

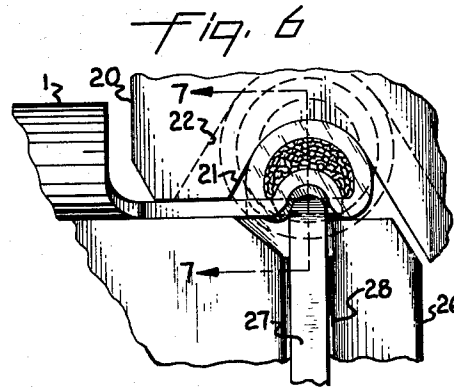
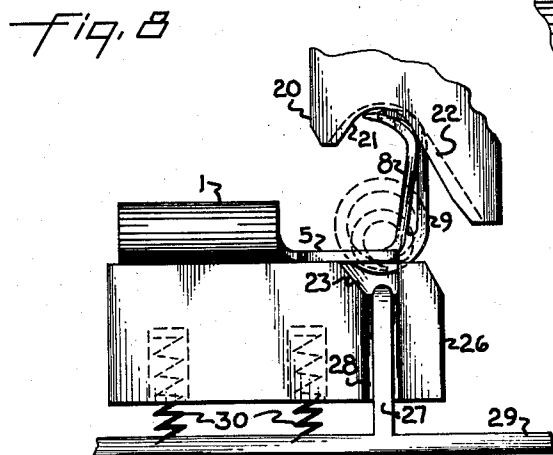
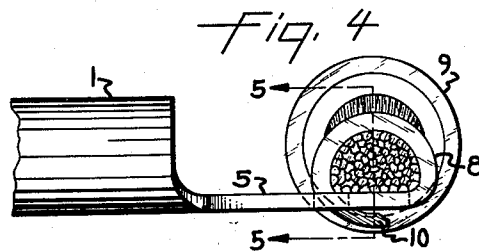
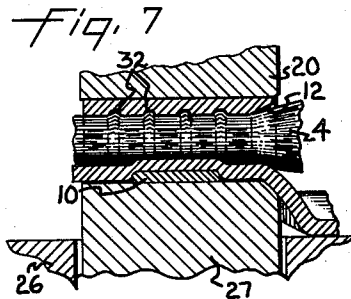
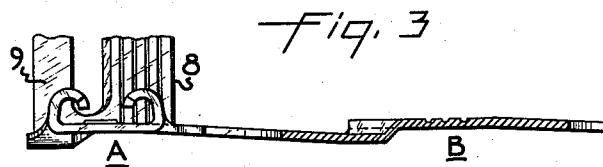
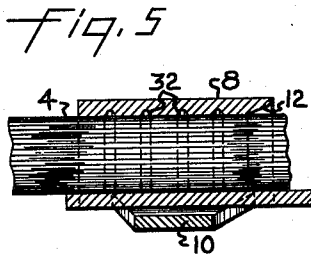
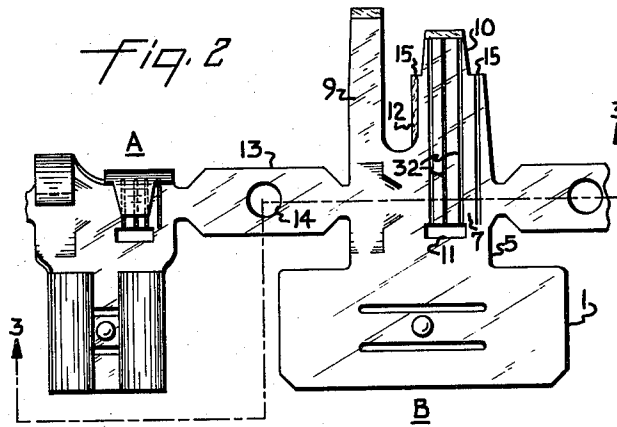
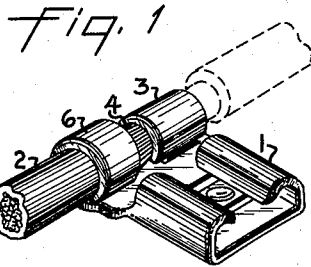
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ELECTRICAL CONNECTORS

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ELECTRICAL CONNECTORS

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This invention relates in its presently preferred forms to electrical terminals of the flag or lateral tongue type and more particularly to the terminal ferrules or barrels from which the flag contact member extends and to methods for forming the same as an electrical connection with a wire conductor.

Heretofore, it has been the practice where a terminal of the flag type is desired to provide a contact member with a laterally extending tongue which, in application, is simply wrapped around a bared conductor. To secure the terminal on the wire, reliance is placed either on tight wrapping of the tongue or on brazing. The wrapped connection is ineffective, however, where any significant lateral tension is involved since the stresses, amplified by acting at a moment arm equal to the diameter of the ferrule, imposed on the wire transversely of the ferrule tend to unwrap the tongue. Any opening of the ferrule, of course, decreases the electrical conductivity of the connection between the wire and the contact member, but in addition, renders the contact surface accessible to the corrosion. Such flag terminals are further limited in the application in that for each wire size, a separate size ferrule-forming tongue is required to obtain optimum ferrule formation. That is, the principles of crimping a ferrule having a given diameter onto wires of various sizes cannot be utilized with the simple wrapped barrel inasmuch as such ferrules cannot withstand the pressures involved in the crimping operation without unwrapping.

On the other hand, to braze the seam of a wrapped barrel constitutes an additional step in the formation of the electrical connection, which is time-consuming, expensive, and requires complicated machinery to effect automatically.

It is, therefore, a primary object of this invention to provide an electrical connection of high quality but low cost.

Another object of the present invention is to provide an improved method and means for making a pressure-formed electrical connection of the flag contact type.

A further object is to provide in a terminal a ferrule capable of being applied to wire conductors of various diameters.

Still another object is to provide a method and means for closing and latching the wire supporting ferrule of a terminal.

A still further object is to provide a flag type terminal having a latched wire supporting ferrule which may be applied at any point along the length of a conductor by semi-automatic or automatic means.

Additional objectives reside in the provisions of a commercially feasible organization which will be substantially foolproof in use and overcomes certain well known disadvantages inherent in the prior art.

Other important features and objects of the invention to which reference has not been made above will become apparent in the following detailed description and claims,

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when considered in conjunction with the accompanying drawings.

Figure 1 is a perspective view of a terminal according to the present invention as applied to an electrical conductor;

Figure 2 is a plan view of a strip of connector blanks in accordance with the present invention;

Figure 3 is a view in elevation of the connector blank strip taken along line 3-3 of Figure 2;

Figure 4 is a side view of the terminal in an intermediate stage in the application thereof to an electrical conductor;

Figure 5 is a sectional view taken along line 5-5 of Figure 4;

Figure 6 is a side view illustrating the terminal in the final stage of application to an electrical conductor;

Figure 7 is a sectional view taken along line 7-7 of Figure 6; and

Figure 8 is a side view of the terminal positioned in the applicator die prior to the application.

Referring to Figure 1, there is shown an electrical connector or terminal which includes a contact member 1 of the flag or laterally extending tongue type electrically coupled, in accordance with the principles of the present invention, either to the end or intermediate the length of an electrical conductor 2. The precise form and characteristics of contact member 1 are, in general, immaterial to my invention, but may typically take the form of a receptacle for a tab contact, as shown, or may simply be a ring or spade tongue for cooperation with a binding post. In addition while my invention is to be primarily described in connection with flag-type terminals, contact member 1 may alternatively be positioned in the more conventional end-wise arrangement as desired.

To affix the terminal to the conductor, a laterally extending tongue integral with contact member 1 is curled to form a wire supporting barrel or ferrule 3 about a bared portion 4 of conductor 2, the end of the tongue being crimped or indented into the terminal body as will be described in detail hereinafter. Thus latched, ferrule 3 is rendered capable of withstanding transverse stresses at least to the degree normally encountered in terminals of this type without uncurling of the ferrule-forming tongue. An additional ferrule 6, serving mainly to support the insulated portion of conductor 2, may be provided if desired. No great amount of lateral stress is involved in this function and accordingly ferrule 6 may be of the conventional wrapped form. Ferrule 6 additionally serves to prevent the conductor wire from being sharply bent, and perhaps cut, at the point of entering ferrule 3. In this connection to further insure against the wire being cut, the inner side edges of ferrule 3 may be chamfered or swaged as at 12 in Figure 5, to bell the ferrule mouth and thus remove sharp corners at the bending point.

The terminals or connectors of my invention are contemplated to be formed from sheet metal material by conventional blanking techniques, a typical shape for the blank after leaving the blanking dies being generally designated at B in Figures 2 and 3. Preferably, the terminal blanks are stamped in a continuous strip from sheet metal material whereby the terminals may be advantageously handled in reel form by automatic applicator machines, although my invention also embraces terminal blanks in single form. In the connected strip, however, the blanks are joined end-to-end by a connecting link 13 which is sheared off the terminal body in the application of the terminal to a conductor. Link 13 in length will be dependent on the nature of contact member 1, and if sufficiently long such link provides a convenient means for carrying registration indicia, for example aperture

14, by which the feed of the strip within the automatic machines operating thereon may be controlled.

It is preferred that the terminal or connector blanks be partially preformed to the extent which facilitates application of the terminals, hence, the strip of blanks are formed, as exemplified by the terminal blank generally designated at A in Figures 2 and 3, with the ferrule-forming tongues upstanding and slightly curled at the ends which simplifies the applicator die arrangement and operation as will be described. Where the terminal or connector is to be employed only as a termination at the end of a wire, the ferrules may, of course, be more fully preformed to a generally cylindrical cross-section. In either case it is to be understood that the terminals in a finally processed strip will be substantially identical in shape, the transition from generally flat form of blank B to the preformed or processed blank, such as blank A, in Figure 2 being accomplished by forming dies in successive stages according to techniques well known in the art.

In the application of the terminal the wire supporting tongue is curled to a cylindrical cross-section with the end thereof securing the tongue in ferrule-forming position, which requires substantial bending and stressing of the sheet metal material from which the blank is formed. While the physical properties of the metal may be limited in selection and controlled by the characteristics desired in the terminal or connector portion, such as contact member 1, in general the metal chosen need not be so soft as to prevent spring-back tendencies after application, nor should it be so hard as to invite cracking during application. For the specific contact member illustrated in Figure 1, cartridge brass three-quarters hard gives the desired characteristics therein, such material also being satisfactory for the purposes of my invention.

As shown in Figure 2, the blanks include a base section 7 which will provide the root or bottom portion of the ferrules to be formed. Contact member 1, through shank 5, is integrally connected to and extends laterally from one side from base section 7, while tongues 8 and 9, ultimately to form ferrules 3 and 6 respectively, extend from the other side of base section 7. Tongue 8 is reduced in width at end portion 10, defining shoulders 15 therebetween, which is adapted to be inserted in a slot 11 formed in shank 5 adjacent base section 7. Upon curling or rolling tongue 8 around the bared portion 4 of conductor 2, tongue end 10 is threaded through slot 11 until shoulders 15 abut the edges of slot 11 and preferably is of sufficient length to extend along the underside of the base section 7 to a point slightly beyond the longitudinal center line thereof as shown in Figure 4.

An important feature of my invention resides in the capability of the terminal to accommodate wires of various sizes, and to insure good electrical conductivity characteristics the wire barrel should be crimped or indented so as to compact the metal of the bared conductor within the indented area. The crimping or indenting action may be advantageously combined with the action required to secure the tongue end 10 in ferrule-forming position through utilization of the method and means of my invention, now to be described, which precludes deleterious loosening of the wire barrel.

With reference to Figure 8, the applicator dies for affixing the terminal on a conductor typically comprise a movable upper die block 20, resiliently mounted lower block 26 and a stationary indenter 27. The die nest may conveniently be mounted or installed in a power press (not shown) or other suitable mechanism capable of forcing the die parts together with sufficient pressure to effect the formation and crimping of the barrels. While such mechanism may be part of an automatic applicator machine utilizing terminals by the reel, the die nest may also comprise the opposed jaws of a pliers-type tool or the like. The upper die block is channeled to provide a pair of rounded faces 21 and 22, die face 22 serving to form

the insulation barrel and preferably has a radius of curvature slightly tighter than the curvature of the insulated portion of the conductor whereby tongue 9 will be tightly wrapped thereon. Die face 21 serves to form the wire barrel and, although having a radius of curvature slightly greater than the curvature of the wire sizes to be used for the given size terminal, is primarily designed to curl tongue 8 into a generally cylindrical cross-section in a manner which results in tongue end 10 being threaded through slot 11. In practice, upper die 20 may conveniently be formed by cutting die faces 21 and 22 in separate plates which are then secured together by any suitable means such as bolts. In this connection, as the insulation thickness for a given wire size may radically vary, the formation of die faces 21 and 22 in separate plates is preferred whereby the plates may then be made relatively adjustable to permit of a variable diameter for the insulation ferrule for a given diameter of wire-supporting ferrule.

Lower die block 26 mainly serves to support the body of the terminal while the ferrules are formed and crimped, a recess 23 curved to conform with the base of the insulation supporting ferrule providing means for registering the terminal in the die nest. Slot 28, extending through die block 26 in alignment with the position at which the wire barrel is to be positioned, serves as a guide for bringing indenter 27 into engagement with the bottom of ferrule 3 and tongue end 10 (see Figures 6 and 7). Lower die block 26 is resiliently mounted, as by springs 30, on a base 29 such that during the final stages of applying a terminal as die 20 moves downwardly, die block 26 is forced towards base 29 against the tension of springs 30 to cause indenter 27 relatively to rise in slot 28 against the bottom of the wire barrel thereby to effect an indenting action as best shown in Figures 6 and 7.

With conductor 2 positioned for crimping, such that a bared portion 4 and an insulated portion thereof lies within the partially preformed ferrules 3 and 6 respectively, and with the upstanding tongues 8 and 9 projecting into the channels formed in the upper die block 20, the terminal is ready to be applied to the wire. As the upper die block is moved downwardly, the pre-curved ends of tongues 8 and 9 are engaged by die faces 21 and 22 and further curled in conformance with the curvature thereof. In this connection, it is to be understood that the force required to flex springs 30 is greater than the force necessary to bend the relatively thin sheet metal constituting the ferrule-forming tongues, hence die block 20 will engage shank 5 of the terminal, at which time ferrules 3 and 6 will have been substantially formed as in Figure 4, before sufficient force is imparted through die block 26 to cause compression of springs 30. To insure that the insulation supporting ferrule tightly embraces conductor 2, die face 22 is designed so that the end of tongue 9 leaves the die channel prior to engagement of the upper and lower die blocks. Since the tongue is being curled throughout the initial movement of the upper block, as the die blocks near one another a re-entrant curvature of tongue 9 will be effected, as best illustrated in Figure 4, to produce a tightly wrapped ferrule. Similarly, tongue end 10 is curled beyond the face of die 21 and into slot 11 until shoulders 15 engage shank 5, which occurs substantially in coincidence with engagement of the die blocks. Further downward movement of block 20 results in a relative upward movement of indenter 27 which engages and deflects tongue end 10 toward the bottom of base 7. With the ferrules being constrained within the die blocks, further relative movement of indenter 27 presses and coils tongue end 10 into generally a cup-shaped form into base 7 which is indented as shown in Figures 6 and 7. The depth of the crimp or indentation is pre-determined in relation to the wire size of conductor 2 and the diameter of ferrule 3, being deeper for wires of relatively small size for a given size ferrule, but in general is sufficiently deep to produce a tight compacting

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of the wire within the ferrule without cutting the wire strands or substantially reducing the tensile strength thereof.

As a result of the indenting action, the tongue end 10 is latched or hooked around the deformed portion of base 7 to secure tongue 8 in ferrule-forming position. In addition the coining of the metal results in a partial cold-welding and increased frictional engagement between the contacting surfaces and the surface edges respectively which further tends to secure the tongue end in its hooked position whereby the closed ferrule may effectively resist all lateral stresses on the contact member normally encountered in the ordinary use in terminals of this type. Indenting the ferrule in the manner described is additionally advantageous in that in providing a sharp edge around which the tongue is bent, any tendency in the metal of the ferrule to relax or spring back is restrained by the positive latching of the tongue thus afforded. Accordingly, the method of crimping of my invention is especially suited to applications where the connector is to be formed from spring metal having high resilience.

Since the conductor, in the forming of the ferrules, is disposed along a generally flat surface, constituting the terminal blank, the center lines of the insulated and bared portion of the conductor tend to be displaced whereby sharp bending and stressing of the wire at the point of entering of ferrule 3 results. This displacement is emphasized by the indenting action described above. Such stressing tends to weaken the wire but may be substantially reduced by bowing, in the forming process, that portion of base section 7 which supports the insulated conductor so as to realign the center of the wire and the insulation.

Indenting the ferrule to compact the conductor wire therein provides a tight connection which has considerable resistance to the longitudinal pullout of the wire. The pullout resistance may be substantially increased, however, by serrating, as at 32, the inside of tongue 8, whereby during indenting of the ferrule the metal of conductor 2 is extruded into the serrations, as shown in Figure 7.

In the specification and the accompanying drawings, I have shown and described a preferred embodiment of my invention, but it is to be understood that such embodiment is not intended to be exhaustive nor limiting of the invention but on the contrary, is given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it to practical use so that they may modify it and adapt it in various forms each as may be best suited to the conditions of a particular use.

I claim:

1. Means for connecting a contact member to an electrical wire comprising a sheet metal connector having a ferrule portion which includes a base section and a tongue extending laterally from one side of said base section, said contact member having a shank portion extending from the other side of said base section and a slot in said shank portion, said tongue being wrapped around the wire with the end thereof extending through said slot and along the bottom of and bonded to said base section.

2. Means for connecting a contact member to an electrical wire comprising a sheet metal connector having a ferrule portion which includes a base section and a tongue

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extending laterally from one side of said base section, said contact member having a shank portion extending from the other side of said base section, a slot in said shank portion, said tongue being wrapped around the wire with the end thereof extending through said slot and indented into the bottom of said base section.

3. Means for connecting a contact member to an electrical wire comprising a sheet metal connector having a ferrule portion which includes a base section and a tongue extending laterally from one side of said base section, said contact member having a shank portion extending from the other side of said base section, a slot in said shank portion, said tongue being wrapped around the wire with the end thereof extending through said slot and along said base section, and the bottom of said base section being indented along a line across said tongue end in a re-entrant indentation for compacting the wire within said ferrule and coining a portion of said tongue end into said base section.

4. The method of forming a sheet metal connector on a wire which includes forming a contact member extension with a slot therein and a ferrule-forming tongue extension on opposed sides of a base section, disposing the wire along the longitudinal axis of the base section, curling the tongue around the wire and threading the end thereof through the slot and along the base section, and indenting the base section through the tongue end to compact the wire within the curled tongue and to coin a portion of the tongue end into the base section.

5. The method of forming a sheet metal connector on a wire which includes forming a contact member extension with a slot therein and a ferrule-forming tongue extension on opposed sides of a base section, disposing the wire along the longitudinal axis of the base section, curling the tongue around the wire and threading the end thereof through the slot and along the base section to form a ferrule, and forming a re-entrant indentation in the ferrule by indenting the base section along a line extending across the tongue end to compact the wire within the curled tongue and to coin a portion of the tongue into the base section.

6. Means for connecting a contact member to a wire comprising a sheet metal connector having a ferrule portion which includes a base section and a tongue extending laterally from one side of said base section, said tongue being wrapped around the wire to form with said base section a substantially cylindrical ferrule, the end of said tongue underlying said base section, a re-entrant indentation in at least a portion of the tongue end and contiguous areas of said base section compacting the wire in said ferrule and securing said tongue end in ferrule forming position, the contact member being integrally connected to said base section.

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