Aug. 2, 1949. W. S. WATTS 2,478,143

ELECTRICAL CONNECTOR

Filed April 10, 1944 2 Sheets-Sheet 1

Fig. 1

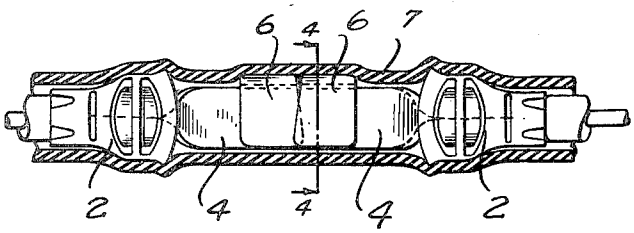


Fig. 3.

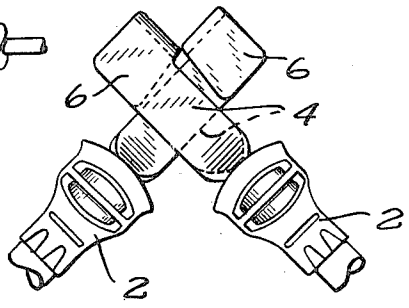


Fig. 2.

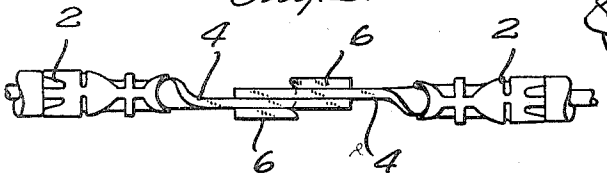


Fig. 5.

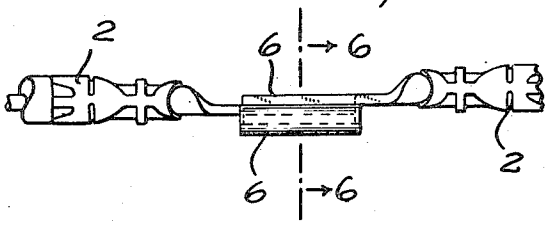


Fig. 4

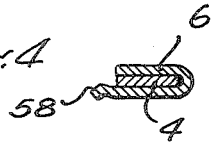
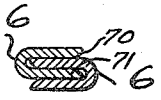


Fig. 6.



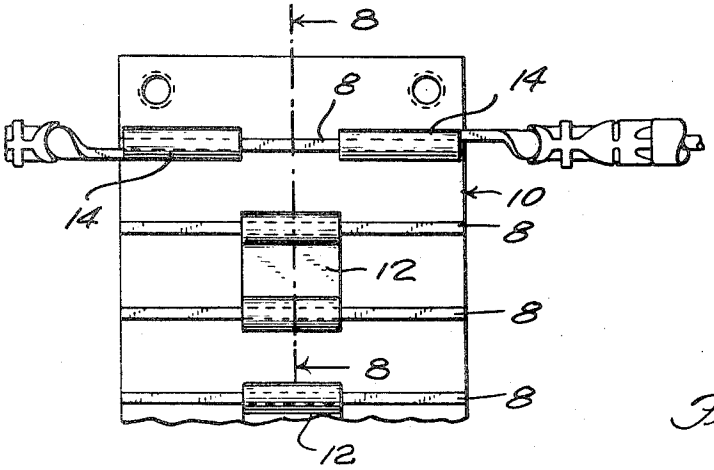


Fig. 7.

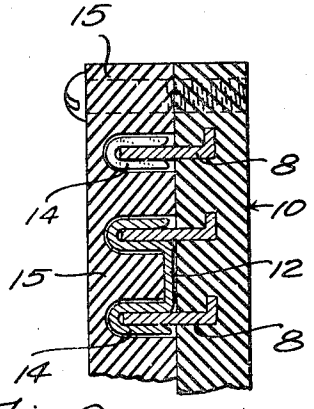


Fig. 8.

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ELECTRICAL CONNECTOR

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Fig. 9.

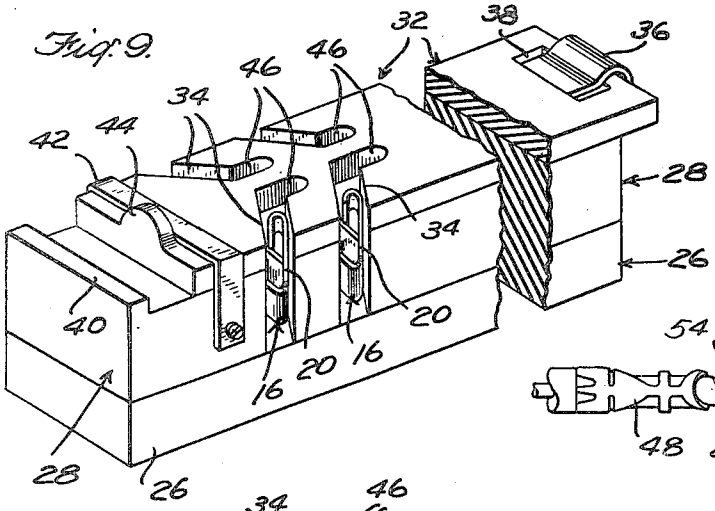
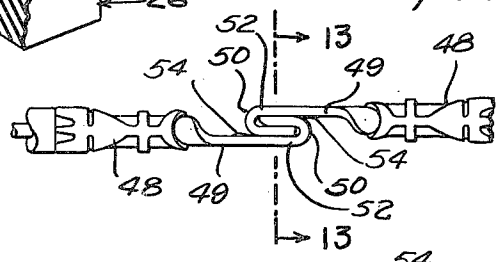


Fig. 12.



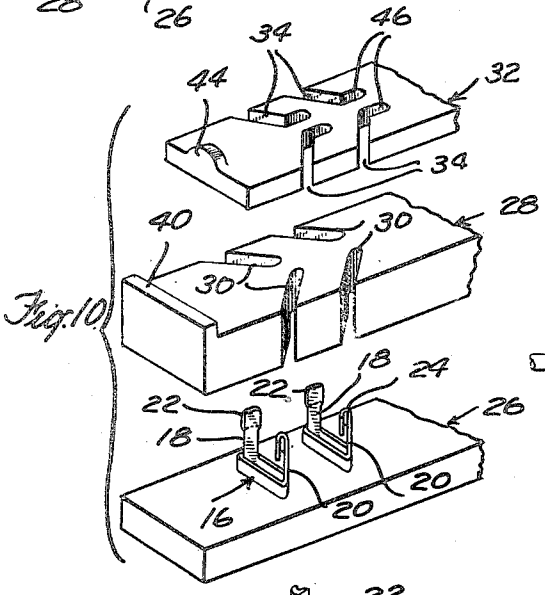


Fig. 10.

Fig. 13.

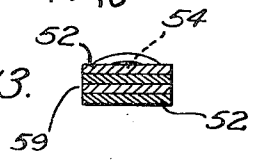
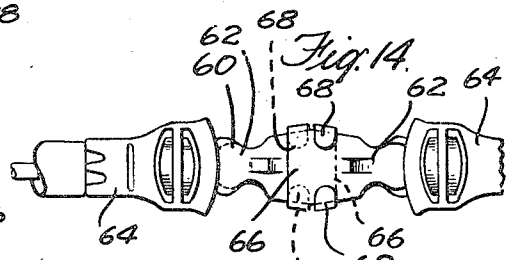


Fig. 14.



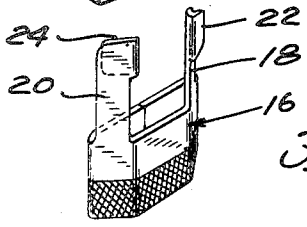


Fig. 11.

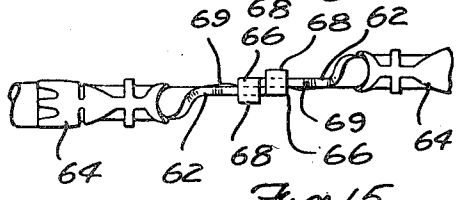


Fig. 15.

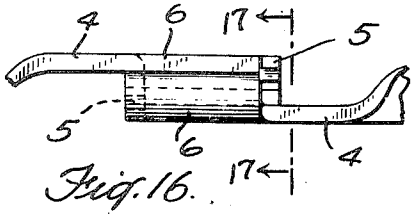


Fig. 16.

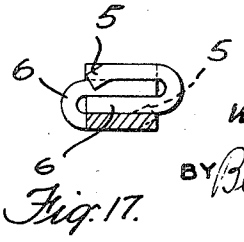


Fig. 17.

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Patented Aug. 2, 1949

2,478,143

UNITED STATES PATENT OFFICE

2,478,143

ELECTRICAL CONNECTOR

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Application April 10, 1944, Serial No. 530,296

6 Claims. (Cl. 173—324)

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This invention relates to connectors for wires, cables, cords, and the like and has for its general object to provide a connector made up of two interengaging terminals, each of which can be stamped up out of an integral piece of metal suitable for forming also the ferrule or other part for engaging the wire, etc.

In the manufacture of terminals for electrical conductors, it is often required that the metal be of such a character that the ferrule part of the terminal can readily be crimped into interlocking engagement with the conductor end substantially without elastic spring-back. In such a terminal difficulty has been experienced heretofore in forming, from the relatively soft metal required for the ferrule part of the terminal, an interengaging element of a connector having sufficiently strong grip to insure maintenance of the interengaging and electrically conducting relation of the two terminals, without other connecting means. I have found, however, that if the interengaging connection of the two terminals comprises closed folds such that terminals provided with similar cooperating folds can interfit with one side of each engaged within the fold of the other, a very satisfactory connector can be made of sheet copper of the quality usually employed in the manufacture of terminals.

I have found, moreover, that there is advantage in making such terminals so that the line of fold is crosswise of the grain of the metal; and if the terminal is to be crimped onto a conductor, I find it advantageous also to have the grain of the metal circumferential of the ferrule.

It is an important advantage of my invention that it lends itself well to the use of soft electrical copper and if the terminal is annealed before the fold is made, the metal can be fully annealed except in the actual fold. Thus the fold develops a work-hardening which gives the necessary spring for a high pressure contact.

Another important feature is the form of the interengaging parts with an inner radius of curvature in the fold slightly less than one-half the maximum thickness of the metal. Although it is most advantageous to use these features in combination, it is also within the purview of this invention to use these individually or in lesser combinations as will appear in the several examples given below.

The invention contemplates not only the provision of a connector made up of interengaging terminals, which require no screws or other fastenings to complete the connection, but also the provision of a terminal construction such that,

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not only do the terminals effect an interengagement sufficient to form a good electrical connection but they also can readily be made to effect an interlocking engagement against separation by lengthwise pull.

An important feature of the invention in the preferred embodiment thereof is such an arrangement of elements of the two folded portions of the connector on each of the terminals that they can be brought either into interconnecting or into disconnecting relation to each other only by first bringing them into a relation to each other in which they are at an abnormal angle. This insures not only against separation by lengthwise pull but also against other causes of accidental separation.

Other objects and important features of the invention, to which reference has not been made hereinabove, will be apparent from the following description and claims.

Although in the accompanying drawings I have shown a preferred embodiment of my invention and have described the same and various modifications thereof in this specification, it is to be understood that these are not intended to be either exhaustive or limiting of the invention, but, on the contrary, are chosen for the purposes of illustrating the invention in order that others skilled in the art may so fully understand the invention, its principles and the application thereof, that they may embody it and adapt it in numerous forms, each as may be best suited to the requirements of its particular use.

In the accompanying drawings,

Figure 1 is a plan view of a connector embodying the present invention in its assembled condition with an insulating tube shown in longitudinal section;

Figure 2 is a side elevation of the connector shown in Figure 1;

Figure 3 is a view showing the method of effecting the interengagement and the disengagement of the two terminals making up the connector shown in Figures 1 and 2;

Figure 4 showing a modified structure is a section at a position corresponding to line 4—4 of Figure 1;

Figure 5 shows a simple form of non-interlocking connector made by directly engaging with each other the clips of terminals similar to those shown in Figures 1 and 2;

Figure 6 is a section on the line 6—6 of Figure 5;

Figure 7 is a plan view of a simple connector block connection, with the cover removed, for

use with terminals such as shown in Figures 1 to 3, 5 and 6;

Figure 8 is a side elevation and partial section on line 8—8 of Figure 7, of the connector shown in Figure 6;

Figure 9 is a perspective view partly broken away of a connector block for use with connectors such as shown in Figures 1 to 3;

Figure 10 is an expanded perspective view of the construction shown in Figure 9;

Figure 11 is a perspective view on a larger scale of a connector element of Figures 9 and 10;

Figure 12 shows another simple form of connector embodying the invention, this figure showing the connectors in assembled relation and also showing means for insuring interlocking;

Figure 13 is a sectional view taken on line 13—13 of Figure 12;

Figure 14 is a plan view of another embodiment of the invention;

Figure 15 is a side elevation of the connection shown in Figure 14; and

Figures 16 and 17 are views similar to Figures 5 and 6 but showing a structure modified to provide for positive interlocking.

In the illustrated preferred embodiment of the invention shown in Figures 1 to 3, inclusive, each of the terminals which, when combined, make up the connector of the present invention, comprises means for securing the terminal to a wire, cable or other transmission means, in this case shown as a ferrule 2 having integral with and extending therefrom the blade 4. Each of said terminals also has formed integral therewith, but located preferably beyond the blade portion 4, the clip 6. It will be seen that, in the structure shown, the blade 4 extends directly from and forms an integral continuation of one side of the ferrule 2. In the illustrated construction the bent-over portion which, together with the end of the blade 4, forms the clip 6 is shown as bent inwardly so that the blade portions lie face-to-face. It obviously could be bent the other way so that the blades would lie back-to-back. The terminal is advantageously made from rolled sheet or strip of high conductivity oxygen free copper, the terminal blanks being stamped out transversely of the strip so that the direction in which it has been rolled is perpendicular to the folded edge of the clip 6 and circumferential of the ferrule 2.

With counterpart terminals, each constructed as just described, it will be obvious that to bring them into the interengaging and interlocking relation shown in Figures 1 and 2 they must first be brought together at a considerable angle to each other, as shown in Figure 3, so that each clip 6 may hook over the blade part 4 of the other terminal. To facilitate this hooking engagement the edges of the blade part 4 and of the clip 6 are bevelled inward. It will further be seen that when the parts are in the position shown in Figures 1 and 2 clips 6 will overlap in such manner that separation of the two terminals cannot take place by a mere endwise pull. It will also be seen that before they can be separated at all they must again be brought into the angular relation to each other shown in Figure 3. Thus it is possible to lock the connection against separation by slipping a tube 7 over it as shown in Figure 1. If this tube is of flexible material such as rubber or plasticized vinyl polymers, the angular flexibility of the connection is retained, while securing it against disconnection.

Although the terminals shown in Figures 1 to 3 are preferably connected to each other in the manner thereshown to form a connector not only interlocked against separation by endwise pull but also not disconnectible except when brought to the angular position of the parts shown in Figure 3, it will be understood that for quick temporary connections or where the parts are not subject to pulls that might separate the terminals, they can readily be brought together with the clip 6 instead of the blade 4 under the clip of the other terminal. In Figures 5 and 6 there is shown a modification designed to be directly engaged with each other in this manner instead of each engaging the blade portion of the other terminal. When thus engaged either the blade portion or the clip of either terminal may be inserted into the recess between the other blade and its clip; the blade or clip portion of the latter then being caused to enter the corresponding recess of the other terminal. In the form shown in Figures 5 and 6 the clip portion is made longer to increase the frictional engagement and thus to reduce the chance of accidental disengagement.

With the connection shown in Figures 5 and 6 as with that shown in Figure 1, and in fact with all forms of my invention, there is advantage in providing a stiffly flexible or resilient insulating tube 7, which not only insulates the otherwise exposed parts but also secures the parts together against disconnection by transverse movement. With such an embracing tube the long area of contact in the terminal of Figure 5 is sufficient to hold the connection against longitudinal tension encountered in many types of service. Where greater security against direct pull is required one or both of the edges at one end of the clip 6 can be upset or partially sheared as shown at 5 in Figures 16 and 17. These portions block the recess between the blade 4 and the clip 6 so that the clip on the other terminal cannot slide out by any direct pull.

Instead of connecting both terminals to conductors by means of ferrules as described above, one of the terminals may be rigidly mounted to serve as a binding post.

This adaptability to various uses of the form of connector as shown, for example, in Figures 1 to 6 is illustrated further in Figures 7 and 8 where the clip portion 6 of each of two terminals is caused to engage a blade 8 embedded in a connector block 10, preferably formed of some good molded insulating material such as Bakelite. As shown in Figures 7 and 8, a number of the blades 8 may be so embedded in a connector block that a number of circuits can be closed in the manner shown in the upper part of the figure, through the blades 8. If it be desired to interconnect a number of terminals this can further be done by providing bridge members 12 having at each end clips 14 similar in construction to the clips 6 and thus adapted to engage the blades 8. A cover 15 of molded insulation may be used as shown in Figure 8 to secure these parts together.

Instead of the simple blade 8, shown in Figures 7 and 8, for use in effecting a stationary connection between two terminals, there may be provided a connector member such as shown in Figure 9 having a base portion 16 which may be embedded in the insulating block and which serves both as a support for and connection between two blade portions 18 and 20 having at their upper ends clips 22 and 24. It will be seen that a connector member of the construction shown in Figure 9 can be used with the individual connectors shown in Figures 1 to 3, either in the manner there

shown, or two or more of these bases 16 can be connected by bridge members 12 as shown in Figure 7.

In Figures 10 and 11 is shown a connector block having connectors of the form just described, embedded in a base 26 of molded insulating material but leaving enough of the connector bases 16 above the insulating material to permit application of the bridge members 12. Mounted upon the insulation base 26 and rigidly connected thereto is an intermediate block 28 of insulating material provided with slots 30 positioned to receive the blades 18 and 20 and the clips 22 and 24. These slots are of such a depth and are so located in relation to the clips 22 and 24 and the blades 18 and 20 that terminals, such as shown in Figures 1 to 3, inclusive, can readily be inserted from the side, overlapped and swung upright to bring them into connected relation.

To prevent movement of the terminals, when thus brought into connected relation, a locking block 32 may be provided. This block, as shown particularly in Figure 10, is slidable lengthwise of the intermediate insulating block 28 and has therein oblique slots 34 registering with the slots 30 of the block 28 when the block is in the position shown in Figure 10. A spring 36, however, is so mounted upon the intermediate block 28 that its upper end, which is received in a recess 38 in the slide 32, tends to move the slide toward a stop 40 on the intermediate block 28. The movement of the block in the direction to bring the slots 34 and 30 into register may be limited by a yoke 42 straddling the slide 32 and the block 28 and arranged to be engaged by the thumbpiece 44 on slide 32 when the slide has moved to a position in which the slots 34 and the slots 30 are in register.

At its inner end each of the slots 34 of the slide 32 communicates with a slot 46 extending lengthwise of the slide 32. The slots 46 are of sufficient length so that when the slide 32 is in its normal position of rest, that is, with the thumb piece end of the slide abutting the abutment 40, the entrance into each of the slots 30 will be closed and each terminal will thus be locked in engagement with the clip 22, or the clip 24, as may be.

It will be understood that the clips 22 and 24, like the clips 6 of the terminals shown in Figures 1 to 3, are advantageously formed by bending them about axes perpendicular to the grain of the copper or other metal of which the clips are formed.

In Figures 12 and 13 is shown another modified form of connector in which the two terminals which make up the connection, instead of engaging each other laterally, are arranged to interengage longitudinally. In this form of the invention each of the terminals comprises a ferrule 48 from one side of which there extends a tongue or blade 49 bent back upon itself at 50 to form the clip 52.

It will be seen that in this form of connector the hook-like arrangement provides for resistance to disconnection by longitudinal pull. When used on flexible wires a direct transverse strain is very unlikely and the frictional engagement is, therefore, adequate. However, if a locking against disconnection is desired, each of the terminals may be provided upon its inner face with a projection 54 adapted to snap up behind the end of the other terminal when the connector is in assembled condition. It will be seen that this snap lock arrangement holds the assembly against accidental disconnection by a pull in any direction.

A similar locking detent can be used in the embodiments illustrated in Figures 1 to 3, inclusive, 4 and 5; or a projecting lip like the lip 58 in Figure 4 can be used at the side of the clip 52, i. e. at 59, which produces a snap-latching to resist angular movement of the terminals and thus prevent accidential disconnection. In every case, however, such detent, if used, should be sufficiently low to avoid straining the clip beyond its elastic limit when the terminals are interengaged.

In Figures 14 and 15 is shown another embodiment of the invention, in this the blade section 60 expands from a narrow neck 62 adjacent the ferrule 64 to a broader end 66 at each side of which is a clip 68. These clips 68 engage and give pressure contact with the blade of the connected terminal as in the case of the other figures. The space between the ears 68 is such that the neck 62 of the other terminal just fits between them when the end 66 is against the end of the opposite ferrule 64. Small strips or humps 69 may be punched up as shown at Figure 15, to serve as a detent for latching the terminals in connected relation. Such precaution, however, is not necessary for most purposes since the terminals before separation must in any case be pushed together and while held parallel and centered with respect to each other one must be lifted from the other.

I have referred above to the utilization of the "grain" produced in the metal by its previous working, and to the increase in spring at the "fold" or bend where the clip is folded back over the blade, as well as to the various forms and locations of the blades and clips.

In order to give maximum effective contact in the connection and the desired work hardening at the bend, the fold is first formed so as to give an inside spacing at the bend substantially equal to the thickness of the blade portion and sufficiently closer in the various parts beyond the bend so that an inelastic bending, i. e., beyond the elastic limit, is required for each such part before it is spread to a spacing equal to the least thickness of the blade portion 4. The spacing, when the terminals are not connected, decreases progressively from the bend toward the opposite edge, so that each part thereof, substantially up to the bend itself, is bent out by the insertion of the blade without thereby moving other parts away from contact with the blade. This effect is enhanced if the clip 6, when free, is somewhat curved toward the blade (i. e., concave on its inner side). The clip is then bent back by inserting a blade of thickness no greater than the least thickness of the blade portion of the terminal, thus effecting the necessary inelastic bending, but leaving the full elasticity of the metal to press the clip against the blade. Since this leaves the clip with a tendency to spring toward the blade when the terminals are separated, I bevel the inner face of the clip and/or the blade where they first contact each other so that the bevel can cam the clip over the inserted member. This is shown at 70 and 71 in Figure 6 of the drawings.

While it is desirable to obtain pressure contact over the full area of the clip as described above, it is also of advantage that the spacing in the area near the bend be slightly closer than the thickness of the blade, since it is in this area that the spring action of the work-hardened bend is most effective, i. e., acts with the best mechanical advantage, but it is most important that this spacing be only slightly less and that adjacent the bend it be no less than the thickness of the blade if the most effective contact is to be attained.

From the foregoing description it will be apparent that the invention provides a simple and inexpensive connector which is convenient to use and which insures a good mechanical connection and also a good electrical conduct when the terminals are connected to electrical conductors of a live circuit; and that the connection when made is not liable to accidental disconnection.

I claim:

1. A metal connector which comprises a blade portion and a clip portion integral with said blade portion, extending therefrom back across said blade portion and spaced therefrom a distance slightly less than the overall thickness of said blade portion, whereby the connector can be connected with a similar connector by inserting a portion of one between the blade and clip portions of the other, the properties of the material of the connector being such that the elastic limit is exceeded when the free end of the clip portion is moved from a repose position parallel to the blade portion to a position touching the blade portion and when released after exceeding the elastic limit the spring back of the clip portion is less than the thickness of the blade portion.

2. A connector having a contact blade interengageable with the contact blade of a like conductor, said blade comprising a sheet of a ductile highly conductive metal having a portion thereof formed to a flat contact face and an adjacent portion folded back across said contact face, whereby to receive an interengaging contact blade between it and said face, said adjacent portion being spaced over the contact area from said contact face a distance less than the overall thickness of the contact blade to be received therein and the properties of the material of the connector being such that the elastic limit is exceeded when the free end of the adjacent folded-back portion is moved from a repose position parallel to the contact face to a position touching the contact face and when released after exceeding the elastic limit the spring-back of said folded-back portion is less than enough to restore the folded-back portion to a position parallel to the contact face.

3. A connector which comprises a pair of interengaging members made of conductive metal and each having means for engaging a wire, cable, cord or the like, a blade portion extending from and integral with said means and a clip portion integral with said blade portion extending therefrom and back thereacross and adapted to be stressed against the blade portion of the other member which is inserted between said blade and clip portions, said members being made of a ductile, highly conductive metal throughout, the properties of the material of the members being such that the elastic limit is exceeded when the free end of the clip portion is moved from a repose position parallel to the blade portion to a position touching the blade portion and when released after exceeding the elastic limit the spring-back of the clip portion is less than the thickness of the blade portion.

4. A connector according to claim 3 in which a resilient tube is telescoped over said interengaged clips and blades portions to grip them whereby to protect and lock the connection.

5. A connector according to claim 3 in which the leading edge of one of said portions, which is first engaged by a similar portion upon interconnection, is at an acute angle with respect to the contact face of the blade portion whereby to facilitate entrance between the blade portion and its adjacent clip portion.

6. A metal connector which comprises a soft metal having one end thereof formed into a ferrule and annealed for crimping onto the wire, an integral blade portion extending from the ferrule and a clip portion integral with said blade at one edge thereof and extending back across one face of said blade portion and spaced therefrom a distance less than the thickness of the blade portion, at least the bend between the blade portion and the clip being work hardened to substantially greater resiliency than the metal of the ferrule, the properties of the material of the connector being such that the elastic limit is exceeded when the free end of the clip portion is moved from a repose position parallel to the blade portion to a position touching the blade portion and when released after exceeding the elastic limit the spring back of the clip portion is less than the thickness of the blade portion.

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