Nov. 11, 1969 W. C. DAUSER 3,478,303

ELECTRICAL CONNECTOR

Filed Dec. 9, 1966 2 Sheets-Sheet 1

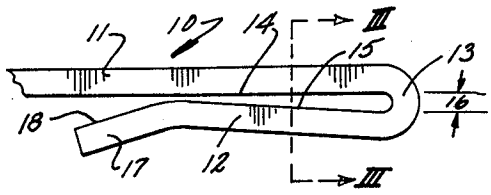

FIG. 1.

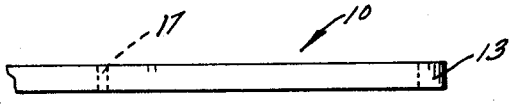

FIG. 2.

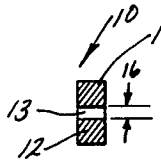

FIG. 3.

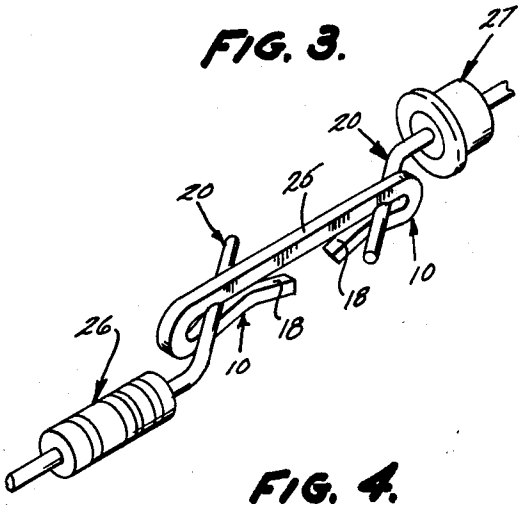

FIG. 4.

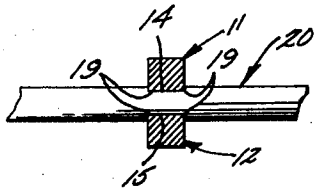

FIG. 5.

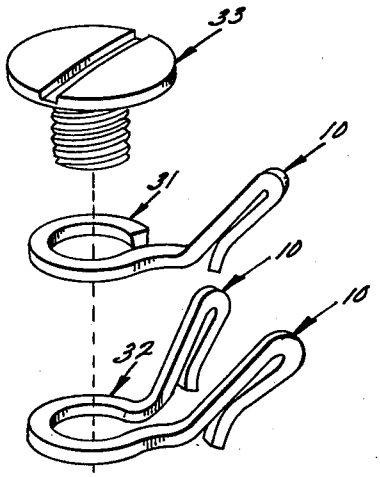

FIG. 6.

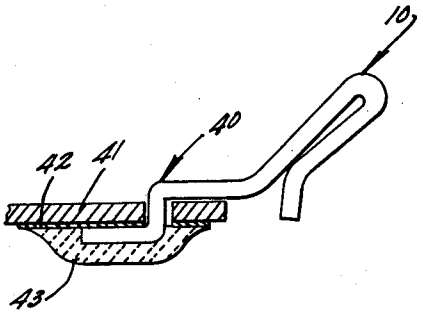

FIG. 7.

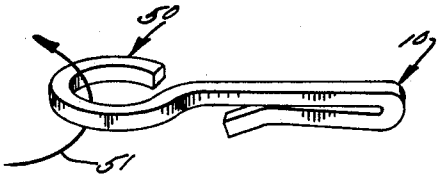

FIG. 8.

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ELECTRICAL CONNECTOR

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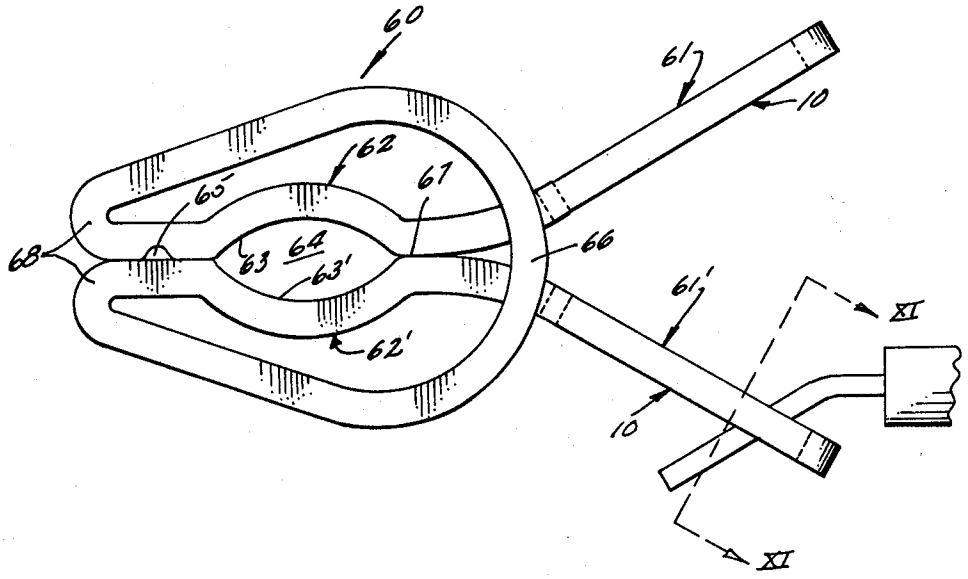

FIG. 9.

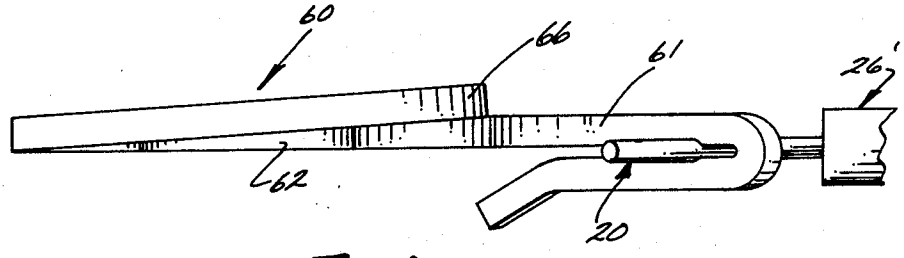

FIG. 10.

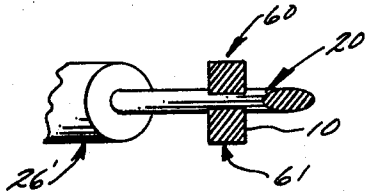

FIG. 11.

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ELECTRICAL CONNECTOR

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U.S. Cl. 339—95 17 Claims

ABSTRACT OF THE DISCLOSURE

A solderless electrical connector formed from an integral length of wire-like, resilient stock of constant cross section. The connector includes a pair of co-extending conductor embracing members interconnected by means of a generally U-shaped junction section.

This invention relates to electrical connectors and, more particularly, to solderless electrical connectors.

In many types of electrical installations the soldering of individual leads to terminal posts, clips and similar connectors is not practical. If, for example, the installation is relatively temporary, the time required to solder each of the electrical connections is not justified and, even if it were, the relative permanence of the finished installation would seriously detract from the reusability of the components. Similarly, if the particular installation is one which often necessitates servicing, repair or the like, the constant melting and resoldering of connections is likely to result in faulty performance as well as loss of operating time.

A number of different types of solderless connectors have been proposed in the past as a means of eliminating these problems. While many of these connectors have proved satisfactory in specific environments, a satisfactory general-purpose connector—i.e. one that can be used in varying types of electrical environments—has not been available heretofore. Attempts to provide such a connector have been frustrated primarily by two factors. First, the connectors have not been operative to clean dirt, oxides, grease and the like from the lead or conductor when the two components were joined. Second, the connection so achieved has been insufficiently tight to prevent oxidation and, thus, probable circuit interruption, at the point or points of contact between the connector and the conductor. Both of these factors, of course, promulgate poor circuit performance and reliability.

It is an object of this invention to provide a solderless electrical connector which is not subject to the disadvantages outlined above.

More particularly, it is an object of this invention to provide a connector of the type described which is operative to clean and scrape the conductor during insertion therein to insure optimum electrical contact.

It is an object of this invention to provide a connector of the type described which mates with the conductor inserted therein over an appreciable surface area and, thus, which minimizes point contact oxidation during subsequent use of the connections.

It is an object of this invention to provide a connector of the type described which deforms the conductor as it is inserted therein to assure proper total-surface electrical contact.

It is yet another object of this invention to provide a novel, spring-type, terminal connector clip which is capable of positively engaging conductors having differing nominal measurements while still providing total-area contact to prevent point contact oxidation during utilization of the connection.

More particularly, it is an object of this invention to provide a terminal clip having a novel configuration enabling it to be positively and resiliently affixed to a conductor of relatively small cross section as well as to a conductor or terminal having a relatively large cross section.

It is an object of this invention to provide a terminal connector clip of the type described which may be easily and positively manipulated by the technician or the like and, yet, whose over-all measurements are minimal and, thus, which may be utilized with a minimum possibility of undesirable shorting and bridging of adjacent circuits.

It is still another object of this invention to provide a terminal clip of the type described having the novel connector engaging means which is also a subject of this invention integrally formed therewith such that the leads to the clip may be readily and positively affixed thereto prior or subsequent to the clamping thereof over a terminal or separate conductor.

These, as well as other objects of this invention, will be readily understood by reference to the following specification and accompanying figures in which:

FIG. 1 is a fragmentary, side-elevational view of the conductor-engaging section of the connector;

FIG. 2 is a fragmentary, plan view of the conductor-engaging section of the connector;

FIG. 3 is a cross-sectional view taken along plane III—III of FIG. 1;

FIG. 4 is a perspective view showing a double-post connector being utilized to connect a pair of circuit components;

FIG. 5 is a fragmentary, cross-sectional view of the conductor engaging section having a conductor inserted therein;

FIG. 6 is an exploded perspective view illustrating the manner in which a single or a double-post connector may be affixed directly to a chassis or circuit board by means of a screw;

FIG. 7 is a side-elevational view, partially in cross-section, illustrating another mode for affixing the connector to a circuit board;

FIG. 8 is a perspective view of a connector having one of its connector engaging extremities formed in the shape of a loop;

FIG. 9 is a plan view of the dual-clamping terminal clip which represents a modified embodiment of this invention;

FIG. 10 is a fragmentary, side-elevational view of the device shown in FIG. 9; and

FIG. 11 is a cross-sectional view taken along plane XI–XI of FIG. 9.

Briefly, this invention comprises an electrical circuit connector adapted to conductively engage a conductor comprising a shank portion and a pressure portion connected by a generally U-shaped junction portion. The pressure portion extends from the junction portion so as to lie adjacent and generally co-planar with the shank portion. Facing sections of the shank and pressure portions are formed from polygonal stock and, preferably, these facing sections are planar with abrupt boundaries so as to provide maximum area contact with the conductors. The junction portion is formed from resilient stock so as to bias the facing sections of the shank and pressure portions toward one another. The relaxed spacing between the shank portion and the pressure portion is less than the nominal cross-sectional measurement of the conductor whereby, when the conductor is slid therebetween, the polygonal section will be resiliently forced into conductor deforming relationship therewith.

This invention comprises, additionally, a spring electrical terminal clip adapted to firmly and conductively engage a conductor, terminal or the like having a pair of co-planar handle portions positioned transversely with respect to one another but abutting on one end to form a fulcrum. A pair of co-planar clamping slot forming portions are affixed to and extend from the handle portion.

The facing surfaces of the slot forming portions diverge from one another and, then, reconverge to form a component-engaging slot. The extremities of the clamping slot forming portions remote from the handle portions are connected by means of a resilient compression portion having a central body section which curls out of the plane of the slot forming portions to bias the clamping slot portions into abutment with one another. Preferably, the diverging and reconverging sections of the slot forming portions are formed from polygonal stock and the facing surfaces are planar.

Referring now to the figures, a preferred embodiment of this invention will be described in detail. FIGS. 1, 2 and 3 illustrate the novel conductor engaging section of the connector which comprises a shank portion **11** and a pressure portion **12** connected by a generally U-shaped junction portion **13**. Preferably, the conductor engaging section **10** is formed integrally from square resilient stock such that the facing sections **14** and **15** of shank portion **11** and pressure portion **12**, respectively, are generally parallel planar surfaces. Preferably, the diameter of curvature **16** of generally U-shaped junction portion **13** is smaller than the smallest conductor to be engaged so as to prevent any tendency for the conductor to pull free from engaging section **10** if it is pushed or slid the entire distance between shank portion **11** and pressure portion **12** into abutment with U-shaped portion **13**.

A guide portion **17**, also preferably integrally fabricated, diverges from the extremity of pressure portion **12** and provides a camming surface **18** which springs pressure portion **12** away from shank portion **11** when a conductor is slid therebetween. As shown more particularly in FIGS. 4 and 5, the conductor **20** is slid, preferably at an angle, between camming surface **18** and the facing surface of shank portion **11** causing the resilient U-shaped section **13** to expand and, thus, to allow the conductor **20** to pass between the facing sections of shank portion **11** and pressure portion **12**. In order to assure proper contact, the stock used to fabricate engaging section **10** is preferably harder than the conductor to be engaged and the spring or resilient properties thereof sufficiently high to cause facing sections **14** and **15** to bite into and deform the conductor **20** as it is slid therebetween (see FIG. 5). The corners **19** of the stock serve as cutting surfaces during the insertion process to insure that the conductor will be properly deformed and that total contact will be obtained between facing sections **14** and **15** and the conductor.

In FIG. 4, two of the engaging sections **10** have been formed integrally with their shank portions joined as at **25**. If, for example, it is desired to connect a diode **27** and a resistor **26**, it is merely necessary to force the leads **20** thereof between camming sections **18** and the facing surfaces of shank portion **11** causing the facing surfaces **14** and **15** to expand and cut into conductors **20**. As the conductors **20** are slid into this position, the pressure causes any foreign matter to be scraped or cut away from the surface of the conductor and the planar, total-area contact prevents undesirable oxidation at restricted points of contact.

As noted previously, the conductor engaging section **10** is preferably formed integrally from a poygonal-resilient stock. Merely by way of example, three materials which have been found suitable are MB Hard Drawn, MB Oil Tempered and Music Spring Steel Wire having alloys added to the base metal in approximately the following percentages:

	MB Hard Drawn	MB Oil Tempered	Music Spring Steel Wire
Carbon	0.45/0.70	0.55/0.70	0.70/1.00
Manganese	0.60/1.20	0.60/1.20	0.20/0.60
Phosphorous (max.)	0.035	0.035	0.025
Sulphur (max.)	0.045	0.045	0.030
Silicon	0.10/0.30	0.10/0.30	0.12/0.30

Of course, many other suitable materials are available as will be readily appreciated by those skilled in the art and, thus, the table set forth is included merely by way of example.

Once the forming of the clip has been completed, it is preferably coated with a relatively inert material having good conductive properties. For example, a layer of tin approximately 0.0015 inch in thickness has been found suitable. The covering of tin serves two primary functions. First, it improves the conductive properties of the clip and,second, it prevents rusting or oxidation of the polygonal stock.

The particular dimensions of the conductor engaging section **10** will depend, of course, upon the range of conductor sizes it must accommodate and the electrical environment in which it is to be utilized. As pointed out previously, the measurement **16** (see FIG. 1) should be less than the cross-sectional measurement of the smallest conductor which the clip is to be utilized in conjunction with. It will ordinarily be necessary, therefore, to provide a number of different sizes of clips to accommodate varying size ranges of conductor leads. The conductor engaging clip illustrated in FIG. 1 is suitable for utilization under ordinary power-transmission conditions as well as in conjunction with electronic circuitry. Thus, for example, an engaging section **10** of the type shown might be affixed to the sides of an ordinary light switch or outlet rather than the screws normally found thereon and connection made by drawing the conventional cable between the facing sections **14** and **15** in a manner identical to that shown in FIG. 4. Particularly good results have been obtained in this regard, when aluminum cable is utilized within the particular building for power transmission. The device will operate satisfactorily, however, with relatively large copper leads.

As will be readily apparent, the physical configuration of the particular base to which the conductor engaging section **10** is affixed may vary depending upon the environment in which the clip is to be utilized. FIG. 6, for example, shows a loop **31** affixed to the single conductor engaging section **10** and a loop **32** affixed to a pair of conductor engaging sections **10**. The loops **31** and **32** may be affixed to a chassis or other operative component by means of an ordinary screw **33**. Once the loops have been so affixed, leads may be connected and disconnected therefrom by merely sliding them into the various conductor engaging sections **10** in the manner described previously.

In FIG. 7, a conductor engaging section **10** is shown formed integrally with a crank-shaped extremity **40** adapted to fit into a suitable aperture in a circuit board **41**. Connection is made to the printed circuit **42** by means of ordinary solder **43** and leads or conductors may thereafter be easily connected into the circuit by merely sliding them into the conductor engaging section **10**.

FIG. 8 illustrates a connector having a solder loop **50** integrally formed with its conductor engaging section **10**. This particular configuration is suitable for utilization in environments where it is desirable to permanently connect a hook-up wire or component lead to the clip. The wire is wound and crimped as indicated by the arrow **51** and then soldered to the loop **50**. The engaging portion **10** may thereafter be slid over any particular conductor which it is desirable to join into the circuit.

Referring now to FIGS. 9 through 11, there is illustrated a modified form of the invention. The resilient or spring-type connector clip **60** comprises a pair of handle portions **61** and **61'** disposed transversely to one another and abutting at one extremity to form a fulcrum **67**. Affixed to the handle portions **61** and **61'** are clamping slot forming portions **62** and **62'**, respectively. Facing sections of the clamping slot forming portions **62** and **62'** recede from one another and reconverge as indicated at **63** and **63'** to form a terminal slot **64**. The extending facing sections of clamping slot portions **62** and **62'** recede

and reconverge again forwardly of terminal slot **64** to form a conductor slot **65**. A compression spring **66** is affixed to the extremities of each of the clamping slot forming portions **62** and **62'** in the manner indicated. The spring **66** curves to the right as viewed in FIG. 9 above and out of the plane of the clamping slot forming portions **62** and **62'**. Preferably, the lead faces of the clip **60** are rounded as at **68** to form a generally V-shaped guide which aids in positively inserting the clip over a terminal or conductor.

As was the case with the various embodiments of the conductor engaging section shown in FIGS. 1 through 8, the entire connector clip **60** is formed preferably from an integral piece of polygonal stock which may also be square or rectangular in cross section. Conveniently, a conductor engaging section **10** identical to that shown in FIGS. 1 through 3 may be incorporated on each of the handle members **61** and **61'** to facilitate the fastening of hook-up leads and the like thereto. After the clip **60** has been formed from resilient stock such as that described previously, it is coated with an inert material such as tin to improve its conductive properties and prevent its oxidation on prolonged exposure to air, moisture and the like.

The provision of two clamping slots, **64** and **65**, permits the clip to be utilized to form a planar area connection with varying sized conductors, terminal posts and the like. The facing surfaces of clamping slot portions **62** and **62'** are, of course, planar and each has a pair of corners adapted to slightly deform the conductor, terminal or the like upon its resilient insertion thereover. In this manner, contact is achieved over a relatively large area and point contact oxidation is avoided.

In utilization, the hook-up leads **20** desired to be affixed to the connector clip **60** with relative permanence are slid between the facing sections **14** and **15** (see FIG. 1) of the conductor engaging sections **10** formed integrally with handle portions **61** and **61'**. It may be desirable, for example, to use merely one such lead and in this particular case only the conductor engaging section **10** on one of the handles will be utilized. Alternatively, of course, two such leads may be connected to the clip by utilizing both handle sections. The two handle portions **61** and **61'** are then squeezed together between the technician's fingers causing them to close on one another about fulcrum **67**. This closing, in turn, causes the rounded faces **68** and clamping slot forming portions **62** and **62'** to separate resiliently under the influence of compression spring **66**. If, for example, it is desirable to connect the lead or leads affixed to the handle portions **61** and **61'** in the manner described previously to a conductor of relatively small cross section, the handle portions are allowed to separate when that conductor has come into registry with slot **65**. The slot **65** should, of course, be smaller than the smallest conductor to which it may be desirable to affix the clip **60**. If, on the other hand, it is desirable to affix the clip **60** to a terminal post or a conductor of relatively large cross section, the handles are retained in their compressed position until the terminal clip or the like has come into registry with slot **64**. The handles are then released and the facing sections **63** and **63'** of slot **64** close resiliently on the particular terminal post or the like. Removal may be executed, of course, my merely recompressing handle portions **61** and **61'** and drawing the clip away from the conductor or terminal to which it has been attached.

While several preferred embodiments of this invention have been illustrated in detail, it will be readily apparent to those skilled in the art that many other differing embodiments may be conceived and fabricated without departing from the spirit of this invention as set forth in the accompanying specification and drawings.

I claim:

1. An electric circuit connector adapted to conductively engage a conductor, said connector comprising:

a shank portion and a pressure portion connected by an integral generally U-shaped junction portion; said portions being formed from an integral piece of wire-like, resilient stock having a constant cross section, said pressure and shank portions each having sections extending from said junction portion, said sections converging toward one another as they extend from said junction portion and forming a channel therebetween; at least said sections of said shank and pressure portions being formed from stock having cutting surfaces facing each other and facing said channel; at least one section of said generally U-shaped junction portion being resilient so as to bias said sections toward one another; the normal spacing between said sections of said shank portion and said pressure portion and the spaced sections of said U-shaped junction portion being less than the nominal cross-sectional measurement of said conductor whereby when said conductor is slid in said channel between said sections of said shank portion and said pressure portion and into said U-shaped junction portion, said cutting surfaces of said sections will be resiliently forced into conductor deforming relationship therewith.

2. The connector as set forth in claim **1** which further comprises a guide portion affixed to the free extremity of said pressure portion and diverging from said shank portion to provide a generally V-shaped guide and camming surface for resiliently separating said pressure portion from said shank portion as said conductor is slid therebetween.

3. The connector as set forth in claim **1** wherein said stock is rectangular in cross section and wherein the portions of said facing sections facing each other are planar.

4. The connector as set forth in claim **1** wherein said shank, junction and pressure portions are formed integrally from a wire-like piece of resilient polygonal stock and wherein said stroke is coated with a layer of relatively inert material having relatively good electrical conductive properties to improve the conductivity of said clip and retard oxidation of said stock.

5. The structure as set forth in claim **1** which further comprises a second like connector affixed to the described connector by means of a common shank portion.

6. The structure as set forth in claim **1** wherein said shank and pressure portions are fabricated from a material having greater hardness than said conductor.

7. The connector as set forth in claim **1** which further comprises a guide portion affixed to the free extremity of said pressure portion and diverging from said shank portion to provide a generally V-shaped guide and camming surface for resiliently separating said pressure portion from said shank portion as said conductor is slid therebetween.

8. The connector as set forth in claim **1** wherein said shank, junction and pressure portions are formed integrally from a wire like piece of resilient polygonal stock.

9. A spring electrical terminal clip adapted to firmly and conductively engage a circuit component comprising:

a pair of co-planar handle portions positioned transversely with respect to one another but abutting to form a fulcrum;

a pair of co-planar clamping slot forming portions, the facing surfaces of said slot forming portions diverging from one another and reconverging to form a slot;

a resilient compression portion having one of its ends affixed to one of said clamping slot portions, having a central body section which curls out of the plane of said slot forming portions, and having its other end affixed to the other of said slot portions whereby said clamping slot portions are resiliently biased into abutment with one another but separable upon the

compression of said handle portions, said handle portions, slot forming portions and compression portion being formed integrally from a piece of resilient, wire-like stock.

10. The clip as set forth in claim **9** wherein the facing surfaces of said slot forming portions diverge and reconverge at least twice to form two slots of differing sizes whereby said clip may be resiliently and firmly disposed upon components of differing sizes.

11. The clip as set forth in claim **9** wherein said clamping slot portions are formed from stock having a generally rectangular cross section, facing surfaces thereof being generally perpendicular to the general plane of said slot forming portions.

12. The structure as set forth in claim **9** wherein said handle, clamping slot and compression portions are formed integrally from a piece of resilient rectangular stock and where said stock is coated with a layer of relatively inert material having relatively good electrical conductive properties to improve the conductivity of said clip and retard oxidation of said stock.

13. The structure as set forth in claim **9** wherein said clip is integrally fabricated from resilient stock having a polygonal cross section.

14. The clip as set forth in claim **13** wherein said compression portion curls rearwardly from the component receiving ends of said slot forming portions to a point rearwardly of said fulcrum.

15. The structure as set forth in claim **9** wherein at least one of said handle portions has a connector integrally formed therewith adapted to conductively engage a conductor, said connector comprising:

a shank portion and a pressure portion connected by a generally U-shaped junction portion, said shank portion forming an extension of said one handle portion; said pressure portion extending from said junction portion so as to be adjacent and generally coplanar with said shank portion; at least facing sections of said shank and pressure portions being formed from polygonal stock; at least one section of said generally U-shaped junction portion being resilient so as to bias said facing sections toward

one another; the relaxed spacing between said shank portion and said pressure portion being less than the nominal cross-sectional measurement of said conductor whereby, when said conductor is slid between said shank portion and said pressure portion, said polygonal sections will be resiliently forced into conductor deforming relationship therewith.

16. The structure as set forth in claim **15** wherein the spacing between facing sides of said generally U-shaped junction portion is less than the nominal cross-sectional measurement of said conductor whereby the sliding of said conductor into abutment with said junction portion will not affect a release thereof.

17. The structure as set forth in claim **16** which further comprises a guide portion affixed to the free extremity of said pressure portion and diverging from said shank portion to provide a generally V-shaped guide and camming surface for resiliently sparating said pressure portion from said shank portion as said conductor is slid therebetween.

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U.S. Cl. X.R.

339—256, 261, 278