Feb. 8, 1966 A. LOGAN 3,234,498

INSULATION-PENETRATING CLIP-TYPE ELECTRICAL CONNECTORS

Filed June 4, 1963 2 Sheets-Sheet 1

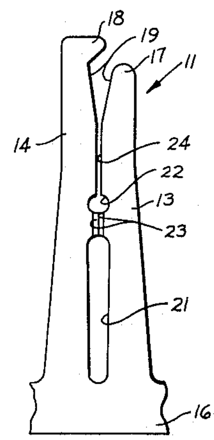

FIG. 1

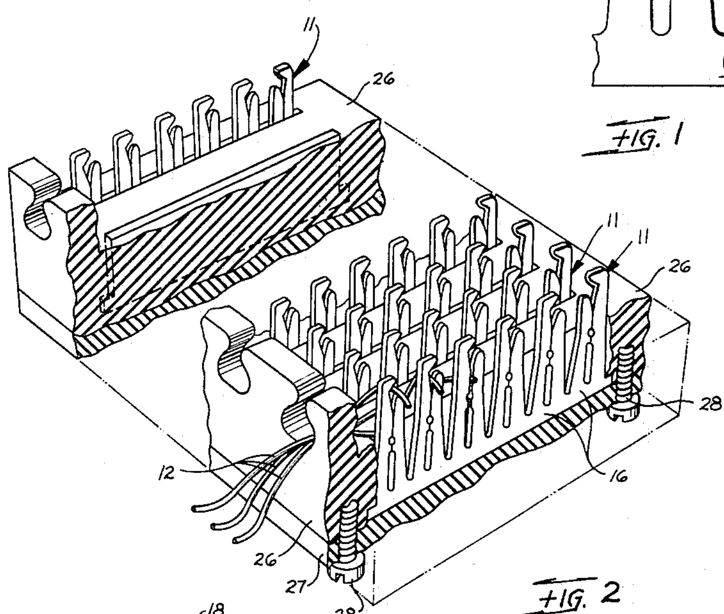

FIG. 2

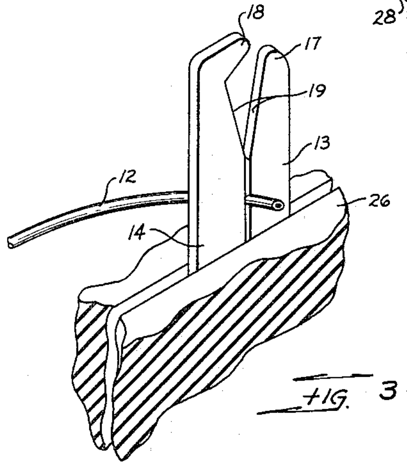

FIG. 3

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INSULATION-PENETRATING CLIP-TYPE ELECTRICAL CONNECTORS

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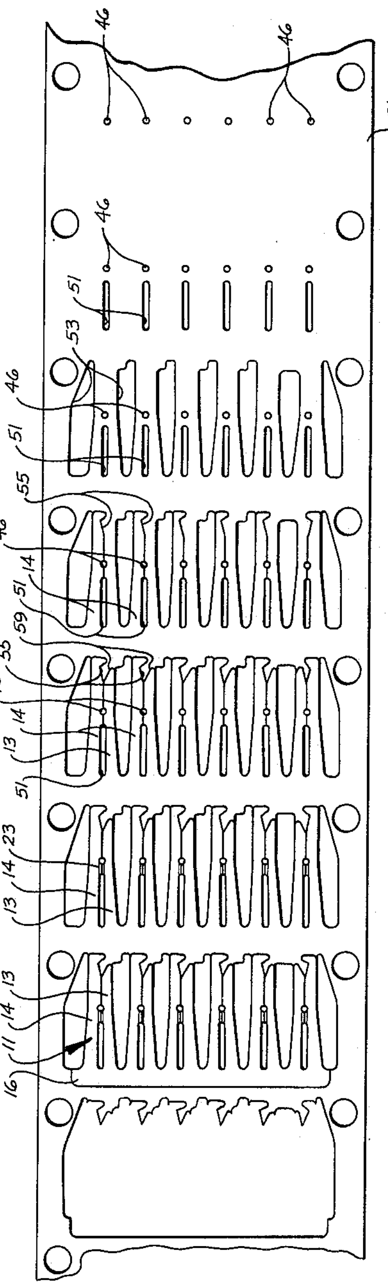

FIG. 5

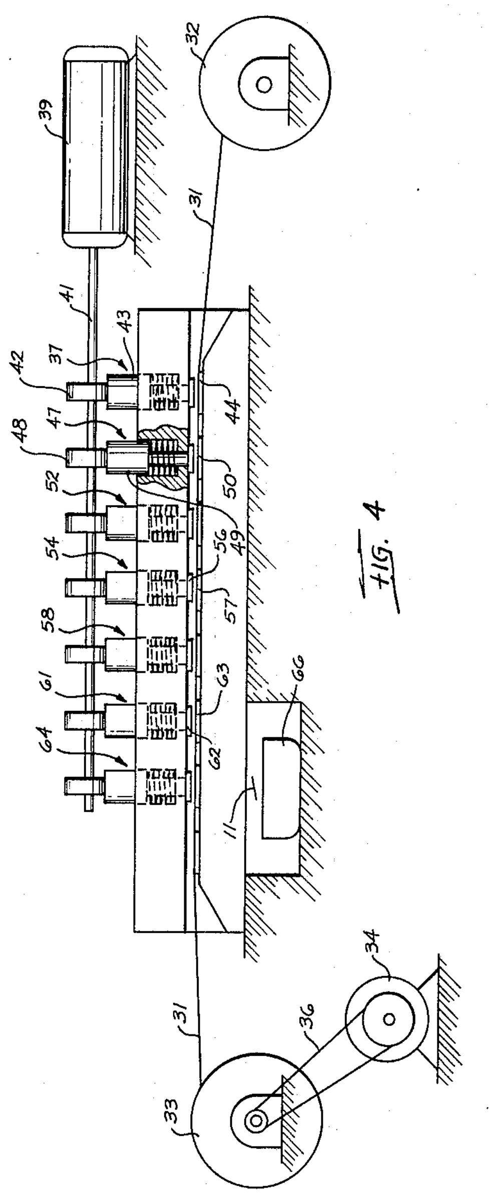

FIG. 4

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INSULATION-PENETRATING CLIP-TYPE ELECTRICAL CONNECTORS

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4 Claims. (Cl. 339—97)

This invention relates to devices for mechanically retaining and electrically contacting conductors. More particularly, this invention relates to corrosion resistant clip-type electrical connectors for penetrating the insulation of electrical conductors to connect such conductors without first removing the insulation therefrom.

Clip-type electrical connectors 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 application Serial No. 182,560 now Patent No. 3,112,147 filed on March 26, 1962 by W. Pferd, K. H. Pohland and D. W. Tyler.) Such connectors include a pair of elongated, contigous, contacting jaws formed from a resilient, electrically conductive material, such as Phosphor bronze or the like. The insulated conductor to be joined to the connnector 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 connector mechanically retains and electrically contacts the conductor.

In using these connectors in moist or corrosive environments, the contacting faces of the resilient jaws have developed nonconducting coatings which interfere with both the electrical connection and 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 connector, the connectors could be used in moist or corrosive environments. Moreover, such plating could increase the wear resistance of the jaws. Accordingly, it is necessary to space apart the contiguous contacting jaws prior to the joining of a conductor thereto a sufficient distance to permit the plating of the faces of such jaws and at the same time without sacrificing the resiliency of the contacting jaws. Moreover, the spacing of the jaws must be equal to a distance of less than the diameter of the conductor to be joined to the connector to thereby enable the jaws to exert a sufficient force on the conductor to securely hold it and provide a good electrical connection.

It is, therefore, an object of this invention to provide new and improved devices for mechanically retaining and electrically contacting conductors.

Another object of this invention is the provision of clip-type connectors for interconnecting a plurality of electrical conductors without first removing the insulation therefrom.

A further object of this invention is the provision of a clip-type electrical terminal block having a plurality of pairs of wear and corrosion resistant resilient jaws, which are spaced apart a predetermined distance, for penetrating the insulation of an electrical conductor and tightly clamping the conductor.

With these and other objects in view, the present invention contemplates a device for mechanically retaining and electrically contacting a conductor. The device includes a pair of electrically conductive elongated elements or jaws joined at one end and free at the other. A spacer, which is produced by deforming the inner edges of the

elements, holds the free ends thereof apart a distance equal to less than the diameter of the conductor.

Other objects and advantages of the invention may be more clearly understood by reference to the following description in the accompanying drawings, wherein:

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

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

FIG. 3 is an enlarged, fragmentary perspective view, showing how an insulated conductor is securely joined to the jaws of the connector and how the terminal block for supporting the connector 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 connectors in accordance with the present invention; and

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

Referring now to the drawings, and more particularly to FIG. 1, there is shown a device or a clip-type connector 11 for mechanically retaining and electrically contacting an insulated conductor 12, FIGS. 2 and 3. The connector 11 is formed from a sheet of resilient, electrically conductive material such as Phosphor bronze or the like.

The connector 11 includes first and second elongated elements or jaws 13 and 14 joined at one end by a 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 sidewise 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 is longer than 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 slideably receive the conductor 12.

Formed between the jaws 13 and 14 is a 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 Serial No. 182,560 filed March 26, 1962. Moreover, an aperture 22 located above the slot 21 is formed between the jaws 13 and 14. The aperture 22, in cooperation with the slot 21, defines the length of portions or protuberances 23 produced by plastically deforming the inner edges of the jaws 13 and 14. The function of the deformed portions 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 inner edges of the jaws 13 and 14 which contact the conductor 12. For a 24 gauge insulated conductor, this lateral dimensions is equal to 0.005 inch.

As shown in FIG. 2, a plurality of the connectors 11 are joined together by the base portions 16 thereof, and a group of such joined connectors 11, are mounted in a terminal block 26 to form a unit. Securely holding the connectors 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 connectors 11, prevents the conductor 12 from sliding too far down the jaws 13 and 14 and into the apertures 22 of the connectors 11.

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

Shown in FIG. 4 is a schematic of an apparatus for making the clip-type electrical connectors 11 joined together by base portions 16 in accordance with the present invention. In making such connectors 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 and 38 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 base portion 16 to form the connector 11, and a group of such connectors 11 are also joined together by a group of such base portions 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 connectors 11 are blanked from the strip 31, they fall into and are collected by a bin 66.

Next, the connectors 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.

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.

Inasmuch as the connectors 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 connectors 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.

Since the connector 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 connector 11 were formed with no space 24. Thus, the jaws 13 and 14 of the connector 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 connector 11 may be readily utilized in an unfavorable environment.

It is to be understood that the above-described product forms only one embodiment of the present invention, and numerous products may be derived from the above-described embodiment without departing from the spirit and scope of the invention.

What is claimed is:

1. An insulation-penetrating terminal connector for an insulated electrical conductor, comprising:

a pair of electrically conductive elongated elements having opposing free ends and an integral base section for supporting said free ends,

said base section biasing said free ends toward one another,

a pair of mutually opposed edges on the elements for shearing insulation from a conductor inserted therebetween, and

a least one protuberance projecting from one of said edges into an abutting relationship with a mutually opposed edge for forcing said elements apart against the bias applied by said base section so that said elements are in a prestressed insulation-shearing state prior to receiving the conductor.

2. An insulation-penetrating terminal connector for an insulated electrical conductor, comprising:

a pair of electrically conductive elongated elements having bifurcated free ends and an integral base section for supporting said free ends,

said base section biasing said free ends toward contact with one another,

a pair of mutually opposed edges on the bifurcated elements for shearing insulation from a conductor inserted therebetween, and

a pair of mutually abutting protuberances formed integral with said edges for forcing said elements apart a distance less than the diameter of the conductor against the bias applied by said base section, so that said elements are in a prestressed insulation-shearing state prior to receiving the conductor.

3. An insulation-penetrating terminal connector for an insulated electrical conductor, comprising:

bifurcated electrically conductive elongated elements having free ends and an integral base section for supporting said free ends,

said base section biasing said free ends toward contact with one another,

a pair of mutually opposed edges on the bifurcated elements for shearing insulation from a conductor inserted therebetween, and

a protuberance formed on at least one of the opposed edges and located between the extremities of said free ends and said base section for forcing said elements apart a distance less than the diameter of the conductor against the bias applied by said base section, so that said elements are in a prestressed insulation-shearing state prior to receiving the conductor.

4. The connector as claimed in claim 3, wherein at least said mutually opposed edges of said connector are plated with an electrically conductive, corrosion resisting material.

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