

PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Terminal Assemblies

We, WESTERN ELECTRIC COMPANY, INCORPORATED, of 195, Broadway, New York City, New York State, United States of America, a Corporation of the State of New York, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to terminal assemblies for mechanically retaining and electrically contacting insulated conductors and to methods of making terminal assemblies. Preferably, this invention relates to corrosion resistant clip-type electrical terminal assemblies for penetrating the insulation of electrical conductors to connect such conductors without first removing the insulation therefrom and methods of making such terminal assemblies.

Clip-type electrical terminal assemblies of the prior art have been used to mechanically retain and electrically contact insulated conductors without first removing the insulation from the conductor (See copending patent application No. 11194/63) (Serial No. 1,030,235). Such terminal assemblies include a pair of elongated, contiguous, contacting jaws formed from a resilient, electrically conductive material, such as phosphor bronze or the like. The insulated conductor to be joined to the terminal assembly is forced between the contiguous jaws to space them apart a slight distance. Due to the resiliency of the jaws, they tend to close or re-obtain their contiguous state, thereby penetrating or tearing apart the insulation and tightly clamping the conductor. Thus, the terminal assembly mechanically retains and electrically contacts the conductor.

In using these terminal assemblies in moist or corrosive environments, the contacting faces of the resilient jaws have developed nonconducting coatings which interfere with both the electrical connection and the mechanical retention of the conductor. However, if the contacting faces of the jaws could be plated with a corrosion resistant conductive metal, such as tin or the like, and if this plating would in no way interfere with the resiliency of the jaws of the terminals, the terminals could be used in moist or corrosive environments. Moreover, such plating could increase the wear resistance of the jaws.

It is an object of this invention to provide new and improved terminal assembly for mechanically retaining and electrically contacting insulated conductors and to provide a method of making such assemblies.

According to one aspect of the present invention there is provided a terminal assembly comprising a substantially flat terminal including a pair of elongated elements and an integral base section, the parts of the elements adjacent the integral base section being spaced apart to form an elongated slot, mutually opposed edges on other parts of the elements remote from the base section serving to penetrate the insulation of and retain a conductor forced between the elements, and protuberance means formed on the inner surfaces of the elements which engage each other so that, in the absence of an insulated conductor, the said other parts of the elements are maintained apart.

According to another aspect of the present invention there is provided a method of manufacturing a terminal assembly with at least one substantially flat terminal for penetrating the insulation of and retaining a conductor, the method comprising the steps of forming an elongated slot adjacent an integral

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base section of the terminal, forming a sheared slit from one end of the said elongated slot to adjacent one end of the terminal, shaping the said one end of the terminal to enable an electrical conductor to be inserted within the sheared slit, and forming a protuberance on each inner surface of the sheared slit adjacent to the said one end of the longitudinal slot, so that the protuberances engage each other in order to maintain the remainder of the said inner surfaces apart.

The spacing apart of the jaws, prior to the jointing of a conductor thereto, by the said distance permits the plating of the faces of the jaws without sacrificing the resiliency of the jaws.

In the preferred embodiment of the invention, the terminal includes a pair of electrically conductive elongated elements or jaws joined at one end and free at the other. The inner edges of the jaws are deformed so that the free ends thereof are maintained apart a distance equal to less than the diameter of the conductive part of the conductor.

The terminal can be manufactured by forming the pair of jaws from a strip of electrically conductive resilient material. After these jaws are formed, the inner edges of the free ends of the jaws are deformed to space apart such free ends a distance less than the diameter of the conductive part of the conductor so that the latter can be mechanically retained and electrically contacted by the terminal.

For a better understanding of the invention, reference is made to the accompanying drawings, wherein:

FIG. 1 is an enlarged, fragmentary, front-elevational view of an electrical terminal, clearly showing the spaced relationship of the jaws of the terminal and the deformation of the inner edges of such jaws for maintaining this spaced relationship;

FIG. 2 is a perspective view of a terminal assembly incorporating a number of the terminals of FIG. 1 and illustrates the manner in which a plurality of insulated conductors are either joined to, or temporarily held by, the terminals;

FIG. 3 is an enlarged, fragmentary perspective view, showing how an insulated conductor is securely joined to the jaws of the terminal and how the support for the terminal prevents the conductor from sliding downwardly beyond a predetermined portion of the jaws into an aperture formed between such jaws;

FIG. 4 is a schematic, front-elevational view of an apparatus for making the electrical terminals; and

FIG. 5 is a plan view of a strip of electrically conductive resilient material from which the terminals are formed.

Referring now to the drawings, and more particularly to FIG. 1, there is shown a terminal

11 for mechanically retaining and electrically contacting an insulated conductor 12, FIGS. 2 and 3. The substantially flat terminal 11, is formed from a sheet of resilient, electrically conductive material such as phosphor bronze or the like.

The terminal 11 includes first and second elongated elements or jaws 13 and 14 joined at one end by an integral base portion 16 and free at the other end. The free end of the first jaw 13 has a rounded portion 17 while the free end of the second jaw 14 has a sideways rounded protruding portion or hook 18 extending partially over the rounded portion 17. The rounded portion 17 coacts with the hook 18 to form a V-shaped conductor-receiving passageway 19 in which an insulated electrical conductor 12 may be conveniently placed and held, as shown in FIG. 2, before such conductor 12 is forced down between the jaws 13 and 14, as shown in FIG. 3. Moreover, the roundness of the portion 17 and hook 18 prevents the jaws 13 and 14 from piercing, tearing or injuring in any way the insulation of the conductor 12 as it is being positioned in, or as it is being temporarily held by, the passageway 19. In addition, the hook 18 of the jaw 14, which extends beyond the jaw 13, in conjunction with the V-shaped conductor-receiving passageway 19, greatly facilitates the positioning of the conductor 12 within such passageway 19. Also, the V-shaped passageway 19 provides an inclined plane against the conductor 12 as it is forced downwardly between the jaws 13 and 14 to slowly open such jaws 13 and 14 and slidably receive the conductor 12.

Formed between the jaws 13 and 14 is an elongated slot 21, the dimensions of which determine the forces exerted by these jaws 13 and 14 against the conductor 12 when it is forced therebetween, as shown in FIG. 3, and as disclosed in the aforementioned application. Moreover, an aperture 22 located above the slot 21 is formed by recesses in the jaws 13 and 14. The aperture 22, in cooperation with the slot 21, defines the longitudinal dimension of protuberances 23 produced by plastically deforming the inner edges of the jaws 13 and 14. The function of the deformed portions or protuberances 23 is to resiliently hold apart the jaws 13 and 14 to establish a space 24 between such jaws 13 and 14. The lateral dimension of this space 24 is critical. Such dimension must be less than the diameter of the conductive part of the insulated conductor 12, but must be sufficiently large to permit plating of the inner edges of the jaws 13 and 14 which contact the conductor 12. For a 24 gauge insulated conductor, this lateral dimension is equal to 0.005 inches.

As shown in FIG. 2, a plurality of the terminals 11 are joined together by the base portions 16 thereof, and a group of such

joined terminals 11, are mounted in a terminal block 26 to form a unit. Securely holding the terminals 11 within the block 26 is a base 27 secured to the block 26 by threaded members 28. As is apparent from FIG. 3, the terminal block 26, in addition to holding a group of joined terminals 11, prevents the conductor 12 from sliding too far down the jaws 13 and 14 and into the apertures 22 of the terminals 11.

Also, as is illustrated in FIG. 2, a plurality of electrical conductors 12 may be temporarily held by the V-shaped passageways 19 of the terminals 11.

On the other hand, with the aid of the inclined edges of the passageway 19, one of the conductors 12 may be slideably forced down beyond such passageway 19, between the jaws 13 and 14, and into the space 24. As the conductor 12 is forced into the space 24, the jaws 13 and 14 are resiliently opened by the conductor 12. Since the jaws 13 and 14 are resiliently biased toward each other, the inner edges of such jaws 13 and 14 pierce or tear apart the insulation of the conductor 12 and bite into the conductor 12 to mechanically retain such conductor 12 with great force and make a good electrical connection between the conductor 12 and terminal 11.

Shown in FIG. 4 is a schematic representation of an apparatus for making the clip-type electrical terminals 11 joined together by the integral base 16. In making such terminals 11, a strip of electrically conductive resilient material 31, such as phosphor bronze or the like, is advanced from a supply reel 32 to a take-up reel 33. The take-up reel 33 is driven by a conventional indexing motor 34 through a standard V-belt drive 36.

The material 31 is initially advanced to a punching station 37; whereupon the material 31 is stopped by the indexing motor 34. Then, a motor 39 rotates a shaft 41 to rotate a cam 42. Rotation of the cam 42 pushes a punch 43 through the material 31 into a die 44 to form a plurality of aligned apertures 46, perpendicular to the longitudinal edges of the material 31, as shown in FIG. 5.

After the apertures 46 are formed in the material 31, the indexing motor 34 advances the material 31 to move the apertures 46 to a position just in front of a second punching station 47. Next, the motor 34 stops the material 31. Then, the motor 39 rotates the shaft 41 to rotate a cam 48. The rotation of the cam 48 then pushes a punch 49 through the material 31 into a die 50 to produce a plurality of slots 51 (FIG. 5) in front of each aperture 46. At the same time that the slots 51 are formed in the material 31, a second series of apertures 46 are also produced at the first punching station 37.

Upon the formation of the slots 51 in the material 31, the indexing motor 34 advances

the material 31 to a third punching station 52 where a plurality of openings 53 are formed in the material 31 in the same manner that the slots 51 are formed in the material 31. The openings 53 are clearly shown in FIG. 5.

Again, the indexing motor 34 advances the material 31, but this time to a shearing station 54 where a first portion of the material 31 is sheared, as shown at 55 in FIG. 5, by a movable shear 56 which coacts with a stationary shear 57. This shearing of the material 31 joins the slots 51 with the apertures 46 and, further, defines the second jaw 14, as illustrated in FIG. 5. Such shearing action is controlled by the motor 39, in the same manner that the punching action at stations 37, 47 and 52 is controlled by the motor 39.

Next, the material 31 is advanced by the indexing motor 34 to another shearing station 58; whereupon, the material 31 is again sheared, as clearly shown at 59 (FIG. 5), to form the first jaw 13. This shearing is accomplished in the same way that the shearing at the station 54 is accomplished.

The material 31 is then advanced to a deforming station 61 where the inner edges of the jaws 13 and 14 are stamped, coined or plastically deformed by a movable stamping die 62 which coacts with a stationary platen 63 to form the portions 23 to thereby space such jaws 13 and 14. This stamping operation is controlled by the motor 39 in the same manner that such motor controls the punching and shearing operations at the other stations 37, 47, 52, 54 and 58.

After the stamping operation, the indexing motor 34 advances the material 31 to a blanking station 64. At this station 64, the jaws 13 and 14 are blanked from the strip 31 in such a manner that such jaws 13 and 14 are joined together by the integral base section 16 to form the terminal 11, and a group of such terminals 11 are also joined together by the integral base section 16. The blanking dies, which are of the conventional type, are controlled by the motor 39 in the same manner that the punching and shearing operations are controlled by such motor 39 at the other stations 37, 47, 52, 54, 58 and 61. After the terminals 11 are blanked from the strip 31, they fall into and are collected by a bin 66.

Next, the terminals 11 are plated with a wear and corrosion resistant, electrically conductive material which does not interfere with the resiliency of the jaws 13 and 14. Since the jaws 13 and 14 are spaced by the deformed portions 23, such plating may be effectuated at the inner edges of the jaws 13 and 14, which bite into the conductor 12 when it is forced into the space 24 between such jaws 13 and 14.

As to the thickness of the plated material,

it must be sufficiently thin so as not to interfere with or block up the space 24 between the jaws 13 and 14.

5 An example of a satisfactory plating material is tin which may be very easily electroplated in accordance with conventional techniques and typically is plated to a thickness of about 0.0001 inch.

10 Inasmuch as the terminals 11, which may be more efficaciously utilized by being positioned within the terminal block 26, are plated with a corrosion resistant material, they may be utilized in a moist, corrosive environment and such terminals 11 would not develop nonconducting coatings on the inner faces of the jaws 13 and 14 which would interfere with the electrical connection and the mechanical retention of the electrical conductors 12.

20 Since the terminal 11 is formed first by shearing the jaws 13 and 14 from the material 31 with no space 24 between such jaws 13 and 14, and then the jaws 13 and 14 are subsequently plastically deformed to produce the portions 23 to space apart such jaws 13 and 14 to establish the space 24 therebetween, the force tending to close the space 24 between the jaws 13 and 14 is the same as if the terminal 11 were formed with no space 24. Thus, the jaws 13 and 14 of the terminal 11 have the same ability to penetrate and tear apart the insulation to tightly clamp and bite into the conductive part of the insulated conductor 12 as the jaws 13 and 14 would have if there were no space 24 between them. In other words, the provision of the space 24 between the jaws 13 and 14 does not sacrifice the resiliency of the jaws 13 and 14 nor the force which the jaws 13 and 14 exert on an insulated conductor forced between such jaws 13 and 14 and into the space 24. Moreover, with the space 24 between the jaws 13 and 14, such jaws 13 and 14 may be easily plated, as mentioned above, with a wear and corrosion resistant material such as tin or the like and the terminal 11 may be readily utilized in an unfavourable environment.

WHAT WE CLAIM IS:—

50 1. A terminal assembly comprising a substantially flat terminal including a pair of elongated elements and an integral base section, the parts of the elements adjacent the integral base section being spaced apart to form an elongated slot, mutually opposed edges on other parts of the elements remote from the base section serving to penetrate the insulation of and retain a conductor forced between the elements, and protuberance means formed on the inner surface of the elements which engage each other so

that, in the absence of an insulated conductor, the said other parts of the elements are maintained apart.

2. A terminal assembly according to claim 1, wherein a recess is formed on each mutually opposed edge of the elements adjacent the protuberance means.

3. A terminal assembly according to claim 2, wherein a corrosion resistant material is deposited on the inner surfaces of the elements.

4. A terminal assembly according to any one of the preceding claims, wherein the inner surfaces of the ends of the elements remote from the base section define a V-shaped notch.

5. A terminal assembly according to any of the preceding claims, comprising a plurality of the terminals having the said integral base section in common.

6. A terminal assembly according to claim 5, further comprising an insulating terminal support member serving to prevent an electrical conductor from entering the aperture.

7. A method of manufacturing a terminal assembly with at least one substantially flat terminal for penetrating the insulation of and retaining a conductor, the method comprising the steps of forming an elongated slot adjacent an integral base section of the terminal, forming a sheared slit from one end of the said elongated slot to adjacent one end of the terminal, shaping the said one end of the terminal to enable an electrical conductor to be inserted within the sheared slit, and forming a protuberance on each inner surface of the sheared slit adjacent to the said one end of the longitudinal slot so that the protuberances engage each other in order to maintain the remainder of the said inner surface apart.

8. A method according to claim 7, further comprising the step of depositing a corrosion resistant material on the inner surfaces of the sheared slit adjacent to the said one end of the terminal.

9. A method of manufacturing a terminal assembly substantially as hereinbefore described with reference to FIGS. 4 and 5 of the accompanying drawings.

10. A terminal assembly manufactured by the method according to claim 7, 8 or 9.

11. A terminal assembly substantially as hereinbefore described with reference to FIGS. 1, 2 and 3 of the accompanying drawings.

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5 An example of a satisfactory plating material is tin which may be very easily electroplated in accordance with conventional techniques and typically is plated to a thickness of about 0.0001 inch.

10 Inasmuch as the terminals 11, which may be more efficaciously utilized by being positioned within the terminal block 26, are plated with a corrosion resistant material, they may be utilized in a moist, corrosive environment and such terminals 11 would not develop
15 nonconducting coatings on the inner faces of the jaws 13 and 14 which would interfere with the electrical connection and the mechanical retention of the electrical conductors 12.

20 Since the terminal 11 is formed first by shearing the jaws 13 and 14 from the material 31 with no space 24 between such jaws 13 and 14, and then the jaws 13 and 14 are subsequently plastically deformed to produce
25 the portions 23 to space apart such jaws 13 and 14 to establish the space 24 therebetween, the force tending to close the space 24 between the jaws 13 and 14 is the same as if the terminal 11 were formed with no
30 space 24. Thus, the jaws 13 and 14 of the terminal 11 have the same ability to penetrate and tear apart the insulation to tightly clamp and bite into the conductive part of the insulated conductor 12 as the jaws 13
35 and 14 would have if there were no space 24 between them. In other words, the provision of the space 24 between the jaws 13 and 14 does not sacrifice the resiliency of the jaws 13 and 14 nor the force which the jaws 13 and
40 14 exert on an insulated conductor forced between such jaws 13 and 14 and into the space 24. Moreover, with the space 24 between the jaws 13 and 14, such jaws 13 and 14 may be easily plated, as mentioned above, with a
45 wear and corrosion resistant material such as tin or the like and the terminal 11 may be readily utilized in an unfavourable environment.

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55 form an elongated slot, mutually opposed edges on other parts of the elements remote from the base section serving to penetrate the insulation of and retain a conductor forced between the elements, and protuberance means formed on the inner surface of
60 the elements which engage each other so

that, in the absence of an insulated conductor, the said other parts of the elements are maintained apart.

2. A terminal assembly according to claim 1, wherein a recess is formed on each mutually opposed edge of the elements adjacent the protuberance means. 65

3. A terminal assembly according to claim 2, wherein a corrosion resistant material is deposited on the inner surfaces of the elements. 70

4. A terminal assembly according to any one of the preceding claims, wherein the inner surfaces of the ends of the elements remote from the base section define a V-shaped notch. 75

5. A terminal assembly according to any of the preceding claims, comprising a plurality of the terminals having the said integral base section in common. 80

6. A terminal assembly according to claim 5, further comprising an insulating terminal support member serving to prevent an electrical conductor from entering the aperture. 85

7. A method of manufacturing a terminal assembly with at least one substantially flat terminal for penetrating the insulation of and retaining a conductor, the method comprising the steps of forming an elongated slot adjacent an integral base section of the terminal, forming a sheared slit from one end of the said elongated slot to adjacent one end of the terminal, shaping the said one end of the terminal to enable an electrical conductor to be inserted within the sheared slit, and forming a protuberance on each inner surface of the sheared slit adjacent to the said one end of the longitudinal slot so that the protuberances engage each other in order to maintain the remainder of the said inner surface apart. 90 95 100

8. A method according to claim 7, further comprising the step of depositing a corrosion resistant material on the inner surfaces of the sheared slit adjacent to the said one end of the terminal. 105

9. A method of manufacturing a terminal assembly substantially as hereinbefore described with reference to FIGS. 4 and 5 of the accompanying drawings. 110

10. A terminal assembly manufactured by the method according to claim 7, 8 or 9.

11. A terminal assembly substantially as hereinbefore described with reference to FIGS. 1, 2 and 3 of the accompanying drawings. 115

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