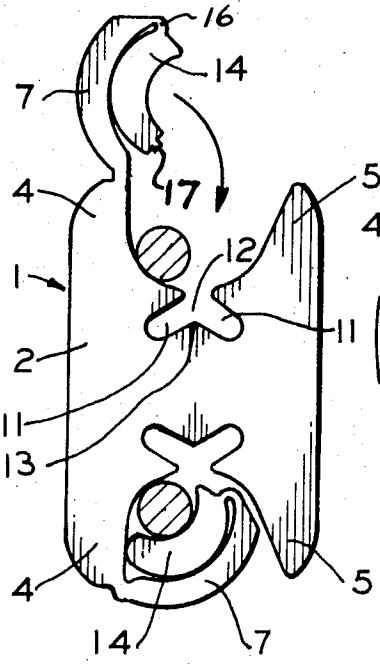


FIG. 5.



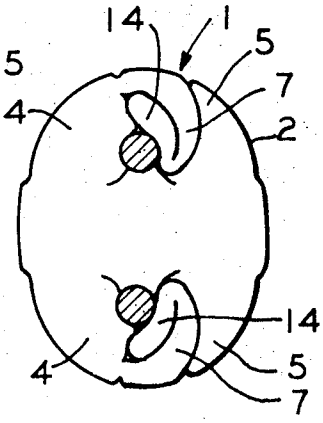


FIG. 6.

COMPRESSION CONNECTOR FOR ELECTRICAL CONDUCTORS WITH TABS IN SERIES

BACKGROUND OF INVENTION

1. Field of Invention

Crimp connectors for bare electrical conductors.

2. Description of Prior Art

Compressible electrical connectors of the general type herein described are well known in the art. For example, in U.S. Pat. No. 2,707,775 to Hoffman et al., issued May 3, 1955, there is shown an electrical connector for connecting a takeoff wire to a power line cable. This connector has a body with conductor-receiving recesses at its opposite edges. At one of the recesses the body is provided with a tab which can be bent manually to hold the conductor in the recess temporarily until the connector body has been gripped sufficiently to firmly embrace and grip the conductor. However, the range of diameters of conductors which can be connected by such a connector of a given size is limited. If the conductor is very small in diameter, it may not be gripped sufficiently tightly by the crimped body. On the other hand, if the conductor is large, the tab and conductor may overfill the recess so that, when the body is subjected to the crimping tool, it is overcrimped and distorted and damaged thereby.

In the patent to Toedtman, U.S. Pat. No. 3,156,764, issued Nov. 10, 1964, an attempt was made to increase the range of sizes of conductors which could be accommodated in a connector of given size by providing longitudinal ribs on the wall of the recess. These ribs are readily deformable so as to conform to the surface contour of the conductor, as the body is crimped thereabout, without overstressing the body.

The patent to Eldridge, Jr., U.S. Pat. No. 3,235,654, issued Feb. 15, 1966, discloses a compression connector similar to that in Hoffman. In this patent, one arm of each conductor-receiving recess is provided with a tab more substantial than that shown in Hoffman and such that it can partially fill the recess so that the body can be crimped into firm embracing relationship with a conductor of small diameter.

In my copending application, Ser. No. 273,468, filed July 20, 1972, a connector of the same general character as that herein contemplated is disclosed, but which is designed to accommodate conductors throughout a greater range of diameters than the earlier connectors. This it accomplishes by the configuration of the cross section of the body so that the sizes of the conductors themselves control the particular movement and disposition of the metal of the body and side walls of the recesses during crimping of the connector so that the walls firmly envelop the conductor which controls their movement.

All of these prior structures function generally on the basis of controlled bending of the side walls of the conductor-receiving recess into proper relation to the conductor and remainder of the connector body.

SUMMARY OF INVENTION

The present connector is one which is rendered adaptable for a greater range of conductor diameters by means of a plurality of recess closing and filling tabs for each conductor-receiving recess. The tabs are integral with the body in such a manner, and are so arranged, that they can be folded into stacked face to face relation in the recess. They are readily detachable so that one or more can be detached and removed for changing the amount of recess filling material in an inverse relation to the diameter of the conductor to be accommodated. In the case of a large diameter conductor, one tab is wrapped partially around the outer surface of the conductor and acts as recess closure or holder to constrain the conductor from radial movement out of its associated recess. In the case of a smaller conductor, the one tab and/or one or more additional tabs serve as a recess filler so that the conductor is embraced to a greater extent circumferentially, part of the filler passing between the conductor and the base of the associated recess so as to center the conductor and reduce the size of the recess upon crimping the body within the allowable limits of distortion thereof.

Various specific objects and advantages will become apparent from the following description wherein reference is made to the drawing.

DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic perspective view of a compressible connector embodying the principles of the present invention, and connecting a pair of conductors;

FIG. 2 is an enlarged fragmentary perspective view of the connector illustrated in FIG. 1, showing in more detail the configuration of the connector in its original unused condition;

FIG. 3 is a cross section view of the connector illustrated in FIG. 2 with the lower portion in condition for crimping onto a minimum size conductor and the upper portion in condition for crimping onto a maximum size conductor;

FIG. 4 is a view similar to FIG. 3 showing a connector crimped into connecting relation to the conductors indicated in FIG. 3;

FIG. 5 is a view similar to FIG. 3, showing the connector in condition for crimping onto two intermediate size conductors;

FIG. 6 is a view similar to FIG. 5 showing the connector crimped into connecting position relative to the conductors shown in FIG. 5.

Referring to the drawing, the compressible connector, indicated generally at 1, is shown in FIG. 1 as connecting two conductors C_1 and C_2. As described in my above identified copending application, the connector 1 comprises a metal body 2 of the proper compressibility and cold flowability to form, when crimped under proper pressure, an effective mechanical connection and an ample electrical connection between the body and conductors connected thereby. The metal may be that commonly employed in crimp type connectors and which distorts and cold-flows properly without fracture or undue thinning within the conventional ranges of crimping pressures employed. As illustrative, the material may be ECO aluminum having a hardness of RH equal to or less than 20, though other materials may be employed, depending upon the particular field of use.

The body 2 is provided at its opposite lateral edges with conductor receiving recesses 3 which open outwardly edgewise of the body and extend in parallel relation to each other endwise thereof. The sides of each recess 3 are defined by two arms or side wall portions 4 and 5 which are integral with the body and which can be distorted inwardly toward each other and toward the midportion of the body by suitable crimping pressure

applied in a direction normal to the bottoms of the recess 3 by suitable hand or power operated crimping dies.

At least one of the arms, such for example as the arm 4, is provided with a tab 7 which is preferably curvilinear on its inner face so as to engage, in somewhat conforming relationship, the outer periphery of the maximum size cable to be gripped in its associated recess. The tab 7 is hingedly connected to the outer edge of the arm 4 so that it can easily be swung inwardly into the open side of its associated recess and toward the midportion of the body 2 to close the recess 3. Preferably, the tab 7 is of such width edgewise of the body 2 and so shaped that its outer edge, indicated at 8, upon swinging of the tab 7 inwardly into closing relation to its recess 3, passes along the inside of the arm 5 and is guided thereby into firm contact and partially embracing relationship to a maximum size conductor in the recess. In such an instance, the tab 7 forms a closure for the open side of the recess 3 and to some extent a filler. In the case of a smaller diameter conductor, the tab 7 continues farther into the recess 3, its edge 8 following along the inner surface of the arm 5 until it embraces the conductor to a greater circumferential extent and thereby serves as a partial filler for the recess to the extent necessary to cause the smaller conductor to be firmly embraced about its circumference and centered in the recess by the coaction of the arms 4 and 5 and the tab 7.

In order to assure the proper swinging of each tab 7 into closing relation into the open side of its associated recess 3 under pressure of the crimping dies, the body 2 is provided with grooves 9. The grooves 9 extend longitudinally of the body parallel to each other and to the axis of the recesses 3 and are positioned one at the base of each tab 7 and the outer edge of the associated arm 4. Each groove 9 is of sufficient depth so that a connecting portion or web 10 is provided between the arm and tab. The web is readily bendable and provides a hinge. It may be about two-fifths of the thickness of the outer edge of the arm 4 or the inner edge of the tab 7. Preferably, each groove is arranged so that, in the cross section of the body 2, its inner side wall is directly opposite the outer edge of the complementary arm 5.

The webs 10 thus provide hinge connections of the tabs 7, respectively, to the body.

In order to obtain the proper coordination of the movements of the different parts of the body when they are crimped and compressed and collapsed about a conductor within the range of the connector, regardless of whether the connector is of large or small size, suitable voids are provided in the body in a preselected relation to the base of each recess 3. Since the relation of the recesses to their associated voids is the same, only one recess and its voids is described in detail herein.

In the form illustrated in FIG. 2, the void of each recess 3 is not only close to the bottom of the recess, but opens into the bottom of the recess. Preferably each void comprises two slots 11 which have a common open side or opening 12 into the bottom of the recess 3 at the midportion of the cross section of the recess. The slots 11 diverge from each other in a direction away from their common opening in the base of the recess and toward the midportion of the body 2. Thus a peak 13 is provided at the intersection of their adjacent side walls, the peak 13 being aligned with, and centered relative to, the opening 12 and exposed thereby. The central plane of each slot 11, extending from its open side through the midportion of its bottom wall, intersects the face of the body 2 toward which it slopes at or close to the lateral midportion of that face.

The structure thus far described is illustrated and described in my above copending application, and is one which can accommodate conductors throughout a wide range of sizes, and the manner of functioning is therein fully set forth.

The die travel of the compression or crimping tools used for connecting conductors is usually quite limited and fixed for a particular range of connector sizes. Generally, for a given size connector for general use, both recesses are of the same size. As a result, if a very small conductor is to be connected to a very large one, excess recess filler material over that required in the case of the large size conductor must be provided in the case of the small size conductor.

Under these circumstances, to extend the range of conductor diameters that can be connected by a connector of given size beyond the range that can be connected by the connector of my pending application, a plurality of tabs are provided for each recess, for closing and filling the recess to a greater or less degree, selectively in inverse relation to the diameter of the conductor to be accommodated. This eliminates crushing, thinning, and reduction of the cross sectional area of the connector, and resulting weakening of its structure. Instead of each single tab 7, tabs in addition thereto may be provided. For example, three tabs are shown for each recess 3, these being the tab 7, and additional tabs 14 and 15, respectively. One or several additional tabs may be used, depending upon the range of conductor sizes to be accommodated.

In the form illustrated, the tab 7 is the basal tab which is connected directly to the arm 4 and which supports the additional tabs 14 and 15, thus connecting them to the body. In this form, the tabs 7, 14 and 15 extend endwise of the body and are arranged side by side in parallel relation in a row which itself extends transversely of the length of the body 2. The tabs 7, 14 and 15 are hingedly connected in series at their respective adjacent edges in this edge by edge relation by hinges which are provided by thin, integral webs of the metal 16 and 17, provided by notches 18 and 19 in the tabs. Thus the body and tabs provide an integral structure.

Since all or less tabs may be used for closing and filling an associated recess, depending on conductor size, the webs 16 and 17 are made very thin relative to the thickness of the tabs. They are sufficiently stiff to hold the tabs normally in the extended positions, illustrated in FIG. 2, respectively, but are readily bendable by hand for disposing the tabs in proper initial relation in the recess, in overlying relation to the conductor, for initiation of the crimping operation. Further, because the tab 7 may be used alone or with one and/or both of the additional tabs 14 and 15, the webs are made sufficiently thin so that they can be torn or severed readily by forces applied manually, and thereby render the tab 14, or the tabs 14 and 15, detachable readily when one or both are to be eliminated so as to decrease the volume of tab metal to be used for closing and filling the recess 3 during crimping of the connector about larger size conductors.

The tabs are arranged so that they can be folded about the hinge connections afforded by the webs into

face to face stacked relation to each other. They are preferably concavo-convex in cross section so that they can nest in each other, the convex face of the tab **14** engaging the inner concave face of the basal tab **7**, and the convex face of the tab **15** engaging the concave face of the tab **14**.

Knowing the size of conductor to be connected, the proper number of tabs to use becomes readily apparent and the tabs of those selected are then swung about their hinge axes, respectively, in the directions of the arrows shown in FIG. **2**, to stack the required number, if any, against the inner concave face of the tab **7**.

For example, in FIG. **3**, a maximum size conductor C_1 and a minimum size conductor C_2 are to be connected, the maximum size conductor being in the top recess and the minimum size conductor in the bottom recess. The larger conductor C_1 fills a large portion of the cross section of the upper recess and very little tab metal is required to close the open side of the recess and provide filling material. Accordingly, both tabs **14** and **15** are detached and only the basal tab **7** is used. It may start from the position illustrated in FIG. **3** or it can be swung into slightly overhanging relation to the recess preparatory to crimping. For the smaller conductor C_2, all three tabs **7**, **14** and **15** are used. They are swung initially into the stacked relation, as illustrated in FIG. **3**, the tab **15** being disposed innermost for engaging the conductor C_2, and the tab **14** being disposed in stacked relation between the tabs **7** and **15**. In this condition, the connector is crimped by the proper power tool to dispose the tabs in the position illustrated in FIG. **4** and with the distortion of the body being within the permissible limits.

Referring next to FIGS. **5** and **6**, two intermediate size conductors are to be connected. In such case, the tab **15** of each recess **3** is detached and removed, the associated tabs **7** and **14** only being used. The tab **14** is folded or swung about its web hinge into stacked face to face relation with the tab **7**, and the two are then swung into the recess **3**. In this condition, with conductors in the two recesses **3**, respectively, the body **2** is crimped, to form the connection illustrated in FIG. **6**.

It is apparent that the number of tabs that can be provided for each recess is dependent upon the precision of proportioning of filler material and conductor, the centering desired, the strength and crimping qualities of the metal of the body **2**. Three tabs for each recess are satisfactory, for most connections.

The manner in which the tab material and body cooperate in firmly embracing and centering the conductor is fully disclosed in my above identified copending application.

By the simple provision of multiple selectively detachable tabs for each recess, the range of sizes of conductors that can be connected by a given size or model of connector is greatly increased, and the dangers of overstressing of the body and tabs during crimping are greatly reduced.

Having thus described my invention, I claim:

1. A compression connector comprising:

an elongated compressible metal body having at one of its lateral edges a pair of spaced arms providing a conductor-receiving recess which extends lengthwise of, and opens outwardly edgewise of, the body;

and metal tab means hingedly connected to the outer edge of one of said arms and supported normally in an open position relative to the recess and such that a conductor can be moved transversely of its length past the tab means into the recess, and the tab means can be swung inwardly into the recess into a recess-closing and filling position overlying the conductor when the body is subjected to a crimping force applied to the tab means and arms in a direction generally toward the bottom of the recess;

characterized in that:

said tab means include a plurality of individual tabs, each extending endwise of the body; and

hinge means connect the tabs to the body so that the tabs can be swung about parallel axes into stacked relation to each other and into the recess in said stacked relation; and

said hinge means for each tab are readily destructible so that selected tabs can be detached and removed for reducing the amount of tab material disposed in the recess.

2. The connector according to claim **1** wherein the tabs are concavo-convex in cross section and contoured so that they are in nested relation when in said stacked relation.

3. The connector according to claim **1** wherein said tabs are arranged in edge to edge series relation in a row extending transversely of their length;

the hinge means include hinges between the adjacent edges of adjacent ones of the tabs and about which the tabs can be swung into said stacked relation to each other; and

the tab at one end of the row is a basal tab and is hingedly connected to said outer edge of said one of the arms and provides the hinge connection of said tab means to said one of the arms.

4. The connector according to claim **3** wherein the tab adjacent to the basal tab is of less width than the basal tab.

5. The connector according to claim **3** wherein said tabs are concavo-convex in cross section, respectively, and, in said stacked relation, said basal tab in closing position relative to the recess has its concavo-side positioned to face the base of the recess; the next adjacent tab has its convex face facing the concave face of the basal tab, and the next successive tab in the series has its convex face facing the concave face of said next adjacent tab.

6. The connector according to claim **3** wherein each successive tab of the series, beginning with the tab connected to said basal tab, is less in width than its predecessor.

7. The structure according to claim **6** wherein the series comprises three tabs and the intermediate tab is thicker than each of the other tabs.

8. The connector according to claim **1** wherein the hinge means are webs of metal integral with the tabs and of less thickness than their associated tabs, respectively.

* * * * *