

United States Patent [19]

Kapell

[11] 3,778,749

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[54] CONNECTOR

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339/95 R, 95 P, 97 R, 97 P, 98, 99; 24/125
R, 85 R, 87 R, 243 B, 243 FS, 263 A, 263
LS, 259 PS

[56] References Cited

UNITED STATES PATENTS

3,594,691 7/1971 Neal 174/78 X

3,676,836	7/1972	Gillemot et al.	174/78 UX
3,701,839	10/1972	Smith	174/78
3,253,247	5/1966	Vos	174/78 UX R
3,388,367	6/1968	Brown	339/97 P X

OTHER PUBLICATIONS

Herr et al., German Printed Pat. Application No. H22,583, printed May 3, 1956.

Primary Examiner—Darrell L. Clay

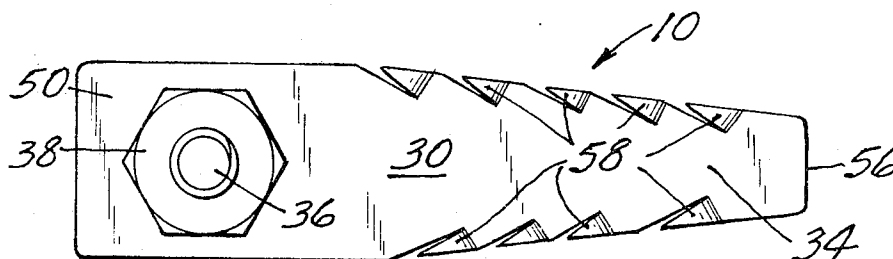
Attorney—Alexander, Sell et al.

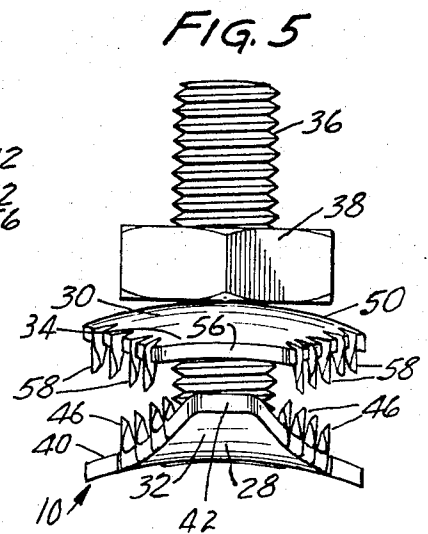
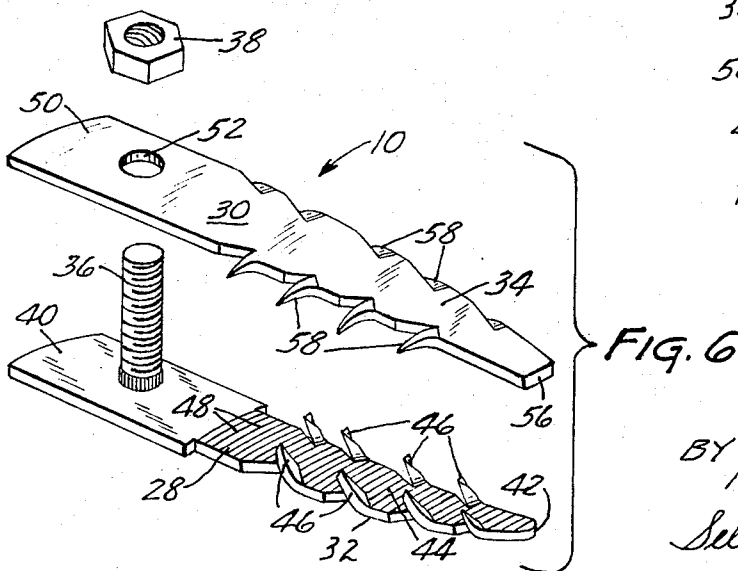
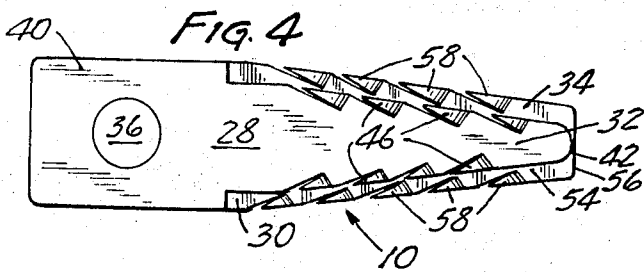
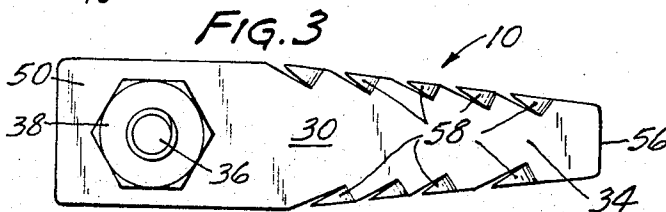
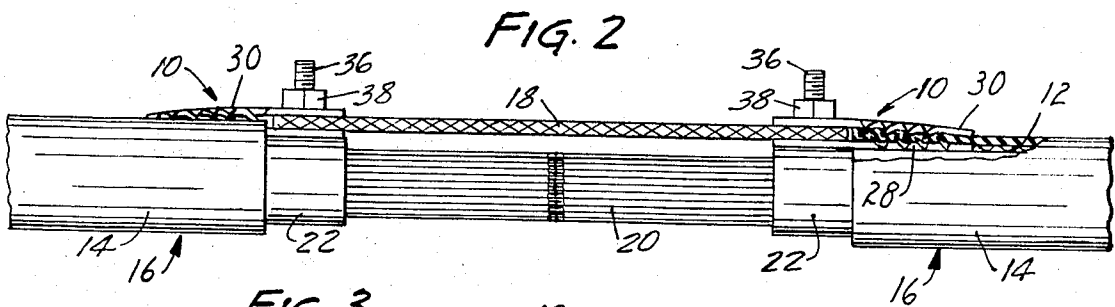
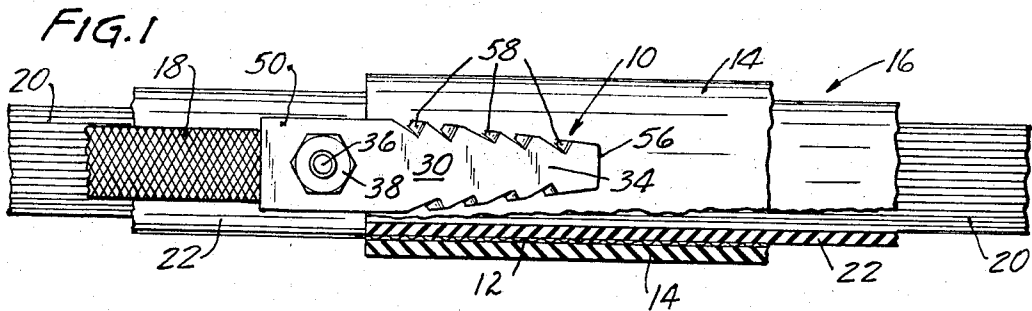
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ABSTRACT

A connector for making electrical connection between an externally jacketed conductive shield on a communication cable and a conductor. The vise-like connector includes a pair of resilient opposed plate-like jaws formed with barbs along tapered projecting portions and adapted to be clamped in engagement with an end of the externally jacketed shield.

4 Claims, 6 Drawing Figures





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CONNECTOR

BACKGROUND OF THE INVENTION

This invention relates to electrical connectors of the type disclosed in U.S. Pats. No. 3,499,972, 3,253,247 and 3,594,691 for making an electrical connection between a conductor and the conductive shield on a communication cable.

A communication cable commonly comprises a number of individually insulated wires which may be bound together with an electrically insulating inner sheath, a sleeve-like electrically conductive shield around the wires, and an electrically insulating outer jacket over the shield. When splicing or terminating the wires, a reliable electrical connection must be made between a conductor and the conductive shield to carry an electrical path across the splice or connect the shield to a source of ground potential to afford grounding of currents from extraneous electrical fields such as lightning.

Some prior art connectors for making such a connector which provide positive mechanical clamping to engage the connector with the conductive shield have required time consuming preparation of the conductive shield or outer jacket, such as notching the conductive shield and jacket as required for use of the connector disclosed in U.S. Pat. No. 3,499,972, or stripping a portion of the outer jacket from about the conductive shield as required for use of the connector disclosed in U.S. Pat. No. 3,253,247. The connector disclosed in U.S. Pat. No. 3,594,691 includes an elongate plate-like contact member formed with in-line rows of spurs projecting from a contact surface and angled toward a first end of the contact member. This connector is attached to a shield by positioning the contact member beneath the conductive shield with the spurs in contact therewith, pulling the first end of the member to draw the spurs into contact with the conductive shield, and maintaining the contact by bending the first end of the contact member about the end of the conductive shield. This connector, however, does not afford mechanical clamping to maintain positive contact between the spurs and the conductive shield.

SUMMARY OF THE INVENTION

A connector according to the present invention provides and maintains a mechanically strong and electrically efficient grounding connection with a jacketed section of an electrically conductive shield on a communication cable without the time consuming preparation of the shield or jacket. The vise-like connector includes a resilient conductive plate-like first jaw having a tapered projecting portion which may be inserted beneath the conductive shield of a communication cable. The projecting portion is formed along its converging edges with a series of barbs oriented for engagement with the inner surface of the conductive shield to effect an efficient electrical connection and the points of the barbs project away from the smaller end to restrict extraction of the first jaw. The connector also includes a resilient second jaw having a projecting portion for contacting the outer surface of the jacket surrounding the shield. The connector includes clamping means for clamping the jaws in opposed relationship on the end of the jacketed conductive shield. The clamping means slightly deforms the resilient jaws so that an electrically efficient and mechanically strong connection will be maintained despite slight deformation of the jacket

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caused by continued application of the clamping force.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be further described with reference to the accompanying drawings wherein like numbers refer to like parts in the several views, and wherein:

FIG. 1 is a horizontal view of a connector according to the present invention shown attached between a conductor and a jacketed section of the conductive shield of a sectioned communication cable fragment;

FIG. 2 is a fragmentary vertical sectional view partially in section of a pair of connectors according to the present invention each shown attached to a woven conductor and to a jacketed conductive shield section on separate communication cables to provide a continuous electrical path for the shields over a splice between the cables;

FIG. 3 is a horizontal plan view of a connector according to the present invention;

FIG. 4 is a bottom view of the connector shown in FIG. 3;

FIG. 5 is a right end view of the connector shown in FIG. 3; and

FIG. 6 is a perspective, exploded view of a connector according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, there is illustrated a connector 10 according to the present invention. The connector 10 is shown engaged with an end of a conductive shield 12 and outer jacket 14 of a communication cable 16 to afford electrical contact between the conductive shield 12 and a woven conductor 18. The conductor 18 may be attached to a source of ground potential or may be a portion of an electrical path around a splice between separate lengths of communication cable 16 as shown in FIG. 2.

The communication cable 16 comprises a series of individually insulated wires 20 which may, as illustrated, be surrounded by an electrically insulating inner sheath 22, a sleeve-like conductive shield 12 around the wires 20 and inner sheath 22, and the electrically insulating tubular outer jacket 14.

The connector 10, best seen in FIGS. 3 through 6 is vise-like comprising a pair of resilient elongate plate-like jaws 28 and 30 each having a projecting portion 32 and 34 respectively adapted for engagement in aligned opposed relationship with a jacketed section of the conductive shield 12. The connector 10 includes clamping means or a bolt 36 and a nut 38 for connecting the jaws 28 and 30 together and to the conductor 18, and for pressing the projecting portions 32 or 34 into contact with a section of the jacketed conductive shield to slightly deflect the resilient jaws 28 and 30 so that firm clamping engagement will be maintained despite changes that may occur in the thickness of the jacketed conductive shield section engaged by the clamp 10.

The projecting portion 32 of the first jaw 28 is designed for insertion axially beneath the conductive shield 12 of a communication cable 16 at an end of the conductive shield 12, for affording efficient electrical connection between the jaw 28 and the shield 12 and for restricting removal of the jaw 28 subsequent to insertion.

The jaw 28, best seen in FIGS. 4 and 6 is formed of a resilient highly conductive metal such as one-half hard cartridge brass or beryllium-copper. The jaw 28 has a base portion 40 to which the bolt 36 may be anchored as by staking. The base portion 40 is slightly curved about a lengthwise axis to conform to the contour of the inner sheath 22. The projecting portion 32 is symmetrically tapered along its length to a smaller generally pointed end 42 and defines a contact surface 44. The contact surface 44 is adapted for engagement with the inner surface of the shield 12. A multiplicity of barbs 46 are formed along the converging edges of the projecting portion 32. Each barb 46 is curved to protrude from the contact surface 44 with the points of the barbs 46 being directed generally away from the end 42. The barbs 46 afford piercing engagement with a conductive shield 12 to insure efficient electrical connection therewith despite coatings such as oxides or the thin layer of polyethylene often present on the shield 12. The configuration of the projecting portion spaces the barbs 46 with respect to the width of the jaw 28. Upon insertion of the projecting portion 32 beneath a conductive shield 12, the point of each barb 46 will trace a separate line of contact against the shield 12 due to the biasing typically caused by the snug fit of the wires 20 and any inner sheath 22 within the shield 12. This affords piercing by the barbs 46 of protective coatings or oxides on the shield 12 while restricting gouging of the shield 12 as might occur upon passage of successive barbs along the same line of contact. The projecting portion 32 may also be formed with a series of transversely extending ridges 48 along the surface 44 to afford a slight filing of the inner surface of the conductive shield upon insertion of the projecting portion 32 to remove coatings or oxides and afford good electrical connection. The projecting portion 32 is slightly curved about a transverse axis to provide a cylindrically concave contact surface 44 so that the barbs 46 and contact surface 44 will attain full length engagement and generally uniform pressure contact with the inner surface of the conducting shield 12 upon deflection of the jaw 28 when the connector 10 is clamped onto a jacketed conductive shield section.

The projecting portion 34 of the second jaw 30 is designed for engagement with the exterior surface of the outer jacket 14, in aligned opposed relationship with the contact surface 44 of the first jaw 28.

The jaw 30, best seen in FIGS. 3-6 is formed of a resilient material such as one-half hard brass or stainless steel. The jaw 30 is similar in structure to the jaw 28, having a base portion 50 formed with an opening 52 to receive the bolt 36. The projecting portion 34 is symmetrically tapered to a smaller end 56 and defines a contact surface 54 adapted for engagement with the outer surface of the jacket 14 on a communication cable 12. A multiplicity of barbs 58 are formed along the converging edges of the projecting portion 34. The barbs 58 are curved to protrude from the contact surface 54 with the points of the barbs 58 directed away from the smaller end 56. This positioning of the barbs 58 affords piercing engagement of the barbs 58 with the outer surface of the jacket 14 to restrict removal of the jaw 30 by longitudinal forces applied toward the base portion 50.

The projecting portions 32 and 34 are generally the same length, however, the projecting portion 34 of the second jaw 30 overlaps the projecting portion 32 of the

first jaw 28 along each converging edge by approximately the width of the barbs 58 on the second jaw 30. This overlap insures that a section of jacketed shield 12 to which the connector 10 is attached will be pressed around each barb 46 on the first jaw 28 to insure complete electrical contact.

The jaw 30 is generally domed with a concave contact surface 54. The jaw 30 is curved about a transverse axis, and about a lengthwise axis to conform to the periphery of the outer jacket 14. This configuration provides high structural strength for the projecting portion 34 and full length engagement between the contact surface 54 and the jacket 14 upon deflection of the projecting portion 34 when the connector 10 is attached to a section of a jacketed conductive shield 12. The material of the jaw 30 is resilient to maintain firm engagement with the outer jacket 14 despite deformation of the jacket which may occur due to prolonged clamping pressure.

The barbs 46 and 58 are formed on the jaws 28 and 30 by a multiplicity of linear spaced slits oblique to and extending inwardly from the converging edges of the projecting portions 32 and 34. Each slit forms an angle (preferably in the range of 15° to 45°) with a converging edge to define a triangular barb 46 or 58. Each barb is curved to protrude from the contact surface of the projecting portion 32 or 34 with the point of the barb directed away from the smaller end 42 or 56 of the projecting portion. Jaws formed with barbs of this type have been found to have surprisingly high resistance to fracture starting at the slits forming the barbs upon application of high clamping forces, apparently due to a favorable orientation of the slit ends with respect to the bending forces in the jaws. Additionally, the barbs along the converging edges on each jaw are spaced with respect to the longitudinal axis of the projecting portion 32 or 34 so that barbs will not be positioned opposite each other on a jaw which would substantially reduce the cross sectional area and strength of the projecting portion. The barbs 28 or 30 are preferably formed in spaced relationship along corresponding edges of the projecting portions 32 and 34 to position the barbs on each jaw generally in the interstice between the barbs on the opposing jaw. This configuration aids in pressing the shield 12 about the barbs 46 on the first jaw 28, and insures that slight misalignment of the jaws 28 and 30 will not result in interference between opposing barbs 46 and 58.

The conductor 18 is illustrated as a braided stranded cable, however, the conductor may also comprise a solid or stranded circular wire attached via a suitable terminal lug to the connector 10. The conductor 18 or terminal lug is positioned over the bolt 36 between the base portion 40 and 50 of the jaws 28 and 30. The conductor 18 or lug should have generally the same compressed thickness as the thickness of the jacketed shield section to which the connector is to be attached to insure proper deflection of the jaws upon tightening of the nut 38.

Although this invention is subject to considerable variation without departure from the spirit thereof, it is believed that the following specific example will facilitate understanding: The jaws 28 and 30 are formed of tin plated 1/16 inch thick copper alloy No. 260, one-half hard with the projecting portion 32 of the first jaw 28 being approximately 3/8 inch wide adjacent the base portion 40 and tapered over its 1 inch length to an end

42 with a 1/16 inch radius. The projecting portion 34 of the second jaw 30 is slightly wider, being approximately 1/2 inch wide adjacent the base portion 48 and tapered over its 1 inch length to a 1/4 inch wide end 30. Each barb 46 or 58 on the jaws 28 or 30 is formed by making a 0.2 inch long slit oriented at approximately 30° to the edge of the jaw. Each jaw is curved with a 3 inch radius about a transverse axis, and the second jaw 30 is curved about a longitudinal axis with a 3/4 inch radius to form a concave contact surface 54. Connectors of this construction securely connected between a jacketed conductive shield section of a communication cable and a conductor 18 of braided stranded copper cable of 6 gauge equivalent have consistently met the portion of Automatic Electric Company Requirement No. AE 8363 for grounding jumper clip assemblies calling for 1200 ampere current flow for 10 seconds with no more than a 5 milliohm increase in contact resistance.

I claim:

1. A connector for making electrical connection between a conductor and a jacketed electrically conductive shield on a communication cable, said connector comprising:

a resilient plate-like conductive first jaw having a base portion, and a relatively flexible elongate symmetrically tapered projecting portion extending from said base portion and terminating in a smaller end, said elongate projecting portion being arcuate about an axis transverse to the width thereof to form a cylindrically concave contact surface adapted for engagement with the inner surface of said shield and having a multiplicity of linear spaced slits oblique to and extending inwardly from its converging edges to form triangular barbs, with each of said barbs being curved to protrude from said contact surface with the point thereof directed generally away from said smaller end;

a resilient plate-like second jaw having a base portion, and an elongate symmetrically tapered projecting portion extending from said base portion and terminating in a smaller end, the projecting portion of said second jaw being domed to define a concave contact surface adapted for engagement with the outer surface of the jacket on said communication cable in aligned opposed relationship with said contact surface of said first jaw and having a multiplicity of linear spaced slits oblique to and extending inwardly from its converging edges to form triangular barbs, with each of said barbs being curved to protrude from said concave contact surface with the point thereof directed generally away from the smaller end, the projecting portion of said second jaw being of essentially the same length as the projecting portion of said first jaw and being sufficiently wide to extend over the projecting portion of said first jaw along each converging edge by approximately the width of said barbs formed on said second jaw; and

means coupled only between said base portions for connecting said first jaw to said conductor and to said second jaw, and for pressing said jaws into contact with a section of the jacketed shield to engage said barbs and to deflect the projecting portion of said first jaw.

2. A connector useful in making an electrical connection between a conductor and a jacketed electrically conductive shield on a communication cable, said connector comprising:

a resilient plate-like conductive first jaw having a base portion and a relatively flexible elongate tapered projecting portion extending from the base portion and terminating in a smaller end, said elongate projecting portion being arcuate about an axis transverse to the width thereof to form a cylindrically concave contact surface adapted for engagement with the inner surface of said shield and having a plurality of spaced slits formed along each edge and extending inwardly from said edges away from the base portion at an angle of between 15° to 45° with the edge to form triangular barbs, with each of said barbs being curved to protrude from said contact surface with the point thereof directed generally away from said smaller end;

a resilient plate-like second jaw having a base portion and a projecting portion extending from the base portion and defining a contact surface adapted for engagement with the outer surface of the jacket on said communication cable in aligned opposed relationship with said contact surface of said first jaw, said projecting portion of said second jaw being wider than corresponding portions of the projecting portion of said first jaw; and

means coupled only between said portions for connecting said first jaw to said conductor and to said second jaw and for pressing said jaws into contact with a section of the jacketed electrically conductive shield to engage said barbs with said shield and to deflect the projecting portion of said first jaw.

3. The connector of claim 2 wherein the projecting portion of said second jaw is tapered toward a smaller end opposite the base portion thereof, and has a multiplicity of linear spaced slits oblique to and extending inwardly from its converging edges to form triangular barbs positioned along its converging edges, each of said barbs being curved to protrude from said contact surface with the point thereof directed generally away from said smaller end; and the projecting portion of said second jaw is wider than the corresponding projecting portion of said first jaw by approximately the width of said barbs formed on said second jaw.

4. The connector of claim 4 wherein the barbs on said first and second jaws are formed in spaced relationship along corresponding edges to position the barbs on each jaw generally in the interstice between barbs on the opposing jaw.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,778,749

Dated December 11, 1973

Inventor(s) Henry K. Kapell

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 4, line 1, change "claim 4" to -- claim 3 --.

Signed and sealed this 9th day of April 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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