

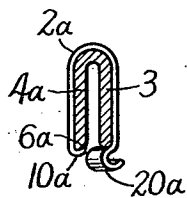
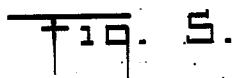
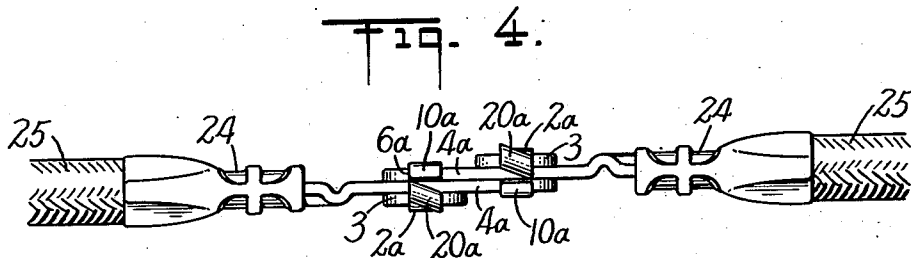
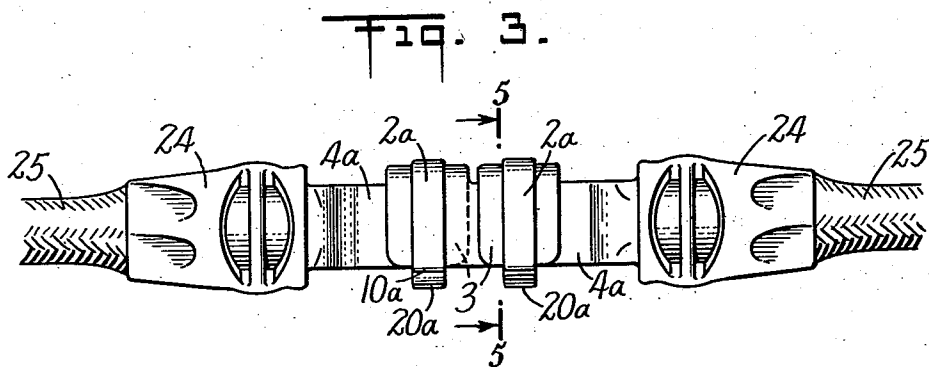
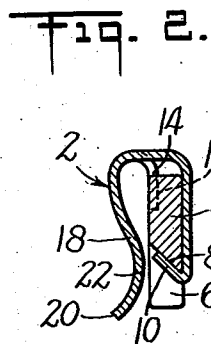
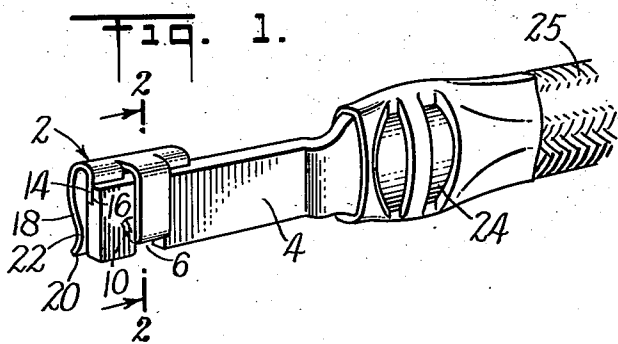
Dec. 25, 1951

W. S. WATTS
ELECTRICAL CONNECTOR.

2,580,206

Filed Sept. 2, 1944

3 Sheets-Sheet 1



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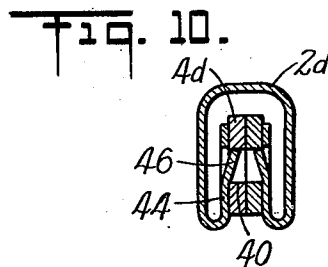
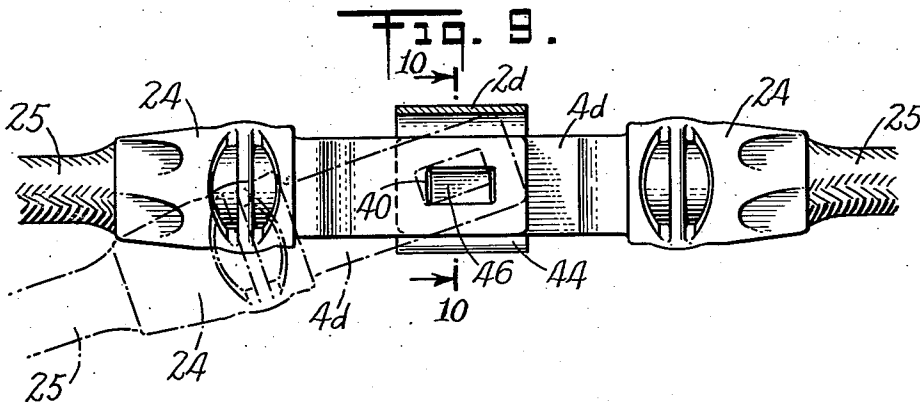
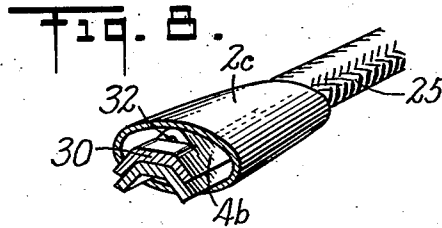
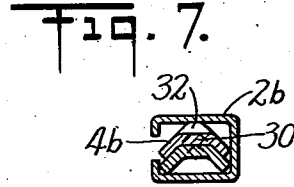
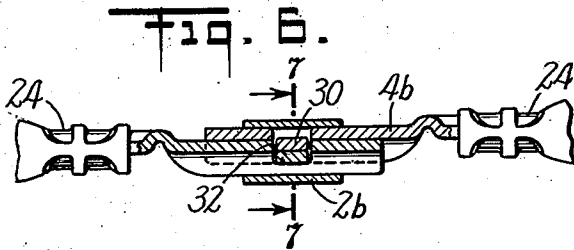
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ELECTRICAL CONNECTOR

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3 Sheets-Sheet 2



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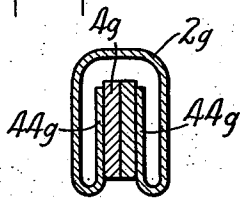
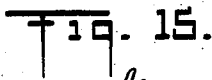
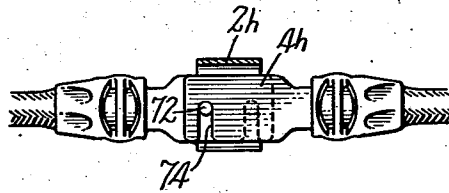
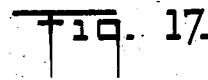
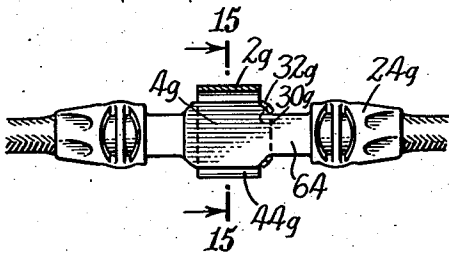
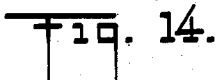
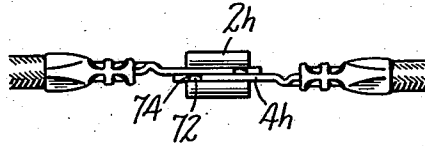
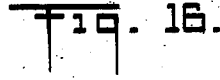
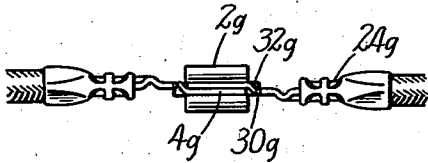
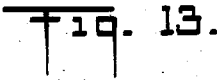
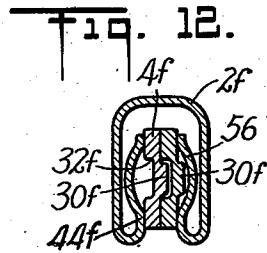
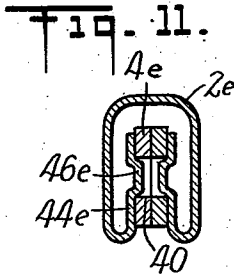
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ELECTRICAL CONNECTOR

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3 Sheets-Sheet 3



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2,580,206

ELECTRICAL CONNECTOR

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Application September 2, 1944, Serial No. 552,523

7 Claims. (Cl. 287—76)

1

This invention relates to connectors and particularly to readily disconnectible connectors of the type having blades pressed face-to-face with blades of counterpart connectors.

In order that a good electrical connection may be made between electrical conductors by means of a connector of the so-called solderless type, it is important, first, that the counterpart terminals which together form the connector be of highly conductive metal, such, for example, as comparatively pure copper, and, secondly, that the surfaces which are brought together to complete the electrical connection be also of the highly conductive metal and engage over a relatively large area to reduce as far as possible any resistance to flow of current through the contact. Various connectors have been designed which provide separable connection between electrical conductors. For the most part such connectors make contact not directly with each other but through an intermediate conducting member. One object of the present invention is to eliminate such intermediate member and thus to simplify the structure and to reduce the contact resistance. In copending applications, Serial Numbers 530,296, now Patent No. 2,478,143, and 530,317 of myself and of James C. Macy, respectively, both filed April 10, 1944, are shown various connectors adapted to be directly inter-engaged with blades which lie in face-to-face contact and integral clips for holding the blades pressed into such contact. With all of such parts formed integrally of the highly conductive metal, certain important advantages are attained, but certain limitations are imposed which may become important under special conditions of use. It is an object of this invention to overcome such limitations and thereby to make this type of connector more generally applicable to provide good and secure electrical and mechanical connection.

It is well understood that the metals most suitable for effecting solderless electrical connections, because of their high conductivity, are comparatively soft and malleable and have very limited inherent resiliency. In connections described in the copending applications above referred to, this softness and liability to easy deformation is taken advantage of and is an important feature of the invention. When, however, the connectors are to be used in places where they are subjected to stress which tends seriously to deform or disconnect such connectors when in use, a special problem is encountered which it is an object of the present invention to solve.

2

A general object of the present invention is to provide an improved electrical connector capable of repeated connection and disconnection with counterpart connectors. One feature of the invention by which these objects are achieved is that the contact faces of conductor terminals are of softer metal maintained in good contact with each other by means associated therewith formed of a metal, metal alloy or other material which is more resilient than the metal of the engaging contact faces.

The invention further aims so to construct the counterpart terminals of the connector that, when brought into conductive engagement with each other and pressed into face-to-face contact, these counterpart connectors will be interlocked, preferably both against endwise separation and against sidewise separation.

Another important feature of the invention is the arrangement of the resilient contact maintaining means in such relation to the cooperating parts of the counterpart terminals that, when the counterpart terminals are brought into the desired conductive relation to each other, the said resilient means will automatically become effective to maintain them in such relation.

Other objects and important features of the invention to which reference has not specifically been made hereinabove will appear hereinafter when the following description and claims are considered in connection with the accompanying drawings.

Although in these drawings and in the following specification I have shown a preferred embodiment of my invention and various alternatives and modifications thereof, it is understood that these are not intended to be exhaustive nor limiting of the invention, but, on the contrary, are given with a view to illustrating and explaining the principles of the invention, and their embodiment for practical use, in order that others skilled in the art may be enabled to adapt and modify them in numerous embodiments and modifications, each as may be best adapted to the conditions of any particular use.

In the drawings,

Figure 1 is a perspective view of a conductor terminal constituting one of the counterpart elements of a connector of the knife switch type embodying the present invention;

Figure 2 is a section on the line 2—2 of Figure 1;

Figure 3 is a view in side elevation of another embodiment of the invention;

Figure 4 is a bottom view of the same;

55

3

Figure 5 is a view in cross section taken on line 5—5 of Figure 3;

Figure 6 is a view partly in longitudinal section and partly in elevation of another embodiment of the invention in which the resilient means comprises a separate element;

Figure 7 is a section on the line 7—7 of Figure 6;

Figure 8 is a view partly in perspective and partly in section of a connection similar to that of Figures 6 and 7, but with a different spring member;

Figure 9 is a view in side elevation of an embodiment of the invention in which a separate resilient means is used in the form of a clip arranged to be sprung sidewise over the contacting blades;

Figure 10 is a section on the line 10—10 of Figure 9;

Figure 11 is a section similar to Figure 10 but showing a modification of the clip construction;

Figure 12 is another section similar to Figure 10 but showing a modification both of the clip construction and of the overlapping terminal construction;

Figure 13 is a side elevation of still another embodiment of the invention in which the spring clip is sprung sidewise over the overlapping terminals, this embodiment showing the terminals themselves so constructed that they interlock when maintained in conductive relation to each other;

Figure 14 is a plan view of the overlapping terminals shown in Figure 13 with the clip shown in section;

Figure 15 is a section on the line 15—15 of Figure 14;

Figure 16 is still another modification of the invention showing a different form of interlock of the overlapping terminals; and

Figure 17 is a plan view of the overlapping and interlocking terminals with the clip shown in section.

In the form of the invention shown in Figures 1 and 2, the resilient means of the present invention is shown as applied to counterpart terminals of the knife-disconnect type similar to that disclosed in the copending application Serial No. 530,296.

As shown in Figures 1 and 2 of the drawings, the clip part 2 of each of the counterpart terminals is formed of a metal, metal alloy or other material of considerably greater resiliency than that of the highly conductive metal employed to form the blade 4. Since the actual electrical connection is made through the contacting faces of the counterpart blades 4 of the connectors, it is not important that the clip 2 be of highly conductive material and there is even advantage in making it of an insulating material, for example, cellulose ester, vinylidene polymer, etc. As shown, the primary function of the clip 2 is to hold the adjacent faces of the blades 4 in good face-to-face contact over substantially their entire face area and thus to reduce as far as possible the contact resistance between the faces and to give a strong frictional engagement between the counterpart connectors such as will hold them against accidental disengagement.

The clip 2 may be connected to the blade 4 in any suitable manner, as, for example, bending parts over, and embracing the blade 4, or by spot welding thereto, or both. To this end the blade 4 is provided in its lower edge with a notch 6 having an inclined bottom 8 which forms an acute angle with the face of the blade 4 remote

4

from the main part of the clip 2 and thus forms an undercut edge over which the lip 10 of the clip 2 is bent to give secure engagement.

Cooperating notches 16 on the upper edge of the blade 4 receive the portions 14 at opposite ends of the clip. It will be obvious that when the clip 2 has been secured upon the blade 4 in the manner shown, it will be held firmly in position and the free arm 18 thereof close to the blade 4 at 22, but with the edge 20 spaced from the edge of the blade 4 a distance slightly more than the thickness of the blade 4. The spacing at the upper edge of the blade is slightly less than the thickness of the blade so that when a counterpart blade is inserted under the clip, the latter will press the counterpart blade throughout its width into full face-to-face engagement with the front face of the blade to which the clip is attached.

As shown in Figure 2 the lower edge of the clip 2 is bent outwardly as shown at 20 to facilitate insertion of a blade 4 of the counterpart terminal in the clip. If desired, latching means of any of the types hereinafter described may be provided to effect interlocking of the parts against the angular movement necessary to disconnection.

The counterpart connectors may be provided with any appropriate means 24 for connecting it more or less permanently to one of the wires 25 or other members to be connected.

In Figures 3 to 5, inclusive, a connector is shown with an integral clip 3 turned back from the edge of the blade portion 4a with a spacing therefrom at said edge equal to or only slightly less than the thickness of the blade 4a and sloping from said edge toward the opposite edge of the blade, closer to the face of the blade, all as set forth in my copending application, Serial No. 530,296.

The lower edge of the blade 4a is recessed at 6a to receive the bent over end 10a of a spring clip 2a. As in the case described above and shown in Figures 1 and 2, the clip 2a may be made of any spring material metallic or insulating as desired. If it is desired to use an insulating material it may be a thermoplastic or thermosetting material molded in situ so as to completely cover the external surfaces of the clip 3 and the back of the blade 4a in the area behind the clip. If the clip 2a is of metal, the end 10a is advantageously secured as by spot welding or brazing, although that is not essential.

The main body of the clip 2a fits closely to the clip 3 and the back of the blade 4a, but the edge 29a is formed into a catch which, as best shown in Figures 4 and 5, extends across the mouth of the gap between clip 3 and blade 4a. On its lower (external) edge the catch 20a is sloped away from the mouth of the gap both vertically and longitudinally of the blade whereby to cam the catch aside when a counterpart blade is forced into said mouth. On its opposite side the catch is formed approximately perpendicular to the face of blade 4a, so that the edge of the blade is held until the catch 20a is manually pushed aside.

In the form of the invention shown in Figures 6 and 7, the counterpart terminals are not of the knife disconnect type but comprise simply blades 4b, angular in section, and preferably formed integral with the ferrules 24, each blade having between its ends a portion thereof stamped inwardly to form a tongue 30 extending across the apex of the dihedral angle and a recess

32 where the apex is thus depressed, the tongue 30 of one blade 4b being adapted to be received in the recess 32 of the other blade, which has been formed by the stamping of the tongue from the angle apex. It will be seen that this engagement of the tongue 30 of one blade with the recess 32 of the other blade effects a locking of these blades against lengthwise disengagement so long as they are held in the face-to-face relation as shown in Figures 6 and 7.

To effect a holding of the blades in the good electrically conductive engagement as shown in Figures 6 and 7, a resilient clip 2b is provided. Such a clip 2b may be more or less permanently secured to each counterpart connector as in the case illustrated in Figures 1 and 2 or it may be an element separate from either of the counterpart blades, this clip being formed of a metal, metal alloy or other material of sufficient resiliency to resist permanent deformation, but yieldable to direct transverse pressure to permit separation of the counterpart connectors. As shown in Figure 7, the clip 2b is preferably open at one side so that it may either be sprung into position laterally over the blades 4b after they have been brought into the interlocking relation shown in Figures 6 and 7, or it may be slipped over one of the counterpart terminals before they are brought into this relationship and then slid lengthwise thereof into the position shown in Figures 6 and 7. In either event the resiliency of the clip 2b is sufficient to maintain the contact faces of the blades 4b in good electrically conductive engagement with each other.

As shown in Figure 8, a tube of stiff resilient insulating material 2c replaces the clip 2b. As this tube is normally of relatively flat elliptical cross-section in its central portion, its tendency to regain its original shape serves to press the blades 4b together at the same time affording complete insulation for the connection, as more particularly described and claimed in a copending application, Serial Number 562,975, filed November 11, 1944, now abandoned. When the tube is to be slipped over or removed from the connection, it is compressed on its major axis so that it is expanded on its minor axis.

It will be seen that the blades 4b are not only locked against lengthwise displacement or disconnection by reason of the engagement of the tongue 30 in one blade in the recess 32 of the other blade but that, by reason of their angular shapes, when the clip 2b or 2c is in the position shown in Figures 6 to 8, they are interlocked also against sidewise displacement or disconnection.

In the form of the invention shown in Figures 9 to 11, inclusive, the blades 4d of the counterpart connectors are advantageously formed integral with their ferrules 24 but are here shown as flat blades presenting contact faces of relatively large area, each blade being provided with an opening 40 therethrough, of generally rectangular shape, adapted to register with a projecting portion of the spring clip 2d when the parts are in the desired overlapping relation for effecting the connection between the electrical conductors 25 for which they constitute the terminals. In this form of the invention, to secure the desired interlocking of the parts against lengthwise or sidewise displacement or disconnection and, at the same time, to insure good electrical conductivity between the contact faces thereof, the spring clip 2d is formed, as shown in Figure 10, of a highly resilient metal, metal alloy or other

suitable material, generally U-shaped in cross-section with parallel pressure arms, so that it may be slipped laterally over and clamp the overlapping blades. Each of the arms of the U are, in the example illustrated, turned, as shown at 44, to engage an outer face of one of the blades 4d and thus insure the pressing of the inner faces of the blades into good electrically conductive engagement with each other. It will be seen that the inturned arms 44 of the clip 2d extend far enough so that when the clip is slipped over the blades 4d it will engage the outer faces thereof throughout their width. The clip 2d is also of sufficient length so that it engages the outer faces of the blades 4d substantially throughout their overlap.

In order to effect the interlocking of the terminals against lengthwise or sidewise displacement or disconnection, each of the inturned arms 44 of the clip is provided with a spring tooth 45 stamped up from the material of the arm in such manner that when the clip 2d is slipped over the blades 4d sidewise these teeth 45 will spring into the openings 40 in the two blades, the dimensions of the teeth 45 lengthwise of the blades being substantially equal to, but slightly less than, the lengthwise dimension of the openings 40 whereby the teeth 45 serve not only to prevent lengthwise displacement of the blades 4d but also to resist sidewise displacement thereof. When the blades are to be separated any direct pull or push is ineffective; but, due to the spacing between the back of the clip 2d and the edge of the blades 4d, the blades can be swung to an angle, pushed toward the clip, so that the sloped latch portions 46 are depressed, then swung further until it is freed from the clip.

In the form of the invention shown in Figure 11, the blade construction is substantially identical with that shown in Figures 9 and 10 but the means for preventing lengthwise and sidewise displacement of the blade has been modified somewhat. Instead of the stamped up spring teeth 45 as shown in Figure 10, the means for engaging the openings 40 of the blades and locking the blades against lengthwise and sidewise displacement comprise bosses 45e stamped up on the arms 44e of clip 2e and of substantially the outline of the holes 40 so that when sprung into position in the holes 40 they effect the desired retention of the blades against lengthwise and sidewise displacement. It will be seen that the edges of the bosses 45e which engage the sides of the openings 40 are sufficiently rounded so that the clip may readily be sprung into interlocking relation to the blades 4e and equally readily sprung out of such interlocking relation.

In the form of the invention shown in Figure 12, the interlocking of the blades 4f there shown against lengthwise and sidewise displacement is effected by stamping each blade with a projection 30f on one face and a recess 32f on the other face for cooperation respectively with recess 32f or projection 30f of the adjacent blade and then providing a clip 2f having the inturned arms 44f thereof so curved at 56 as to span the projection 30f while engaging the blade on both sides.

In the form of the invention shown in Figures 13 to 15, inclusive, the clip 2g, as shown, comprises simply straight inturned arms 44g which smoothly engage the smooth outer faces of the blades 4g shown in this form of the invention, the interlocking of these blades, when the connector is assembled, being effected by upturned ears 32g engaging the oblique shoulders 30g

7

which connect the neck portion 64 with the blade portion 4g thereof, the neck portions 64 being preferably integral with the ferrule 24g as well as the blade 4g. It will be seen that, when these blades are assembled in the relation shown in Figures 13 to 15 and the spring clip 2g is sprung into clamping relation thereto as shown in Figure 15, the ears 32g, engaging the oblique shoulders 30g on each of the enlarged blades 4g, will effectively prevent either relative lengthwise or relative sidewise movement of the blades 4g. For disconnection, the clip 2g is slipped off whereupon the blades drop apart.

In the form of the invention shown in Figures 16 and 17, each of the blade portions 4h of the counterpart terminals is provided with a pin or stud 72 which is received in a transversely extending slot 74 of the other blade so that when the blades are brought into face-to-face contact with each other they are locked against lengthwise displacement. Since the slot 74 fits closely against the sides of the pins 72, this construction also obviously resists angular displacement of the blades 4h with respect to each other so long as they are held in face-to-face contact. As shown in Figure 16, the clip 2h, employed to maintain the blade 4h in face-to-face contact in the form of the invention shown in Figures 16 and 17, may be like that shown in Figure 15.

I claim:

1. A connector comprising a contact blade of highly conductive metal constructed and arranged to be brought into overlapping engagement with a counterpart connector with extensive face-to-face contact, means for securing a counterpart blade in pressed face-to-face contact, and resiliently releasable interlocking means mounted on said connector and adapted to lock the counterpart connector against sliding withdrawal while in face-to-face contact.

2. A connector according to claim 1 in which the means for securing the counterpart blade in pressed face-to-face contact comprises a clip of a more highly resilient metal composition than that of the blade.

3. A connector according to claim 1 in which the means for securing the counterpart blade in pressed face-to-face contact comprises a clip of a more highly resilient metal composition than that of the blade, secured to the blade and extending from one edge across its contact face.

8

4. A connector according to claim 1 in which the means for securing the counterpart blade in pressed face-to-face contact comprises a clip of a more highly resilient metal composition than that of the blade, secured to the blade and extending from one edge across its contact face, and the interlocking means is a catch on the end of said clip adapted to snap over and engage the opposite edge of the counterpart terminal.

5. A connector comprising a blade member having a face adapted to make a face-to-face contact, means for connecting said blade member to a conductor, means for holding the face of a counterpart blade member pressed against said face of said blade member, and releasable spring catch means adapted to lock said blade member against sliding disengagement when coupled to a counterpart blade member.

6. A connector comprising two portions, each of said portions having a face section for positioning one against the other; interlocking means to prevent movement of the sections in the plane of the respective faces; and gripping means for preventing separation of the two sections in a direction normal to the plane of their faces; said gripping means being a U-shaped spring clasp applied to said portions in the plane of the faces.

7. A connector comprising two portions, each of said portions having a face section for positioning one against the other, interlocking means to prevent movement of the sections in the plane of the respective faces, gripping means for preventing separation of the two portions in a direction normal to the plane of their faces, and said gripping means being movable with respect to one of said portions and the plane of the faces.

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