July 11, 1967 E. E. HOLKE ETAL 3,330,903

COMPRESSION CONNECTOR WITH REMOVABLE TABS FOR A RANGE OF CONDUCTOR SIZES

Original Filed May 16, 1963 2 Sheets-Sheet 1

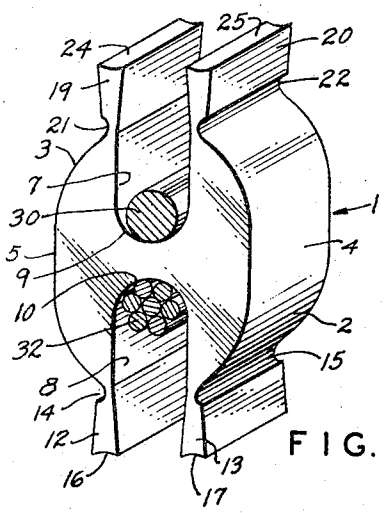


FIG. 1.

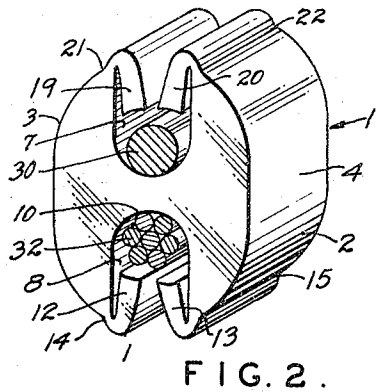


FIG. 2.

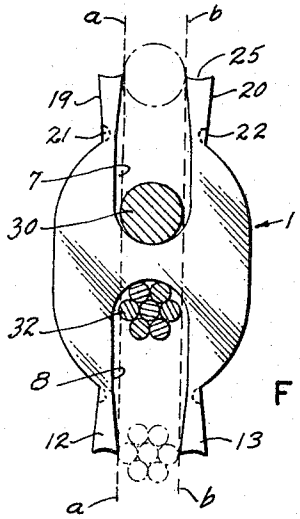


FIG. 4.

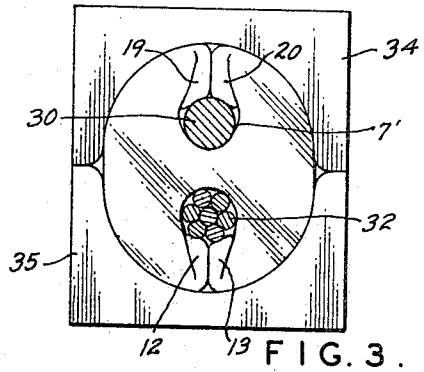


FIG. 3.

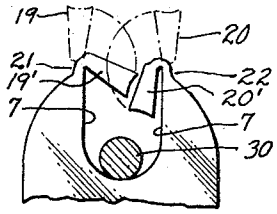


FIG. 5.

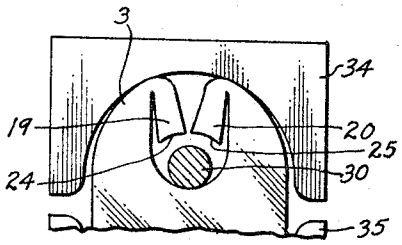


FIG. 7.

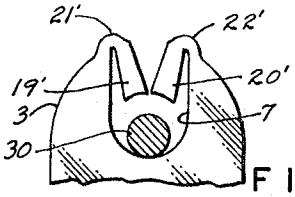


FIG. 6.

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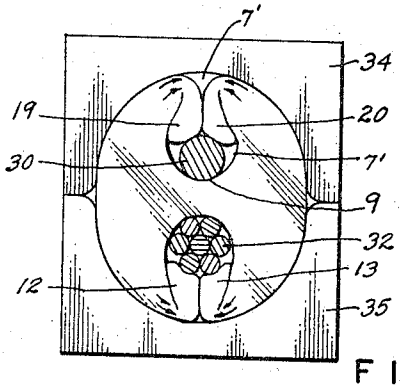


FIG. 8.

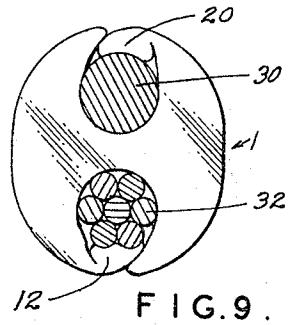


FIG. 9.

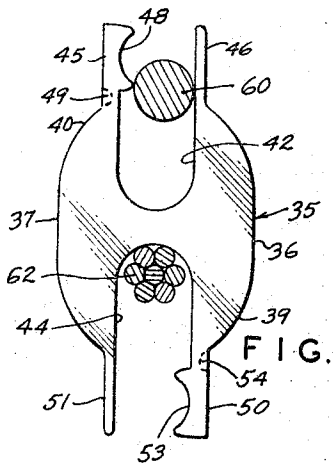


FIG. 10.

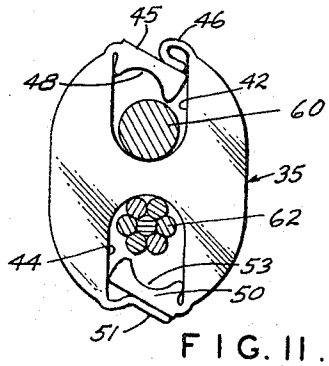


FIG. 11.

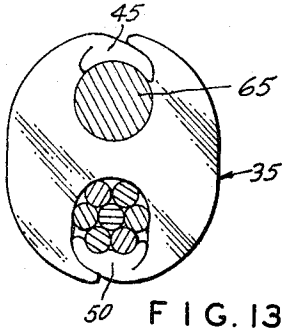


FIG. 13.

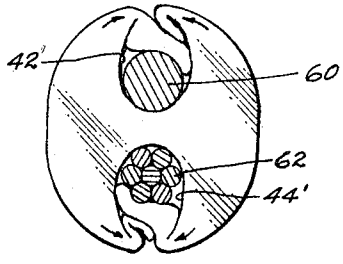


FIG. 12.

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COMPRESSION CONNECTOR WITH REMOVABLE TABS FOR A RANGE OF CONDUCTOR SIZES

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Continuation of application Ser. No. 280,852, May 16, 1963. This application June 18, 1965, Ser. No. 470,269

12 Claims. (Cl. 174—94)

This application is a continuation of my prior copending application, Ser. No. 280,852, filed May 16, 1963, now forfeited.

This invention relates to compression fittings used in electric line installations for splicing two conductors, or for making a tap connection to a conductor, and more particularly, to a novel compression fitting adapted by its construction to form a good electric connection with a range of different sized conductors. Heretofore, compression type fittings have been made to fit a certain combination of conductor sizes. This invention is a new form of fitting to accommodate ranges of different sized conductors and, accordingly, a fitting of greater usefulness.

It is one of the objects of this invention to provide a compression type fitting for use in connecting conductors in electric line installations.

It is another object of this invention to provide a compression type electric fitting to accommodate a range of different sized conductors.

It is still another object of this invention to provide a compression type electric fitting to accommodate a range of different sizes and kinds of conductors, and one which can be made as a metal extrusion.

Compression type connector fittings for splicing electric conductors are well known in the art, for example, the patent to Hoffman and Holke 2,707,775 and are commonly termed "H-frame" compression connectors. The Hoffman et al. construction is a fitting having a generally oval cross-sectional shape with oppositely located U-shaped sockets in each side of the fitting having the minimum curvature in the oval. Each socket is a slot with a curved bottom wall and side walls spaced to fit a conductor of a certain size. In operation, a conductor is placed in each socket, or vice versa, and small tabs at the socket openings are manually bent over the open mouth of each socket to cage the conductors in the sockets in a temporary manner. A tool with opposite relatively movable jaws is used to compress the metal of the fitting onto each conductor simultaneously. This tool carries a pair of approximately semi-cylindrical die pieces one in each jaw. The tool is placed on the fitting so that each die piece covers a socket mouth and the die pieces are brought together with great pressure. The fitting is made of a ductile metal (aluminum or copper alloy), which metal will flow under the pressure developed between the die pieces so as to conform in outside shape with the die pieces when fully closed. In other words, the fitting changes shape from oval to nearly round under die pressure. During this change in shape, the metal, in excess of that necessary to fill the dies when the dies are brought together initially, flows into the sockets. This metal migration is by cold flow until the metal forcibly grips the conductor, or conductors, to permanently interconnect them mechanically and electrically with the fitting and with each other.

Now it can be readily appreciated that if the conductor is smaller in diameter than the socket is designed to fit, it is very likely that the smaller size conductor would not be gripped tightly when the fitting is compressed, because there might not be enough metal in the fitting to fill the space left in the socket by the smaller size conductor. In

order to produce enough contraction in the fitting to close the metal on the smaller conductor, the die pieces would have to be smaller themselves to produce a greater reduction and greater metal flow. If the cavity in the dies is made smaller, however, then this would preclude their use with conductors of the proper size which fit the socket. It would also preclude their use with different sizes of conductors in opposite sockets. Thus, the problem of adapting a socket in a fitting for use with a range of sizes of conductors had not been solved until this invention.

This invention provides the fitting with means extending its usefulness to operate satisfactorily with a range of sizes of conductors in a socket of a given size without a change in the size, or shape, of the compression die pieces. This novel result is accomplished by providing additional metal, properly placed on the fitting to close the socket on conductors having sizes at the small end of the range of sizes to be accommodated. Since all of this additional metal on the fitting may not be necessary to close the socket on conductors having a size in the intermediate and upper end of the range of sizes, the fitting has a novel construction so that, when not necessary, some, or all, of the additional metal can be readily discarded.

In the embodiments of the invention hereinafter described, this result is obtained by providing a fitting with two tabs, preferably located one along each side of the opening to the socket and spaced to limit the size of the conductor entering the socket, to one having a diameter less than the socket width. When the conductor is of larger size than this, but will still go into the socket, at least one of the tabs is broken off and discarded. With the largest sizes of conductors, the fitting can operate with one tab only, or possibly none at all.

Where the conductor is of a size to pass between the tabs, or smaller, the tabs supply the added metal to fill the space in the socket around the conductor due to the fact that the socket is oversize in width and depth with respect to a conductor in the socket. Where the socket is oversize with respect to the conductor, both tabs are folded into the pocket, one at a time, by finger pressure. The tabs roll into the pocket as the fitting is compressed in the dies into contact with the adjacent accessible sides of the conductor to grip the conductor firmly, regardless of size or shape. Both tabs supply added metal. This added metal may not completely fill the socket all the way to the mouth, or socket opening, but, because of the direction of metal flow, the socket is filled around the conductor. A substantially solid mass of metal is formed around the conductor. This, it has been found, is all that is necessary to form a good electrical connection and one that has the necessary mechanical strength. One tab can operate the same way as when both tabs are used.

Other objects and advantages of this invention will appear from the following detailed description which is in such clear, concise and exact terms as will enable any persons skilled in the art to make and use the same when taken in conjuncton with the accompanying drawings, forming a part thereof, and in which:

FIG. 1 is an end elevational view in projection of a compression connector type of fitting showing the conductors in cross-section seated in opposite sockets;

FIG. 2 is a view similar to FIG. 1 showing the tabs bent into the sockets;

FIG. 3 is an end elevation of FIGS. 1 and 2 showing the fitting being compressed;

FIG. 4 is an end elevation of FIGS. 1 and 2 schematically illustrating the gauging function of the tabs;

FIGS. 5, 6, 7 and 8 are views similar to FIG. 4 schematically illustrating the relationship between the parts in each step in the operation of closing a socket;

FIG. 9 is an end view illustrating the same fitting using one tab only;

FIG. 10 is an end elevational view of a modified form of compression connector type fitting;

FIG. 11 is an end elevational view of the fitting shown in FIG. 10 with the tabs bent in;

FIG. 12 is a view in end elevation of the modification shown in FIGS. 10 and 11 after being compressed in the dies; and

FIG. 13 is a view of the fitting shown in FIG. 10 using one tab only.

Referring to FIGS. 1–4 of the drawings, the fitting **1** has a body of ductile metal with curved sides **2** and **3**. The cross-sectional shape of the fitting is generally oval. Preferably, sides **2** and **3** have a smaller curvature than sides **4** and **5**. The latter may be substantially flat as shown. In the side **3** is a socket **7** with a curved bottom wall **9** and substantially straight parallel side walls. In the side **2** is a similar socket **8** with a curved bottom wall **10** and substantially straight parallel side walls. Both sockets need not be of the same size. At the mouth of the socket **8** are a pair of tabs **12** and **13** of generally wedge shape in cross-section. These tabs **12** and **13** are undercut at **14** and **15** so as to provide a weakened section adjacent the mouth of the socket **8**. The ends **16** and **17** of the tabs **12** and **13** may be concave in shape.

Socket **7** has a similar pair of tabs **19** and **20** also undercut at **21** and **22** to form a weakened section at the mouth of the socket **7**. The ends **24** and **25** of these tabs may have a concave shape. Each socket **7** and **8** is sized to receive a conductor, or conductors, of a range of sizes. As shown in these FIGURES, 1–4, this range of size of conductors permissible is relatively wide. This is illustrated in FIG. 1 which shows an example of a smaller size conductor **30** in the socket **7** and a comparatively larger size conductor **32** in the socket **8**.

Operation

It will be noted from FIG. 4 that the spacing between the outermost ends of tabs **12** and **13** is less than the width of the socket **7**. Likewise it will be noted that the distance between the outer ends of the tabs **19** and **20** is less than the width of the socket **7**. The sockets do not have to be the same width. Each socket can take a range of conductor sizes. Dotted lines *a*—*a* and *b*—*b* indicate the maximum size conductor to pass between tabs. The tabs act as a gauge in this respect. Both tabs **12** and **13** or **19** and **20** are used as hereinafter described on a range of sizes of conductor which will pass betwen the tabs. This range includes conductors of the size shown in FIG. 4 and smaller. Of course the spacing of the tabs varies with socket width.

After the fitting is in place upon the conductors **30** and **32**, the tabs **12** and **13** are bent inwardly as shown in FIG. 2 so as to hold the conductor **32** in the fitting or the fitting on the conductor. Thereafter tabs **19** and **20** are bent inwardly of the socket **7** so as to hold the fitting on the conductor **30**, or vice versa. A compression tool having relatively movable jaws mounting the dies **34** and **35** is then applied to the outside of the fitting **1**. These dies have substantially semi-cylindrical cavities and, the application of pressure to the fitting by the dies, causes the metal to flow. Tabs **12** and **13** supply enough excess metal so that, when the fitting is compressed, socket **8** is substantially full and tightly grips the conductor **32**. The same is true of socket **7**, as shown in FIG. 3. Thus with the size conductor illustrated in FIGS. 1–3, the tabs substantially completely fill the socket when the fitting is compressed.

With the minimum size conductor illustrated in FIGS. 5–8, the tabs **19** and **20** close the socket, but do not fill it completely, and the area which is not filled, **7'**, would be that substntially equal to the difference in area between the conductors **30** shown in FIGS. 1–3 and FIGS. 5–8 respectively.

FIG. 5 illustrates the first step in securing a conductor, such as **30**, within the socket **7**. The lineman presses with his fingers against the outside of the wedge-shaped tab **20** and folds it over into the socket **7** from the position **20**, shown in dotted lines, to the position **20'**, shown in full lines. The arcuate dotted line between the two positions **20** and **20'** illustrates the path of swinging. Because of the manner in which the tab **20** is undercut at **22**, the tab **20** swings through an arc, such as indicated by the dotted lines, connecting the positions **20** and **20'**. The lineman then presses on the outside of the tab **19** causing it to fold about its undercut portion **21** into the position **19'**, shown in FIG. 6; the dotted line connecting the two positions of the tab in FIG. 5 indicates the path of swing of the end of the tab **19**. In FIG. 6, both tabs **19** and **20** have been folded into the slot **7** leaving humps **21'** and **22'** projecting from the curved end **3** of the fitting.

In FIG. 7, die piece **34** is shown after it has descended into contact with the curved side **3** of the fitting. During this descent, it contacts humps **21'** and **22'** forcing the tabs **19** and **20** fully into the slot **7**. Where the conductor **30** is of the minimum size acceptable by the slot **7**, there will be considerable clearance between the concaved ends **24** and **25** of the tabs **19** and **20** and the side of the conductor **30**. However, on further compression of the fitting between the dies **34** and **35**, the metal in the fitting **1** rolls in, in the direction of the arrows shown in FIG. 8, as far as is permitted by contact of the concave ends **24** and **25** of the tabs with the outside of the conductor **30**. Any further movement of the tabs inwardly of the socket **7** is prevented, and further compression of the fitting **1** to final size merely narrows the cavity **7'**. The size of the cavity **7'**, which remains after full compression within the dies **34** and **35**, depends upon the size of the conductor **30**. Where the conductor **30** is of the maximum size to pass the tabs, the cavity **7'** would be of a minimum size. Where the size of the conductor **30** is of minimum size, as shown in FIG. 8, the cavity **7'** would be of maximum size. Whatever size of the cavity **7'**, however, the fact remains that the socket **7** has been filled sufficient to totally enclosing the conductor **30** and firmly grip the conductor between the bottom of the curved socket **9** and the concave ends of the tabs **24** and **25**. The voids left in the sockets, illustrated in FIGS. 3, 8 and 9, are exaggerated to facilitate understanding of the operation.

FIG. 9 illustrates the use of but one of the tabs **19** and **20**. Where the conductor is of a size which will not pass between the tabs **19** and **20**, wider than the space between dotted lines *a*—*a* and *b*—*b*, then one of the tabs **19**, or **20**, is broken off and discarded. The other is then folded into the socket to hold the conductor while the fitting is compressed between the dies of a compression tool.

Returning now to FIG. 4, the basic extrusion from which the fitting **1** is constructed is shown by the full line outline. The undercutting at **14**, **15**, **21** and **22** is shown in dotted lines. It will be apparent that the extrusion is symmetrical with sections of adequate thickness to be formed readily by the extrusion process of manufacture usually employed for ductile metal fittings of this kind. The undercuts can be formed thereafter as a final step in the manufacture.

Modification

The double tab type of fitting of this invention may have tabs of the various configurations. One of these modified forms is illustrated in FIG. 10. Fitting **35** is of generally oval shape and has sides **36** and **37**, which are comparatively straight and flat, and sides **39** and **40** of relatively sharp curvature. Sockets **42** and **44** open through the curved sides **39** and **40**. At the mouth of the socket **42** are a pair of tabs **45** and **46**, the latter of which is a relatively straight sided plain tab forming an extension of a side wall of socket **42**. Tab **45**, however, has a concave face **48** and is undercut at **49** to permit manual folding into the socket **42**. Tab **46** is a relatively thin tab and

undercutting is not absolutely necessary to permit folding.

The mouth of socket **44** has a pair of tabs **50** and **51** of the same shape as those above described. Tab **50** has a concave face **53** and is undercut along the dotted line **54** to permit folding into the socket **44**. As in the prior described fitting, the maximum size conductor usable is limited only by the distance between the side walls of the socket. If the conductor will pass between tabs **45, 46** or **50, 51**, then both tabs are used by folding them into the socket before compressing the fitting. The conductors **60** and **62** in FIG. 10 are illustrative of the maximum in such a range in sizes of conductors. Where the size of the conductor is such that it will not pass between the tabs, but will pass into the socket, one or the other of the tabs **45, 46**, or **50, 51**, can be removed. The remaining tab is then bent inwardly into the socket. FIG. 13 illustrates a conductor **65** of maximum size gripped in the fitting **35**. With the maximum size conductor **65**, there is enough metal in the single tab **45** to fill the slot when the fitting **35** is compressed in the dies. Tab **46** has been broken off and discarded.

Operation

Fitting **35** is placed on a conductor, such as **60**, or **62**, so that it lays in the bottom of the socket. Then the lineman bends the tabs into the mouth of the socket, as shown in FIG. 11, by folding the tabs sequentially with finger pressure. Where the conductor is as large as the maximum permitted, one of the tabs is folded in and the other broken off. A compression tool is then placed on the fitting **35** with the die pieces over the sockets and fitting **35** compressed to the shape shown in FIG. 12. The compressing action in the dies caused the metal in the fitting to flow into the sockets **42** and **44** in the manner indicated by the arrows on FIG. 12. This forms a solid mass of metal around the conductors and practically fills the sockets **42**, and **44**, in FIG. 12, as shown at **42'** and **44'**, above the conductors **60** and **62** which are of the maximum size permitting the use of both tabs. It will be understood that the voids, shown around the conductors **60** and **62** are accentuated in order to illustrate the operation of the fitting. With other sized conductors, the operation of this modification is like the first.

The fitting **35**, shown in FIG. 10, is readily produced by the extrusion process in the sectional form shown in full lines in FIG. 10. The undercutting of the tabs **45** and **50** can be performed by a cutter, as the extrusions are fed through a suitable machine. Individual fittings of the desired length are then sliced from the extrusion.

It is thus apparent that the invention provides a relationship between the metal in the tabs of the connector and the metal in the length of conductors which is embraced by the connector, so that the cross-section of metal in the separable tab is approximately expressed by L minus S, where L is the cross-section of a conductor whose diameter is near the maximum in the size range to be accommodated by a given connector; and S is the cross-section of a conductor whose diameter is near the minimum of the size range to be accommodated in that conductor. Thus, when the connector is used with a conductor whose size is near the minimum in the size range to be accommodated by that conductor, no tab is removed from the connector because all the tab-metal on the connector is required to substantially fill the cavity. On the other hand, where the connector is used with conductors of larger size within the size range for which that connector was intended, the separable body of metal delineated by a tab is removed before the connector is compressed because less than all tab-metal is required to fill the cavity, and unless some of the tab-metal is removed, too much metal will be present when the same die is used for compressing the connector as is used to compress the same connector about a smaller conductor.

Changes in, and modifications of, the construction described may be made without departing from the spirit of our invention or sacrificing its advantages.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In a compression type electrical fitting for use with a range of different sizes of electrical conductors, to connect two of such conductors together by compressing the fitting to the same cross-sectional shape and dimensions irrespective of the size of the connected conductors within said range, said fitting having a body of ductile metal, a socket having an open mouth at one side of said body, said socket being shaped to form a seat adjacent the bottom thereof to contact along one side of a conductor, and said socket having spaced side walls extending from said seat to said mouth, said side walls being spaced apart a distance at least as great as the diameter of the largest conductor within said range, and said mouth being spaced from said seat a distance substantially greater than the spacing between said side walls, the improvement comprising,

(a) a plurality of tabs of ductile metal projecting from the body of said fitting adjacent the mouth of said socket and extending therealong,

said tabs together containing a sufficient cross-section of metal to substantially fill said socket around a small size conductor within said range when said tabs are folded inwardly of said socket and said fitting is thereafter compressed to said predetermined cross-sectional shape and dimension, and one of said tabs containing a sufficient cross-section of metal to substantially fill said socket around a conductor of larger size (within said range) than said first mentioned small size conductor when folded inwardly of said socket and said fitting is subsequently compressed to said predetermined cross-sectional shape and dimension.

2. The combination as defined in claim **1** wherein said tabs are wedged-shaped in cross-section with the narrower end of the wedge forming a weakened section near the body of said fitting.

3. The combination as defined in claim **1** wherein one of said tabs has a larger cross-section of metal than the other and said one of said tabs is formed with a cavity to fit the side of a conductor.

4. The combination as defined in claim **1** wherein said tabs are wedge-shaped in cross-section with the narrow end of the wedge forming a weakened section near the body of the fitting and both tabs have concavities to fit against the side of a conductor.

5. The combination as defined in claim **1** wherein one of said tabs has a larger cross-section of metal than the other.

6. The combination as defined in claim **1** wherein at least one of said tabs has a weakened section adjacent the mouth of the socket.

7. The combination as defined in claim **1** wherein said tabs have substantially the same cross-section.

8. In an H-shaped ductile metal fitting for making eletrical connections between two conductors, said fitting having opposite sockets for reception of the respective conductors, the fitting being adapted to be compressed about the conductors with a die which induces cold flow of the metal about the conductors, and means for adapting a given size of said fitting for use upon a wide range of conductor sizes with the same die which comprises: said fitting having a readily separable body of metal adjacent at least one of its sockets, the cross-section of metal in said separable body being approximately expressed by L minus S, where L is the cross-section of a conductor whose diameter is near the maximum in said size range; and S is the cross-section of a conductor whose diameter is near the minimum in said size range; whereby said readily separable body may be removed before applying the fitting to a conductor whose size is at or near the maximum within said range or left in place on the fitting when applying the same to a conductor whose size is at or near the minimum within said range, and whereby

said fitting may be compressed to the same ultimate cross-section when said sockets are occupied by any conductor whose size is within said range.

9. The device of claim **8** having a readily bendable and separable tab of different metal cross-section from said separable body, said tab being located at the opposite side of a socket from said separable body.

10. The improvement of claim **8** wherein said separable body of metal is connected to the main body of the fitting by a weakened portion, and, outwardly of said weakened portion, the side of said separable body closest to said socket being concaved to fit the side of a conductor.

11. In a compression type electrical fitting for connection with a range of different sizes of electrical conductors, said fitting having a body of ductile metal, sockets opening from opposite sides of said body shaped to form a seat at the bottom of the sockets to contact along one side of a conductor, and spaced walls in said sockets extending from said seat to said socket opening, the improvement comprising,

(a) a pair of tabs of ductile metal projecting from the body of said fitting at the side of the openings from the respective sockets and extending therealong,

the spacing between one of said tabs and the opposite wall in the corresponding socket being less than the spacing between said side walls of said socket to limit the size of the conductor passed into said socket, and

(b) a weakened section between one of said tabs and said body.

12. In a compression type electrical fitting for connection with a range of different sizes of electrical conductors, said fitting having a body of ductile metal, sockets opening from opposite sides of a said body shaped to form a seat at the bottom of the sockets to contact along one side of a conductor, and spaced walls in said sockets extending from said seat to said socket opening, the improvement comprising,

(a) a pair of tabs of ductile metal projecting from the body of said fitting at the side of the openings from the respective sockets and extending therealong,

said tabs having, on the sides thereof nearest their respective sockets, a concavity to fit against the side of a conductor.

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