

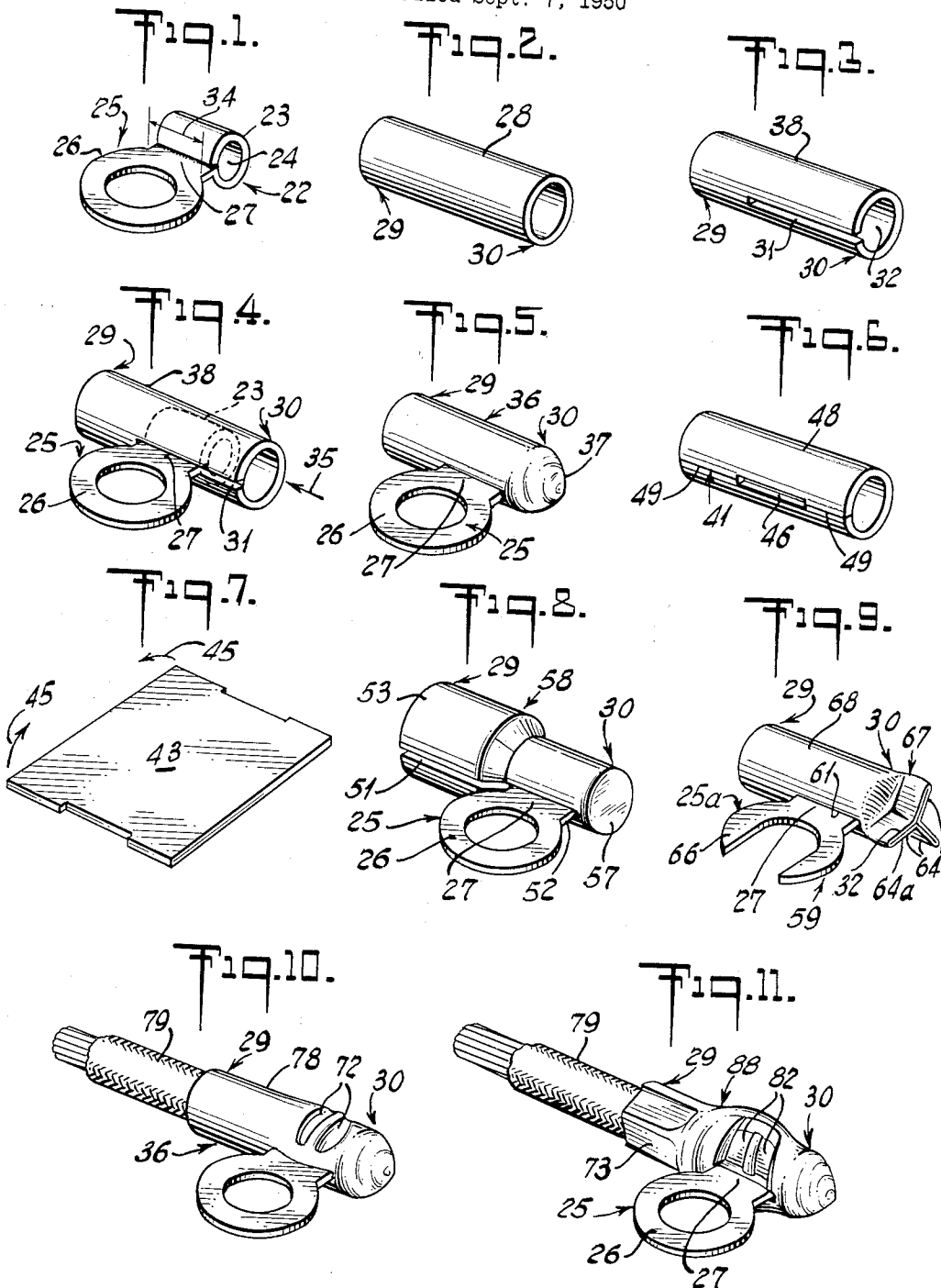
March 27, 1956

T. R. BETTS

2,740,101

ELECTRICAL CONNECTOR AND METHOD OF MANUFACTURING

Filed Sept. 7, 1950



INVENTOR
TRUEMAN R. BETTS.

BY
Curtis, Morris & Safford.
ATTORNEYS

1

2,740,101

ELECTRICAL CONNECTOR AND METHOD OF MANUFACTURING

Trueman R. Betts, Harrisburg, Pa., assignor to Aircraft-Marine Products, Inc., Harrisburg, Pa.

Application September 7, 1950, Serial No. 183,615

11 Claims. (Cl. 339-223)

This invention is related to electrical terminals of the type which can be placed on the end of a wire conductor and pressure-crimped or compressed thereon, and more particularly to such connectors which are insulated before being so crimped and in which such insulation remains effective after crimping.

Among the more recent developments in the art of making electrical connectors and terminals and applying them to conducting wires by compression or crimping means is that of providing such connectors with sheaths of insulating material which withstand the crimping and remain on the completed connections as insulation of adequate dielectric and mechanical strength. This development has been applied to a large variety of electrical connectors, including those which joined wires together and those which terminated wires with a flat ring-tongue, bifurcated spade-tongue or the like, for use in facilitating a secure connection of the wire with such members as binding posts. Of this latter type of connector, referred to generally in the art as electrical terminals, there is one mode of construction which has heretofore resisted application of the new development of properly insulating the terminals in this manner.

This mode of construction is that generally referred to as flag-type, having the wire-gripping member, hereinafter referred to as the "primary connector portion," joined at its side to a secondary connector portion, e. g. a flat ring-tongue or the like. This flag-type terminal is most important in certain applications wherein space limitations necessitate their use. Such space limitations also make their proper insulation of great importance.

The extension of the secondary connector from the side of the primary connector of a flag-type connector made impossible the usual practice of simply applying a length of crimpable insulating material, in tubular form, over the ferrule. It is, therefore, an object of my present invention to extend the benefits of insulation-sheath connectors to the flag-type and similar types.

An object of this invention is to securely enclose the primary connector portion of flag-type terminals with an insulation sheath which can subsequently be pressure-crimped to flow the material of said portion and the enclosed conducting wire into a mechanically and electrically secure connection without itself being destroyed as fully adequate electrical insulation for said primary-connector portion and without becoming insecurely joined to the ferrule. I accomplish this object by forming a tubular sheath of insulating material with a slot extending longitudinally through its wall for a distance equal to or greater than the width of the joining portion between the primary and the secondary connector portion to be received, placing the ferrule into said tubular sheath with said tongue extending through said slot, and, where necessary, deforming the end of said tubular sheath beyond said joining portion to at least partially close the slot and/or cause the insulating material to extend transversely across the end of the primary connector in order to hold the assembly securely together.

2

Another object of this invention is to accomplish the above in such fashion that, in the completed connection, and by virtue of the characteristics of my terminal, the connection between the primary connector and the conducting wire or the like is substantially enclosed and, if desired, even sealed against entrance of corrosive fluids.

A further object of this invention, in its more specific aspects, is that of providing an article which can be rapidly and economically manufactured by virtue of its simplicity.

Yet another object of this invention is to provide means for substantially closing a slot or slit in the side wall of an insulation sheath for electrical connectors which does not require the use of bonding cements nor the application of heat other than frictional heating inherent in this novel sealing means. Other objects of this invention will in part be pointed out in and will in part become apparent from the following specification and drawings taken in conjunction with the accompanying claims.

In the drawings:

Figure 1 shows a metal flag-type electrical connector structure;

Figure 2 shows a length of tubing of insulating material as is used in forming a preferred embodiment of this invention;

Figure 3 shows such a length of tubing with a longitudinal slot in one side thereof;

Figure 4 shows slotted tubing as presented in Figure 3 assembled onto a flag-type terminal as is presented in Figure 1;

Figure 5 shows this assembly after the front end of the plastic tubing has been formed into a smooth, rounded closure;

Figure 6 shows a length of plastic tubing in which a different kind of slot has been made;

Figure 7 shows a flat blank of insulation from which the tubing as presented in Figure 6 could be formed;

Figure 8 presents yet another kind of slotted tubular sheath, in this case a molded piece;

Figure 9 shows an insulated connector assembly with a different kind of end closure;

Figure 10 shows an insulated flag-type terminal embodying this invention in preferred form as it appears after being pressure-crimped onto an electrical conductor or wire; and

Figure 11 shows a connector as shown in Figure 10 but after having a preferred type of crimp compressibly applied.

Referring to Figure 1, a metal electrical connector of the flag-type has what will be referred to generally as a primary connector portion 22 to make contact with an inserted conductor; shown here as a cylindrical ferrule 23 having a longitudinal cavity 24 for reception of the electrical conductor or wire, a joining portion 27, and what will be generally referred to as a secondary connector portion 25, shown here as a flat ring-tongue 26. As shown here these portions 22, 25, and 27 are integrally attached together. Both of these connector portions 22 and 25 can be of many types; they are distinguished here by the fact that one, the primary connector 22, is intended to become a permanent connection terminating a conducting wire, cable, or the like, while the secondary connector 25 is intended to be a removable junction with some such member as a binding post, bolt, Fahenstock clip, etc.

In its preferred form, the primary connector is of the cylindrical ferrule type 23 shown, as this type can be pressure crimped onto a bared electrical conductor to form a junction of very intimate contact, a pull-out strength approaching, equal to, or even greater than the tensile strength of the enclosed conductor wire, and great resistance against corrosion. However, the primary connector can be any member which can be permanently affixed to a wire or the like; a cylindrical or

channel-like structure with wire-insulation-piercing barbs may be successfully employed here, that is, be capable of being properly crimped through, or in connection with, the sheath of insulating material.

The most common secondary connectors 25 among flag-type terminals are ring-tongues, as that shown at 26 in Figure 1, and open-end tongues, i. e., bifurcated members generally referred to in the art as spade tongues, as is shown in Figure 9. Many types of connectors could be used here; pin-type plugs, plug receptacles, other disconnects, etc.

Referring to Figure 2, a tubular sheath 28 of insulating material is shown. The specifications for this material are that it can be shaped into the tubular form shown; that is, can be cut and/or otherwise worked, and is, or can be made, very stiffly flexible, very tough, and yet malleable, i. e., capable of being cold-worked. In its final form, this tubing is so nearly rigid that it cannot be flattened by the pressure which can be exerted between the opposed finger and thumb of one's hand. In short, this material, as a completed connector insulation sheath, must be capable of being crimped between die surfaces, brought together with pressure great enough to compress together the enclosed metal primary connector, and the conductor inserted therein, and to then remain as a substantially unbroken sheath of insulation of adequate thickness and dielectric and mechanical strength. The materials used retain the imprint of the compression means, but are not punctured by it. Extremely slowly at room temperatures, and more rapidly with increases in temperature, however, the materials used tend to recover back toward their original shape from the areas of severe deformation. Materials of the class described include vinylidene-chloride polymers or copolymers of the type known in the trade as "rigid Saran," polyamides of the type known as nylon and vinyl chloride slightly plasticized with vinyl acetate copolymer and/or with other added plasticizer. The amount of vinyl acetate and/or any other plasticizer used should be such, in the completed insulated connector assembly, as to yield the characteristics described above. Crimpable insulating materials and their use are more fully disclosed and claimed in the Patent No. 2,410,321 issued October 29, 1946 to William S. Watts.

The radial thickness of the insulation tubing can vary with the characteristics of tubing, i. e., its hardness, toughness, etc., and those of the primary connector 22. In present practice, with insulating materials as described above, and with primary connectors 22 of the ferrule type as shown in Figure 1 made of soft copper, the thickness of the insulation is similar to that of the walls of the ferrule 23. Generally, if the insulation material were of a softer nature, it would have to be thicker, and if the metal is harder the ferrule would be thinner.

The length of the tubing as shown is sufficiently great to present an adequate current creepage distance to the rear (generally indicated at 29) of the primary connector, which is specified as about five-thirty-seconds of an inch by the Underwriters Laboratories for standard house and appliance wiring, and to permit a portion to be deformed over the front (generally indicated at 30) of the ferrule 23, or of the joining portion 27, in order to hold the assembly together.

Referring to Figure 3, a preferred form of an insulation sheath 38 has had a longitudinal, or lengthwise, slot 31 formed in its wall 32 from the front end 30 of said sheath rearward a distance greater than the longitudinal dimension (taken at 34, Figure 1) of the joining portion 27 of the secondary connector portion 25. This slot has a width approximately equal to, or advantageously less than, that of the thickness of the metal stock of said joining portion 27.

Referring to Figure 4, the arrow 35 indicates the direction in which the ferrule 23 and joining portion 27 are slid into the insulating sheath 28 and slot 31, respectively, in assembly.

Figure 5 shows a completed insulated terminal assembly 36 in which the front end 30 of the sheath 38 has been re-formed to form a rounded closure 37 thereof. This closure, and the process used in forming it, will be hereinafter more fully discussed in conjunction with alternative closures and/or means of holding the terminal assembly together.

Referring to Figure 6, an insulation sheath 48 with a slot 41 of varying width is shown. In its broadest aspects, this invention contemplates the use of any type of slot which will permit the proper structural relationships between the primary connector 22 (Figure 1), the secondary connector 25, and an insulation sheath which substantially encloses the primary connector. In Figure 6 the slot 41 of varying width is shown because it is feasible, for instance, to forcibly open the slot 41 slightly and insert a primary connector 22 into the sheath 48, either laterally, i. e., sidewise through the slot 41 or longitudinally from the end of the sheath, if the joining portion 27 (Figure 1) is in line with the slot 41. In the sheath 48 shown in Figure 6, a widened area 46 of the slot 41 is of appropriate size to receive a connector joining portion 27 (Figure 1) when the edges of the narrower area 49 of the slot 41 are abutted together. After assembly these edges are appropriately sealed together, preferably by heating and/or working them together.

The insulation sheath is tubular in its final form, but, as is shown in Figure 7, the sheath of Figure 6 or a similar structure could be rolled from a flat blank 43 of insulation material. This rolling is indicated by the arrows 45.

Referring to Figure 8, it is within the broader aspects of my invention to mold the insulation sheath 58 out of moldable plastic materials. The slot 51 could be formed in molding, or cut away after molding. As shown in this insulated connector assembly, this slot 51 extends from the front edge 52 of the joining portion 27 to the rear end 29 of the sheath 58. The expanded portion of this sheath 53 enables wire insulation (79, Figure 10) of large size to be accepted therein. This feature can also be included in sheaths formed from tubing 28, Figure 2, by stretching or expanding the rear 29 portion of the tubing.

For purposes of facilitating a more secure grip of the rear end 29 portion of an insulation sheath unto wire-insulation, wide expansion of this portion of the sleeve or for such purposes as forming a stronger connector assembly, a thin metal sleeve or sheath may be used between an insulating sheath and an enclosed primary connector. This practice is more fully disclosed and claimed in a copending application of Robert C. Swengal, Serial No. 523,004, filed February 19, 1944.

Referring again to Figure 8, the slot 51 could be sealed, to the rear 29 of the joining portion 27, by spinning the sheath, i. e., working some of the material of the sheath across and over the slot by tangentially working the sheath 58, from its inside and/or outside surfaces, compressing the sheath from an originally over-expanded size and sealing the thus abutted edges of the slot 51, or otherwise by filling in the slot with insulating material. For some applications, there is no need for the expanded portion 53 of the sheath 58 to be closed over the slot 51, and in such cases small portions of the sheath may be worked or clinched across the slot 51 to the rear 29 of said joining portion 27 to hold the connector assembly together. If desired, suitable cements can be used to hold these assemblies together to add to their strength or to seal any voids between the sheaths and their enclosed primary connectors.

Referring to Figure 9, a metal connector structure 59, illustratively having a spade-tongue 66 as a secondary connector 25a, is shown with its joining portion 27 entering an insulation sheath 68 having an end closure 67 of a kind different from that 37 of Figure 5 and the somewhat flat end closure 57 of Figure 8. Here (Figure 9) the end closure consists of the wall of the sheath 68 having its

32 front end portions pressed transversely together and sealed by such means as pressure and/or heat to form fin-like structures 64. These structures 64 comprise an end closure 67 which is substantially free from openings permissive of the entrance of corrosive gases or liquids and which holds the insulated connector assembly securely together. In these respects note that one fin-like structure 64a can be formed from material adjacent the slot 61 to thus close and seal said slot 61 and to firmly hold the joining portion 27 in place. This fin-like end closure is more fully disclosed and claimed in a copending application of H. O. Woolley, Serial Number 224,370, filed May 3, 1951.

The front end 30 of the insulation sheath may be left open in certain applications, e. g., wherein two wire conductors or the like are to be inserted into a primary connector 22 (Figure 1) from the opposite ends 29 and 30 of a connector assembly. In such application, both ends 29 and 30 of the sheath would extend an electrically appropriate distance from the joining portion 27 (Figure 1) and would, in their final form, preferably be circumferentially continuous.

Means of closing a slot 31 (Figure 3) such as spinning the material of the sheath 28 into and over it have already been discussed. Simultaneous spinning and heating is the means employed to form the rounded end closure 37 (Figure 5) as well as to close the slot 31. A heated cupped member is spun in pressure contact with the front end 30 of a sheath 28 as it is shown in Figure 3. The end closure 57 of the molded sheath 58 is shown flat; it could be molded to any desired shape. The end closure 67 as shown in Figure 9 is in practice made by simultaneous transverse pressure of radially pressed dies, and application of heat to the walls 32. If complete end closure is not required, sheath material could be simply deformed over the front end 30 of the primary connector 22.

The cold-working methods, such as spinning, crimping, or clinching sheath material across a slot, can be employed as means of holding the insulated metal connector, as shown in Figure 1, in place within the insulation sheath and, in the case of spinning, close the slot to form circumferentially continuous insulation beyond the joining portion 27 (Figure 1) of the connector assembly.

Where the closure at the front end 30 is needed either to insulate this end of the assembly or to prevent the access of corrosive fluids to the insulated primary connection and yet allow visual inspection of this connection, the insulation sheaths 28, 38, 48, 58, and 68 etc., may be made of transparent plastic material.

Referring to Figure 10, an assembled connector 36, of the type as shown in Figure 5, is shown after being compressibly attached to an electrical conductor, the insulation 79 of which is seen protruding from the rear end 29 of the insulation sheath 78. Although many types of crimps or compressions may be used, in this instance two D shaped impressions 72 have been forcibly compressed into the insulation. These impressions are formed in both sides of the sheath 78 by a pair of matched crimping dies which are particularly well adapted to form a secure connection between a centrally located ferrule portion as the primary connector 22 and the enclosed wire. This crimp and its use are more fully disclosed and claimed in a copending application of Stephen N. Buchanan, Serial Number 559,604, filed October 20, 1944.

A preferred form of crimp is shown in Figure 11, wherein the D impressions 82 of one die are interrupted by the presence of the joining portion 27 of the metal connector. This crimp is made by providing one of the pair of crimping dies with a slot which receives the secondary connector 25; this is seen to be practicable when the secondary connector 25 is of a generally flat shape, such as the ring tongue 26 shown. This crimp (as shown in Figure 11) or manner of compressing the insulated connector assembly, is preferred in many applications, as it compresses the insulation sheath 88 and the metal

elements therein, away from the secondary connector, thus enabling the greatest lateral dimensions, i. e., from the near extremity of the ring-tongue 26 or the like to the far side of the sheath 88, to be kept to a minimum.

This crimp, as shown in Figure 11, is more fully disclosed and claimed in the copending application of L. B. Paules, Serial Number 243,621, filed August 25, 1951.

Also shown in Figure 11 is a preferred form of a crimp 73 for causing the extended rear end 29 of the sheath 88 to securely grip the enclosed insulation 79 of the wire conductor. This crimp 73, or compression, is preferably applied simultaneously with the D-shaped impressions, i. e., with whatever means of compression is used for securely affixing the wire to the enclosed primary connector.

I claim:

1. The method of making an insulated electrical connector for crimping attachment to an electrical conductor comprising making a metal connector having a primary connector portion for receiving an electrical conductor, a joining portion in a direction transverse to the axis of a conductor received in the primary portion, and a secondary connector portion, making also a cylindrical sheath of insulating material, said sheath having an opening adapted to receive said joining portion in the side wall of said sheath, inserting said primary connector portion into said sheath and said joining portion into said opening, with said secondary connector exterior of the sheath, and transversely deforming said sheath beyond said joining portion.

2. The process as defined in claim 1 wherein the transverse deforming of said sheath beyond said joining portion is done with the application of heat and tangential working, sealing together adjacent edges of said opening in the side wall of said sheath.

3. The method of making an insulated electrical connector for crimping attachment to an electrical conductor comprising making a metal connector comprised of a primary connector portion for receiving an electrical conductor and a secondary connector portion extending from said primary portion in a direction transverse to the axis of a conductor received in the primary portion, making also a cylindrical sheath of insulating material, said sheath having an opening in its side wall, inserting said primary connector portion into said sheath, deforming said sheath adjacent said opening, said deforming taking place in a plane substantially perpendicular to the longitudinal axis of said sheath.

4. An electrical connector having, in combination, a crimpable ferrule for receiving an electrical conductor, a joining portion extending from the side of said ferrule in a direction transverse to the axis of the ferrule, a connector tongue extending from said joining portion and a crimpable sheath of insulation substantially enclosing said ferrule except for the exit of said joining portion and an opening near at least one end of said ferrule, said sheath comprising a material of the class which is stiffly flexible, tough and malleable and through which a radial pressure may be transmitted to the ferrule for cold-forging the ferrule onto the electrical conductor.

5. A connector as defined in claim 4 in which the insulation sheath closely hugs the joining portion and is brought into sealing relation to one end of the ferrule.

6. A connector as defined in claim 4 in which the insulation sheath is brought into sealing relation to one end of the ferrule and extends beyond the open end of the ferrule.

7. A connector as defined in claim 4 having one end of the sheath of insulation crimped into sealing relation to one end of the ferrule.

8. A connector as defined in claim 7 having an assembling slot for receiving the joining portion crimped into closely confining relation to said joining portion.

9. A connector as defined in claim 7 in which the insulation of the sheath is also thermostealing and is heat sealed in its crimped condition.

7

10. The process of making a flag-type insulated electrical connector capable of being crimped into connective and conductive relation to the stripped end of an electrical conductor which consists in providing a flag-type connector having a crimpable ferrule, a connector tongue and a joining portion between said tongue and ferrule extending from a side of said ferrule in a direction transverse to the axis of the ferrule, providing a sheath of crimpable insulation having a slot for receiving the joining portion extending in from one end thereof, assembling the sheath upon the connector and then crimping the slotted end of the sheath into sealing relation to one end of the ferrule and into close confining relation to the joining portion.

11. A process according to claim 10 in which the crimpable insulation is also thermoplastic and thermo-sealing and heat is employed in the insulation crimping step.

8

References Cited in the file of this patent

UNITED STATES PATENTS

318,286	Patterson	May 19, 1885
378,976	Ritchie	Mar. 6, 1888
389,180	Wiggins	Sept. 4, 1888
1,514,831	Chayes	Nov. 11, 1924
1,568,644	Waller	Jan. 5, 1926
1,953,891	Andrew	Apr. 3, 1934
1,974,337	Magnani	Sept. 18, 1934
2,120,150	Marshall	June 9, 1938
2,338,524	McCabe	Jan. 4, 1944
2,410,321	Watts	Oct. 29, 1946

FOREIGN PATENTS

585,670	Great Britain	Feb. 18, 1947
---------	---------------	---------------