May 4, 1965 P. K. TURNER 3,182,282

ELECTRICAL CONNECTION

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Fig. 1.

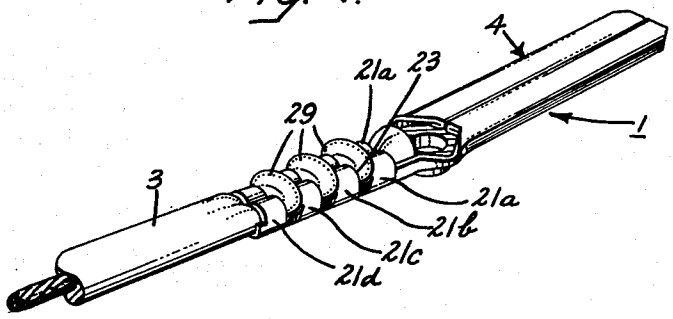


Fig. 2.

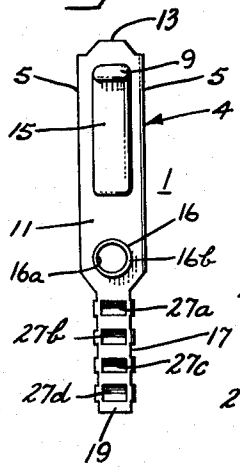


Fig. 3.

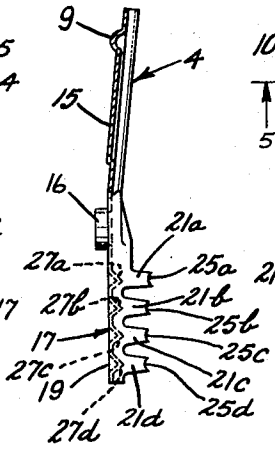


Fig. 4.

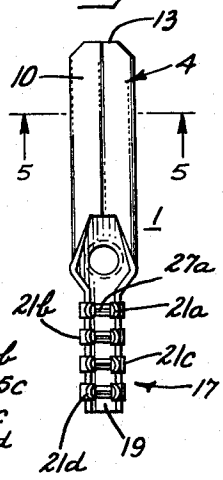


Fig. 5.

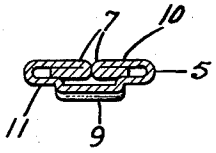


Fig. 6.

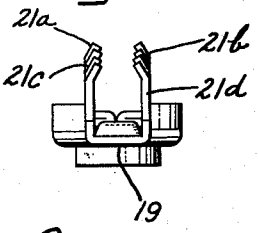


Fig. 7.

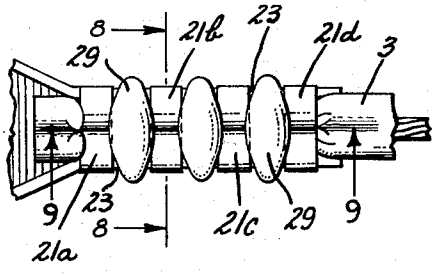
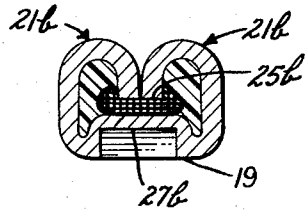


Fig. 8.



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ELECTRICAL CONNECTION

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Fig. 9.

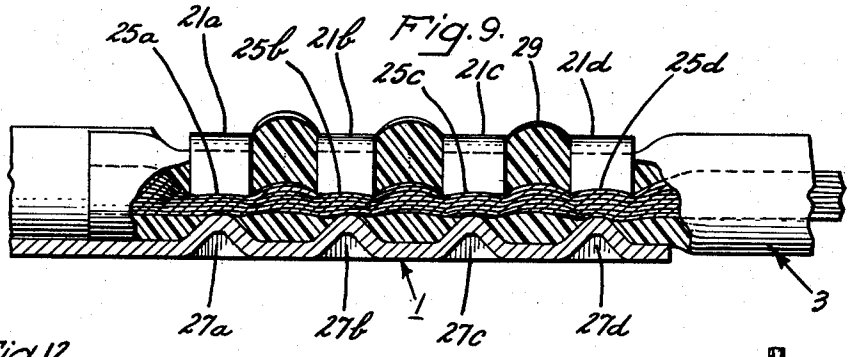


Fig. 12.

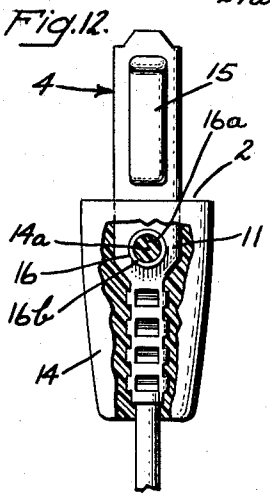
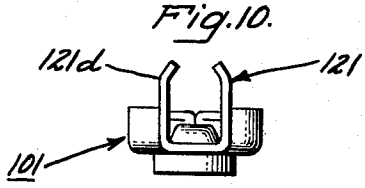


Fig. 10.



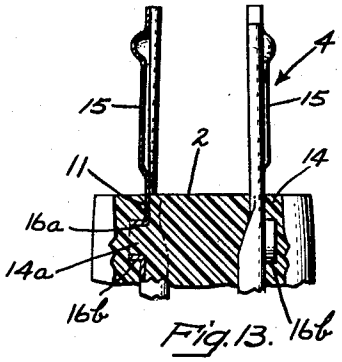
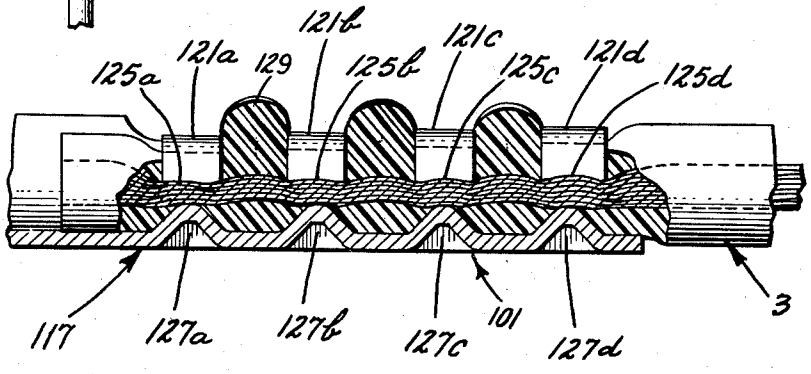


Fig. 13.

Fig. 11.



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United States Patent Office

3,182,282

Patented May 4, 1965

3,182,282

ELECTRICAL CONNECTION

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Filed Oct. 29, 1962, Ser. No. 233,756
10 Claims. (Cl. 339—97)

The present invention relates to crimped electrical connections and particularly to an electrical connector which can be crimped to an insulated conductor to provide a permanent and mechanically strong electrically conductive connection therebetween.

To commercially manufacture nearly all kinds of electrical apparatus and wiring circuits, it is necessary to electrically connect the ends of wires or insulated conductors to some other electrical conducting element, such as a terminal connector. One form of prior art connection which has seen widespread use for electrically connecting a wire to a terminal connector involves the use of "solderless" connectors which are compressed or "crimped" onto the bare wire of an insulated conductor from which the insulation has been removed in a prior operation. Another form of prior art connection utilizes a portion of the terminal connector to pierce through the insulation of the insulated conductor in order to make electrical connection to the wire portion thereof. This latter form of terminal connector has the advantage of not requiring the prior removal of insulation to permit the making of the electrical connection. In prior art forms of insulation piercing terminal connectors, the cold flow characteristics of commonly used wire insulation materials (such as, for example, poly-vinyl chloride) have reduced the electrical efficiency of the connection. More specifically, the cold flow characteristics of these insulative materials have resulted in the ultimate reduction of pressure forces between the terminal connector and the wire of the conductor, thereby increasing the resistance of the electrical joint and limiting the value of electrical current for which the terminal connector is suitable. For certain types of electrical apparatus, it is very important that these crimped terminal connectors be fastened to their associated conductors in such a manner that a secure electrical and mechanical connection is achieved which is capable of withstanding severe wear and tear and rigorous day to day usage. The present invention contemplates an improved crimped electrical connection which effectively satisfies such requirements of secure electrical and mechanical connection.

An important object of the present invention is to provide a new and improved crimped electrical connection which has an enhanced reliability.

It is another object of the present invention to provide an improved connection which is achieved by the novel cooperation between a terminal connector and an insulated conductor, and affords an excellent electrical contact with high mechanical strength.

It is another object of my invention to provide an improved terminal connector which can be applied to insulated electrical conductors without the need for prior removal of the insulation from the conductor.

It is another object of my invention to provide an improved insulation pierce type of terminal connector of relatively high current carrying capacity.

A further object of my invention is to provide an improved terminal connection for an insulated conductor, which connection is of simplified construction and may be very economically manufactured.

In carrying out my invention, in one form thereof, I have provided an improved electrical and mechanical connection for a terminal connector and an insulated electrical conductor. The connector includes a contact portion for electrical engagement with a mating contact

of another wiring device, and a conductor accommodating portion for electrical and mechanical attachment to the insulated end of the conductor. The conductor receiving portion includes a series of spaced apart parallel pairs of opposed fingers curled over toward each other to form a ferrule. This ferrule includes a series of transverse gaps disposed respectively between adjacent pairs of the opposed fingers. With such an arrangement, the insulated end of the conductor is positioned in the conductor accommodating portion of the conductor and the fingers thereof are crimped into insulation piercing engagement with the conductor to establish an electrical contact. When the fingers are crimped into engagement with the insulated conductor the gaps between the fingers allow the relief flow of insulation outwardly therefrom. This relief flow of conductor insulation is in the form of transverse sections of insulation which bulge outwardly from the gaps. The transverse bulging of the insulation from the gaps allows a very efficient electrical connection to be formed between the terminal connector and the conductor. Such a connection has a very high current carrying capacity, improved dimensional and electrical stability over a long period of time and a secure mechanical joint.

Further aspects of my invention will become apparent hereinafter and the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which I regard as my invention. The invention, however, as to organization and method of utilization, together with further objects and advantages thereof, may best be understood by reference to the following description, when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view showing an improved connector contact blade connected to a conductor in accordance with one form of the present invention;

FIG. 2 is a front elevational view of the contact blade of FIG. 1;

FIG. 3 is a side elevation view, partially in section, of the contact blade of FIG. 1;

FIG. 4 is a rear elevational view of the contact blade of FIG. 1;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is a bottom view of the contact blade of FIG. 1;

FIG. 7 is a fragmentary view showing the mode of cooperation between the conductor accommodating portion of the contact blade and its associated conductor end;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 7;

FIG. 9 is a fragmentary sectional view taken generally along the line 9—9 of FIG. 7;

FIG. 10 is a bottom view of a connector contact blade embodying an alternate form of my invention;

FIG. 11 is a fragmentary sectional view of the contact blade of FIG. 10 connected to a conductor;

FIG. 12 is a side elevation view partially in section and partially broken away, of a connector plug which includes the contact blades shown in FIG. 1; and

FIG. 13 is a fragmentary front elevation view of the connector plug of FIG. 12.

Referring first to FIGS. 1–4 and 12 of the drawings, there is illustrated an electrical contact blade 1 for use in a connector plug 2. The plug 2 in which the contact blade 1 embodying my invention is to be incorporated may be of the "molded-on" type, and for such a construction the electrical connections between the contact blades 1 and their associated conductor 3 would be made prior to the molding operation.

The improved contact blade 1 is formed from a very thin sheet of conductive metal, such as, for example,

brass having a thickness in the order of 0.015 inch. As shown by FIGS. 2–4, the contact blade **1** constitutes a two-ply or folded-over type of rigid construction, which in its physical dimensions, accurately conforms to the dimensional requirements of the Underwriters' Laboratories, Inc. More particularly, blade **1** is manufactured by folding over and shaping a contact portion **4** of a thin strip of conductive metal, as shown in FIG. 5, to form longitudinally extending curved sides **5** and abutting curved inner ends **7** (on one side thereof). As illustrated in FIGS. 2–5, the contact portion **4** of blade **1** thus includes two separate elongated coplanar contact surfaces **10** on one side thereof (FIG. 4), and another contact surface **11** (FIG. 2) on the other side thereof opposite surfaces **10**. To provide a detent means for the blade **1**, a transverse embossment or bump **9** is shaped outwardly from the surface **11** of the conductive strip which underlies the curved inner ends **7** (as shown in FIGS. 2 and 5). Embossment **9** projects perpendicularly outwardly from the plane of surface **11** of the blade **1** and extends transversely to the longitudinal axis of the blade. As shown in FIG. 2, the embossment **9** is also located in the center of the strip between the curved sides **5** and extends generally parallel to the outer end **13**. (See also FIG. 4.)

To provide an elongated area of contact thickness for the contact blade **1**, on surface **11** thereof, portion **4** includes an elongated plateau **15**. Plateau **15** provides a uniform contact thickness for each blade and permits a maximum contact pressure to be realized over an elongated longitudinal contact area when the blade is inserted into engagement with a female contact (not shown) of an appropriate receptacle or power outlet. In addition, the plateau **15** serves as a strengthening means for the contact portion **4** of the blade **1**.

To enable the contact blade **1** to be readily interlocked into secure engagement with molded insulating material **14** of the plug **2**, as shown in FIGS. 2, 3 and 12, a swaged eyelet **16** is formed in contact portion **4**. The eyelet **16** includes a round hole **16***a* surrounded by a peripheral rim **16***b* of rigid construction. Rim **16***b* projects perpendicularly outwardly from the plane of surface **11**, as shown in FIG. 13. The insulating material **14** is molded around the lower portion of blade **1**, as shown in FIGS. 12 and 13, and section **14***a* of this material extends through the hole **16***a* and rim **16***b*. The portion **14***a* of the insulating material **14** which extends through the eyelet **16** and the engagement of the outer peripheral surface of rim **16***b* with the molded material **14** serves to provide a very compact structure for enhancing the pull-strength of the contact blade **1** with respect to the plug body. Such an arrangement thus provides a very secure mechanical interengagement between the blade **1** and plug **2**.

Turning now to an important aspect of the present invention whereby an improved mechanical and electrical connection is achieved for a contact, such as the contact blade **1**, attention is now directed to FIGS. 2, 3, 4 and 6. For attaching the two-ply contact blade **1** to an appropriate conductor **3**, a cord accommodating shank portion **17** extends outwardly from the contact portion **4** of the blade **1**, or downwardly as shown in FIGS. 3 and 4. The shank portion **17** includes an elongated U-shaped base section **19** (FIG. 6) and a series of spaced apart pairs of opposed fingers **21***a*–**21***d* which extend outwardly from the opposite sides of base section **19**. The fingers **21***a*–**21***d* are curled over toward each other (as shown by way of example for fingers **21***b* in FIG. 8), to pierce the insulation of conductor **3** and form a ferrule with a transverse gap **23** disposed between each adjacent pair of fingers. Thus, for example, as shown in FIGS. 1 and 7, the opposed pair of fingers **21***a* are crimped over against, into and through the insulation of conductor **3**, and the opposed fingers **21***b* are crimped over against, into and through the insulation of conductor **3**, the fingers **21***b* being spaced apart from fingers **21***a* to provide a transverse gap **23**. An important purpose of the transverse gap **23** as shall be further described hereinafter, is to provide relief or escape for the flow of conductor insulating material when the fingers **21***a*–**21***d* are crimped and pierced into the insulation of the conductor.

Turning now to a more detailed explanation of the structure and function of the insulation piercing fingers **21***a*–**21***d*, attention is directed to FIG. 3. For the illustrated contact blade **1**, the fingers **21***a* include outwardly facing concave ends **25***a*, the fingers **21***b* include outwardly facing concave ends **25***b*, the fingers **21***c* include outwardly facing concave ends **25***c*, and the fingers **21***d* include outwardly facing concave ends **25***d*. The lengths of the fingers **21***a*–**21***d* are progressively varied as shown in FIG. 3 so that for the uncrimped blade **1** the concave end **25***a* is disposed outwardly from base section **19** for a first predetermined distance, the concave end **25***b* of fingers **21***b* is disposed outwardly from base section **19** for a lesser distance, etc. From viewing FIG. 3 of the drawing, it will thus be seen that the concave outer end **25***d* of fingers **21***d* is disposed closest to the base section **19** of the plug blade and the concave end **25***a* of fingers **21***a* is disposed furthest away from base section **19**. The purpose of this dimensional arrangement of the fingers **21***a*–**21***d* shall become apparent hereinafter.

To help assure an effective insulation piercing connection between blade **1** and conductor **3**, on the left side or bight part of base section **19** of the blade **1**, viewing FIG. 3, there are formed a series of four insulation piercing ridges or notches **27***a*–**27***d*, respectively, which together form a corrugated surface. The ridges **27***a*–**27***d* are disposed in transverse alignment with respective pairs of the opposed fingers **21***a*–**21***d* (FIG. 3) and they provide transversely extending projecting edges (FIG. 3) which face toward the right side of base section **19** (viewing FIG. 3) and pierce the insulation of conductor **3** to electrically engage the strands thereof underneath the ends of each pair of crimped fingers. (See FIG. 8.) Thus, more particularly, as shown in FIG. 9, the ridges **27***a*–**27***d* project perpendicularly upwardly from the inner elongated bight surface of base section **19** and extend transversely to the longitudinal axis of the shank portion **17**. Each of the insulation piercing ridges **27***a*–**27***d* is also disposed underneath a pair of insulation piercing fingers **21***a*–**21***d* (as illustrated in FIG. 9).

For a detailed explanation of how the fingers **21***a*–**21***d* and ridges **27***a*–**27***d* of the contact blade **1** coact with the insulated conductor **3** to provide a secure and reliable connection therebetween, attention is now directed to FIGS. 1 and 7–9. The conductor **3** is fastened to the shank portion **17** of the contact blade **1** without requiring any previous removal of insulation from the end of the conductor **3** which is to be fastened to the blade, due to the insulation piercing capability of fingers **21***a*–**21***d* and their opposed respective ridges **27***a*–**27***d*. More particularly, the insulated end of conductor **3** is connected to the shank portion **17** of contact blade **1** by means of a pair of suitably configured crimping dies (not shown). As the dies are closed into engagement with the shank portion **17** of the contact blade **1** (upon positioning the insulated end of the conductor **3** within the U-shaped base section **19** between the fingers **21***a*–**21***d*) sharp cusps or ridges of one of the dies turn inwardly the opposed ends **25***a*–**25***d* of each pair of fingers **21***a*–**21***d*, as illustrated in FIG. 8. When the concave ends **25***a*–**25***d* of the fingers **21***a*–**21***d* are all turned inwardly, they pierce the insulation of conductor **3**, as indicated in FIG. 9. In addition, as the fingers **21***a*–**21***d* are crimped into compressive engagement with the conductor **3**, the inner edges of ridges **27***a*–**27***d* also pierce the insulation of conductor **3**.

To help enable the ends **25***a*–**25***d* of the fingers, and the ridges **27***a*–**27***d* to effectively pierce the insulation of the conductor **3** and also at the same time provide a

secure electrical and mechanical connection between the contact blade **1** and the conductor **3**, during the crimping operation the transverse gaps **23** allow the relief flow of the insulation material surrounding the conductive strands, in response to the compressive forces exerted upon the fingers **21***a*–**21***d* by the crimping dies. This relief flow of the insulation material through the gaps **23** forms transverse bulges **29** of insulation between each pair of opposed fingers **21***a*–**21***d* and a spaced apart adjacent pair of these fingers. By providing a means for relief flow of the conductor insulation material in response to the crimping forces an excellent electrical connection is obtained between the blade **1** and conductor **3**. Such a connection has very stable electrical resistance characteristics and a relatively high current carrying capacity.

As shown in FIG. 1, the bulges **29** of insulation have their long axes in a direction perpendicular to the longitudinal axis of shank portion **17**, and they provide an effective means for mechanical cooperation between the conductor **3** and the contact blade **1**, which achieves excellent pull-out strength.

To further explain the mode of coaction in the illustrated connection between the fingers **21***a*–**21***d*, the ridges **27***a*–**27***d*, and the gaps **23**, as shown in FIG. 9, the axes of the transverse ridges **27***a*–**27***d* are disposed respectively directly underneath the concave insulation piercing ends **25***a*–**25***d* of the fingers **21***a*–**21***d*. With such an arrangement, the opposed fingers of each pair, such as for example, the fingers **21***a*–**21***d*, are crimped into engagement with a portion of the conductor which is sandwiched between them and their underlying notch, such as for example, ridge **27***a*, so that their free ends pierce the insulation, which flows into the transverse gaps **23** (FIG. 7) formed between the fingers. The effect which the crimping of the fingers **21***a*–**21***d* has upon the conductor **3** is similar to that of upper dies (i.e., fingers **21***a*–**21***d*) acting upon lower dies (i.e., the ridges **27***a*–**27***d*) and the conductor material which is compressed between the fingers and ridges has a wave-shaped contour (FIG. 9) in consonance with the configurations of the concave ends **25***a*–**25***d* of the fingers and their centrally associated ridges **27***a*–**27***d*. Since both the apexes of ridges **27***a*–**27***d* and as the concave ends **25***a*–**25***d* of the fingers, pierce the insulation to electrically engage the conductor strands (as shown in FIG. 8) the conductor is intimately clamped between the fingers and their associated ridges. This provides a high quality metal-to-metal contact with very good durability and without in any way damaging the strands of the conductor during the crimping operation.

As previously set forth, the fingers **21***a*–**21***d* are progressively longer between the outer end of the shank portion **17** (i.e., the lower end of sank portion **17**, viewing FIG. 3) and its inner end (i.e., the upper end of shank portion **17**, viewing FIG. 3). With such an arrangement, when crimping dies of uniform size (i.e., depth) are utilized for attachment of the shank portion **17** to conductor **3**, as shown in FIG. 9, the concave ends **25***d* of finger **21***d* will compress the insulation and the conductive material of conductor **3** to a less extent than will the concave ends **25***c* of the fingers **21***c*. In addition, the concave ends **25***b* of fingers **21***b* compress the conductive wires of conductor **3** to a greater extent than the fingers **21***c* but to a lesser extent that the concave ends **25***a* of the fingers **21***a* compress their underlying conductive wires. As a result of the progressively variant compression of conductor **3** by the fingers **21***a*–**21***d*, the bulges **29** project outwardly and away from the axis of the conductor at progressively varying heights and radii of curvature. Thus, more particularly, the bulge **29** of insulation between fingers **21***a* and **21***b* has a somewhat greater height and radius of curvature than the bulge **29** between fingers **21***b* and **21***c* and the bulge **29** between fingers **21***b* and **21***c* has a somewhat greater radius of curvature than the bulge between fingers **21***c* and **21***d*. With such a structural arrangement, the tightest connection is achieved between the shank portion **17** of the contact blade **1** and the conductor at fingers **21***a* (see FIG. 9). The degree of tightness with which fingers **21***b* engage conductor **3** is somewhat less than the degree of tightness with which fingers **21***a* engage the conductor. In addition, the degree of tightness with which fingers **21***c* engage conductor **3** is somewhat less than for fingers **21***b* and the degree of tightness achieved by fingers **21***d* (at the entry location for the conductor) is minimal when compared with fingers **21***a*, **21***b* and **21***c*. Such an arrangement (i.e., the progressively variant tightness obtained by using insulation piercing fingers of different lengths) is desirable because it achieves an efficient strain relief effect between the shank portion **17** of the blade and the conductor **3** where the conductor enters the contact blade, and it also conveniently lends itself to wider manufacturing flexibility by enabling the contact blade to be effectively secured to wires of variable insulation thicknesses and contact metal thicknesses. This approach also helps to compensate for other manufacturing variables involved in connecting the blade **1** to the conductor **3**, such as for example the unintentional variance in crimping heights, and variances in positioning and piercing the conductor. Thus, by using insulation piercing fingers **21***a*–**21***d* of progressively varying lengths and tightnesses an effective strain relief is provided at the mouth of the contact blade **1** and a very broad range of tolerances is permitted for effectively connecting the contact blade **1** to the conductors.

FIGS. 10 and 11 represents a modified form of my invention wherein a contact blade **101** has been employed. Blade **101** is similar to blade **1**, except for some variance in the structure of the insulation piercing fingers **121***a*–**121***d*. For blade **101**, the component parts and sections thereof shown in FIGS. 10 and 11, which have a structural similarity to their correlative parts for blade **1**, and perform the same basic functions, are identified by the same two reference numerals with the numeral **1** prefixed thereto.

The basic difference between contact blade **101** and contact blade **1** resides in the fact that the contact blade **101** is originally manufactured with all of its insulation piercing fingers **121***a*–**121***d* having the same length (FIG. 10). When shank portion **117** of the contact blade **101** is crimped to the insulated conductor **3**, the die sections (not shown) are of nonuniform and progressively variant configuration to provide progressively different heights. Thus, as shown in FIG. 11, the fingers **121***a* have their upper curved surfaces pressed down from above to a greater extent than that of fingers **121***b*, fingers **121***b* are pressed downwardly by the die to a greater extent that the fingers **121***c*, and the fingers **121***d* have their upper surfaces pressed downwardly the least amount. Transverse notches **127***a*–**127***d* are provided and disposed relative to curled over fingers **121***a*–**121***d* in the same arrangement as described above for ridges **27***a*–**27***d*. With this arrangement, the coaction and cooperation between the concave ends **125***a*–**125***d* of the respective insulation piercing fingers **121***a*–**121***d* and the insulation and conductive wires of the conductor **3** is identical to the effect achieved by the fingers **21***a*–**21***d* of the contact blade **1** (i.e., in the same manner as is shown in FIG. 8). By using a die with a progressively varying height configuration together with insulation piercing fingers **121***a*–**121***d* of the same length, the efficient strain relieving effect and wide manufacturing flexibility for blade **101** are obtained to the same extent and in the same manner as previously described for blade **1**.

It will now, therefore, be seen that my new and improved connection for a contact and conductor as illustrated herein provides for the novel and effective securement of these two members together. It will be further understood that my invention provides a simplified and

efficient means for electrically and mechanically connecting a terminal connector to an insulated conductor and thereby obtaining a connection of very high current carrying capacity. The connection of my invention also provides an improved dimensional and electrical stability over a long period of time, and it is very strong mechanically. A connector plug of improved overall mechanical strength has also been provided.

While in accordance with the patent statutes, I have described what at present are considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I, therefore, aim in the following claims to cover all such equivalent variations as fall within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electrical terminal connection for an insulated conductor and a contact, said contact comprising a portion for receiving said conductor, said conductor receiving portion including a plurality of pairs of opposed fingers and a corrugated surface with the corrugations and the fingers extending transversely to the longitudinal axis of said conductor, the fingers of each pair being curled over toward each other and over said corrugated surface to form with the corrugated surface a ferrule for gripping the conductor, the free ends of said fingers and the inner edges of the ridges of the corrugations being arranged in insulation piercing electrical engagement with said conductor, said conductor being compressed between said fingers and said corrugations, each pair of said fingers being spaced apart from an adjacent pair of said fingers by a transverse gap, with a portion of insulation from said conductor bulging outwardly by relief flow from said gap between adjacent pairs of said fingers thereby to enhance the electrical and mechanical connection between said conductor and said contact.

2. An electrical connection for securing an insulated conductor to another device, said connection comprising a contact including a portion for receiving said conductor, said portion including a plurality of spaced apart parallel fingers and a corrugated surface with the corrugations and the fingers extending transversely to the longitudinal axis of said conductor, the lengths of said fingers progressively increasing in length between one end of said conductor receiving portion and the other end of said portion, said fingers curled over said corrugated surface to form with the corrugated surface a ferrule for gripping the conductor, the free ends of said fingers and the inner edges of the ridges of said corrugation being arranged in insulation piercing engagement with said conductor thereby to establish electrical engagement between said contact and conductor, said fingers being crimped into engagement with said conductor with uniform heights to provide progressively increasing degrees of tightness between the one end of said conductor receiving portion and the other end thereby compressing said conductor into waves of increasing magnitude, each adjacent parallel finger being spaced apart by a gap extending therebetween in a direction transverse to the longitudinal axis of the conductor, said fingers of said conductor receiving portion of said contact being crimped into electrical and mechanical engagement with the insulated conductor so that a portion of insulation from said conductor bulges outwardly by relief flow from said gap and cooperates therewith thereby to enhance the electrical connection and strengthen the mechanical connection between said conductor and said contact, the magnitude of said bulges increasing with the increasing tightness of the engagement of the adjacent fingers

3. An electrical connection for an insulated conductor and a contact, said contact comprising a portion for receiving said conductor, said conductor receiving portion including a plurality of pairs of opposed fingers and a corrugated surface with the corrrugations and the fingers extending transversely to the longitudinal axis of said conductor, the lengths of said opposed fingers of each pair being of substantially the same length, the fingers of each pair being curled over toward each other and over said corrugated surface to form with the corrugated surface a ferrule for gripping the conductor, the free ends of said fingers and the inner edges of the ridges of said corrugations being arranged in insulation piercing engagement with said conductor thereby to establish electrical engagement between said contact and conductor, the pair of fingers being crimped into engagement with said conductor with nonuniform heights to provide progressively increasing degrees of tightness between one end of said conductor receiving portion and the other end, each pair of said fingers being spaced apart from an adjacent pair of said fingers by a gap extending therebetween in a direction generally perpendicular to the longitudinal axis of said conductor, said conductor receiving portion of said contact being crimped into electrical engagement with the insulated conductor with a portion of insulation from said conductor bulging outwardly by relief flow from said gap thereby to enhance the electrical and mechanical connection between said conductor and said contact.

4. An electrical connection for securing an insulated conductor to another device, said connection comprising a contact including a ferrule portion for receiving said conductor, said ferrule portion including a plurality of spaced apart pairs of opposed fingers, each pair of said fingers extending in a plane perpendicular to the longitudinal axis of said conductor, the fingers of each pair being curled over toward each other for gripping said conductor and piercing the insulation thereof, and a plurality of ridges one of which is disposed underneath the free ends of each pair of fingers and arranged in clamping association therewith for piercing the insulation of said conductor, each of said ridges extending transversely to the longitudinal axis of the conductor and being generally located in the same plane as its associated fingers, each pair of said fingers being spaced apart from an adjacent pair of said fingers by a gap extending therebetween in a plane perpendicular to the longitudinal axis of said conductor, said pairs of said fingers and their associated ridges being arranged to electrically engage said conductor by piercing the insulation thereof and coacting in compression with the conductor and said insulation so that a transverse portion of said insulation bulges outwardly from said gap by relief flow thereby to provide a reliable and stable connection of high current carrying capacity and good mechanical strength.

5. The connection of claim 4 wherein the lengths of the opposed fingers of each pair are the same and the pairs of fingers have progressively increasing lengths between one end of said conductor receiving portion and the other end of said portion, said pairs of fingers being crimped into engagement with said conductor with uniform heights to provide progressively increasing degrees of tightness between the one end of said conductor receiving portion and the other end thereof.

6. The connection of claim 4 wherein the lengths of said fingers are substantially the same and the free ends of said pairs of fingers are crimped into compressive engagement with said conductor with nonuniform heights to provide progressively increasing degrees of tightness between one end of said conductor receiving portion and the other end thereof.

7. The connection of claim 4 wherein the lengths of the opposed fingers of each pair are the same and the pairs of fingers are arranged so that they pierce the insulation and engage the conductor with progressively increasing tightness between an end of said conductor receiving ferrule portion where the conductor enters said contact and the oher end of said ferrule portion.

8. An electrical connection for securing an insulated conductor to a contact, said contact comprising a conductor receiving portion, said portion including a plurality of pairs of opposed fingers, the fingers of each pair being curled over toward each other for gripping said conductor and piercing the insulation thereof, and a ridge disposed underneath each pair of fingers adjacent the free ends thereof for piercing the insulation of said conductor, each pair of said fingers being spaced apart from an adjacent pair of said fingers by a gap extending therebetween, said fingers and said ridges being arranged to pierce the insulation of said conductor for electrically engaging said conductor, said fingers each having a concave end which overlies the respective ridge when said fingers are fully curled over thereby to compress the metal in said conductor against said ridge and shape it over said ridge and said fingers and said ridges and coacting in compression with said insulation so that portions thereof bulge outwardly by relief flow from said gap thereby to provide a reliable and stable electrical connection of high current carrying capacity and mechanical strength.

9. An improved connector plug comprising a body of molded insulating material, at least one elongated contact extending outwardly from said body, each contact including a flat portion partially imbedded in said molded insulating material and a conductor receiving portion wholly embedded in said molded insulating material, and an eyelet formed in said flat portion, said eyelet having an annular lip projecting perpendicularly outwardly from the plane of said flat portion and being imbedded in said insulating material, portions of said insulating material extending through said eyelet and surrounding said lip thereby to securely anchor said contact to said insulating body, said conductor receiving portion including a plurality of pairs of opposed fingers and a corrugated surface with the corrugations and the fingers extending transversely to the longitudinal axis of said conductor, the fingers of each pair being curled over toward each other and over said corrugated surface to form with the corrugated surface a ferrule for gripping the conductor, the free ends of said fingers and the inner edges of the ridges of the corrugations being arranged in insulation piercing electrical engagement with said conductor, said conductor being compressed between said fingers and said corrugations, each pair of said fingers being spaced apart from an adjacent pair of said fingers by a transverse gap, with a portion of insulation from said conductor bulging outwardly by relief flow from said gap between adjacent pairs of said fingers thereby to enhance the electrical and mechanical connection between said conductor and said contact, portions of said plug insulation material extending into the grooves formed by the back of said

ridges and in between the bulging rib portions of said conductor to further securely anchor said contact to said insulating body.

10. For use in a connector plug having a molded insulating body, a pair of elongated contact blades extending outwardly from said body in spaced parallel relationship, each of said blades including a conductor receiving portion and a flat section embedded in said molded body and with an extruded eyelet formed in said flat section, said eyelet having an annular lip projecting outwardly from the plane of said flat section and embedded in said insulating material with portions thereof extending through said eyelet and surrounding said lip thereby to securely anchor said blade to said body, said contact blade also including a conductor receiving portion, said conductor receiving portion including a plurality of pairs of opposed fingers and a corrugated surface with the corrugations and the fingers extending transversely to the longitudinal axis of said conductor, said conductor receiving portion embedded in said body, the fingers of each pair being crimped over toward each other and over said corrugated surface to form with said corrugated surface a ferrule for gripping an insulated conductor, each pair of said fingers being spaced apart from an adjacent pair of said fingers by a gap extending therebetween in a direction generally perpendicular to the longitudinal axis of said conductor and parallel to said corrugations, said conductor receiving portion of said contact being crimped into electrical engagement with the insulated conductor with a portion of insulation from said conductor bulging outwardly by relief flow from said gap thereby to enhance the electrical and mechanical connection between said conductor and said contact.

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