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(54) **Cordage terminated by modular plug having enhanced terminal to conductor engagement**

Kabel angeschlossen am modularen Stecker mit verbesserter Verbindung zwischen Kontakt und Leiter

Cordage terminé par une prise modulaire avec engagement borne-conducteur amélioré

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Description

Technical Field

This invention relates to cordage terminated by a modular plug having enhanced terminal to conductor engagement.

Background of the Invention

A conductor of a telephone cord which connects a telephone handset to a telephone base and in some instances a telephone base to a wall terminal generally comprises a polymeric core having a plurality of tinsel ribbons, i.e., typically three or four, wrapped helically thereabout. The tinsel conductors are covered with a suitable insulative covering such as, for example, which is disclosed and claimed in U. S. Patent 4,090,763 and in U.S. patent 4,705,823. For those cords which connect a telephone base to a wall terminal, each insulated conductor generally includes an elongated metallic member comprising a plurality of metallic wire-like members stranded together and insulated with a plastic material. A plurality of the individually insulated conductors are jacketed with a plasticized polyvinyl chloride (PVC) composition of matter.

In a commonly used cord connection arrangement, each end of a line or handset cord is terminated with a miniature plug, which is termed modular, to facilitate attachment to jacks in telephone instruments and in wall outlets. An end of a cord is inserted into one end of a modular plug and secured therein. The modular plug is adapted to be inserted into a cavity of a jack of a telephone, for example, or into a wall outlet to establish electrical connections between cord conductors which are terminated within the plug and contact elements in the form of wires in the jack. Modular plugs are disclosed, for example, in U. S. Patent Nos. 3,699,498 and 4,148,539.

Typically, a modular plug includes a plastic housing having conductor-receiving troughs which communicate with a cord-receiving opening at one end of the plug. An opposite end of the plug is referred to as a termination or free end. Terminal-receiving slots extend between the troughs and an outwardly facing inner surface of a well of the housing from which a plurality of partitions extend to an outer surface of the housing. Each slot opens to the inner surface of the well between two partitions or between a partition and a sidewall of the housing.

In one method of termination of a cord with a plug, the jacket is removed from an end portion of a length of cordage. That end portion is inserted into the cord-receiving end of the plug with end portions of the conductors being received in the plug troughs. Then the end portion of the length of cordage is secured within the plug and the plug is positioned in a nest to receive a plurality of terminals. Plated strips of terminals are fed into insertion apparatus such as is shown, for example, in U. S.

Patent 3,839,787. Terminals are severed from the strips and seated within the terminal-receiving slots to engage electrically the cord conductors in the troughs. The slots are spaced to cause the seated terminals to engage the contact wires when the plug is inserted into a jack cavity and thereby connect electrically the cord conductors to the jack. In another method, cord conductors are inserted into an end of a plug housing having terminals preinserted therein. Then the terminals are moved farther into the housing, penetrating the conductors and becoming seated in the housing.

One prior terminal is described in abovementioned U. S. Patent 4,148,539. It is made from sheet stock of an electrically conductive material such as, for example, a Phosphor-bronze alloy. The terminal has flat major faces spaced apart by an edge surface which includes an internal contact portion comprising protruding tangs. When the terminals are seated fully within the plug housing, the tangs pierce the insulation of and engage electrically the conductors of the cord which has been inserted into the one end of the plug.

Each terminal also includes an external contact portion being exposed to an outer surface of the housing and having an outer surface which is spaced slightly from outer edge surfaces of the partitions which are coplanar with the outer surface of the housing. Each external contact portion includes an edge surface having a crown of a predetermined radius termed at each end thereof. The terminal is symmetrical with respect to an axis which extends through its center of gravity and which is normal to the edge surface of the external contact portion. That crown which is adjacent to the termination end of the plug housing functions to engage an aligned wire-like contact element of the jack into which the plug is inserted to complete an electrical connection from a conductor of the cord to the jack.

Each terminal also has barbs formed on opposed end surfaces thereof. The barbs support the terminals within the terminal-receiving slots to space the external contact portions above the inner surface of the well with the barbs being embedded in end walls which define the slots to prevent unintended movement of the terminals while each of the terminals is in a partially inserted position or when each is in a fully seated position.

In one flat blade-like terminal, an external contact portion of the blade has been reconfigured. Each terminal comprises a body portion which includes a reference surface that extends from one end of the terminal toward the other end. Each terminal also includes a fin-like portion having a curved leading edge surface which is adjacent to the termination end of the plug housing and a linear trailing edge surface that is normal to the reference edge surface. The external contact portion protrudes from the body portion and is disposed asymmetrically between the ends of the body portion adjacent to the other end of the terminal.

Substantially the entire surface area of the hereinbefore-described terminal is covered with a base layer

or layers of metallic material which provides corrosion resistance, smooths the terminal metal, and prevents diffusion of the terminal metal into a subsequently deposited layer of metallic material. The base layer is covered with a relatively thin layer of gold which is called a flash and which enhances a connection to a cord conductor. Also, selected surface areas of the external contact portion are covered with an additional layer of metallic material such as gold to enhance conductivity of the connection with a contact wire of the jack.

A terminal, such as one of those described hereinabove, is inserted into each slot of the housing such that an external contact portion of each is oriented toward the outer surface of the housing to which the partitions extend. The internal contact portion of the terminal establishes an electrical connection with a conductor of the cord that has been inserted into the housing prior to the insertion of the terminals. Of course, in the use of a plug having preinserted terminals, the terminals are preinserted prior to insertion of the cord conductors. The external contact portion of each terminal extends beyond the slot in which the terminal is seated and is adapted to make electrical engagement with a wire-like contact element of a jack when the plug is inserted into the cavity of the jack.

U.S.-A-4 184 539 describes a modular plug for terminating a multiconductor cord. The plug has a plastic housing with conductor receiving cells. Terminal receiving slots extend between a chamber in the housing and the exterior of the housing. This document forms the basis for the preamble of claims 1 and 8.

One of the problems which has manifested itself relates to the engagement of the tangs of the terminals with the tinsel or stranded conductors. Electrical opens have occurred, evidently because of a less than satisfactory sustained engagement. Also it has been found that disconnections have occurred when a cord which is terminated by a plug is pulled or moved in an oscillatory manner, for example.

Further, it has been found that because of the way in which tinsel ribbons are wound about the polymeric core, two of the ribbons may become stacked and aligned in a longitudinal plane with the third ribbon of a three ribbon conductor. As a result, it has been commonplace for the tangs of the terminals to penetrate simultaneously stacked portions of turns of two of the ribbons and the aligned portion of a turn of the third ribbon. This may cause the ribbons to become severed, resulting in electrical opens and interruptions to service. Also, gaps appear between successive stacks and adjacent turns of the third, single ribbon. Electrical opens also are caused because of tangs of the terminals engaging the conductors between adjacent ones of the turns of helically wound tinsel ribbons and possibly not engaging the ribbons.

What is needed and what seemingly is not available in the prior art is a modular plug having enhanced and maintained electrical engagement between the termi-

nals thereof and a length of cordage which is terminated by the plug. The sought after modular plug should be one in which an arrangement for enhanced engagement is relatively inexpensive to implement.

Summary of the Invention

According to the invention, there is provided a modular plug which has enhanced terminal to conductor engagement as set out in Claim 1.

Brief Description of the Drawing

FIG. 1 is a perspective view of a portion of a telephone cord which comprises insulated tinsel conductors and which is terminated by a modular plug of this invention, the modular plug including terminals which provide enhanced and sustained electrical engagement of the terminals with conductors of the cord;

FIG. 2 is an elevational view in section of the modular plug which is shown in FIG. 1 with a terminal being positioned in a housing of the plug prior to being driven into seated engagement with an insulated conductor of the cord;

FIG. 3 depicts a stranded conductor of a cord which may be terminated by a plug of this invention;

FIG. 4 is an elevational view in section of a modular plug having terminals of the prior art with one of the terminals positioned to be seated fully;

FIG. 5 is an elevational view in section of the modular plug of FIG. 2 after the terminals have been seated fully in the plug;

FIGS. 6 and 7 are front elevational views of a terminal of this invention and one of the prior art, respectively, positioned for engaging an insulated cord conductor;

FIGS. 8 and 9 are plan views in section of tang portions of the terminal of this invention and one of the prior art aligned with an insulated cord conductor;

FIG. 10 is a simplified view which depicts a portion of a plastic core of a length of cordage with tinsel ribbons wound thereabout in one configuration and with a terminal shown in a preseated and in a seated position, the thickness of the tinsel ribbons being exaggerated for purposes of clarity;

FIGS. 11 and 12 are simplified views which depict a portion of a plastic core of a length of cordage with tinsel ribbons wound thereabout in configurations different from that of FIG. 10 and with terminals positioned for seating in a plug, the thicknesses of the ribbons being exaggerated for purposes of clarity; FIGS. 13, 14, and 15 are side elevational views of terminals which have been used, which are used and which are in accordance with this invention, respectively; and

FIG. 16 shows an end view of a terminal with tangs thereof having been coined.

Detailed Description

Modular cord systems typically include cords 20-20 (see FIG. 1), each comprising a length of cordage 21 terminated at each end by a modular plug 23. The phrase "modular cord system" is intended to describe a system which includes the use of devices mounted in equipment and assembled to cord ends to facilitate customer connection of the cords to the equipment. The cordage 21 includes a plurality of individually insulated flexible conductors 22-22 (see FIG. 2). The cords are terminated with modular plugs 23-23 of the type shown, for example, in priorly mentioned U. S. Patent No. 4,148,539.

The construction of the cordage 21 is well known. The flexible conductor 22 may include a filamentary core 25 (see FIGS. 1 and 2) having a plurality of tinsel ribbons 27-27 wrapped helically thereabout and enclosed with a suitable insulative covering 28 such as that, for example, disclosed and claimed in hereinbefore identified U. S. Patent Nos. 4,090,763 and 4,705,823. In the alternative, a plurality of wire-like metallic conductors 29-29 (see FIG. 3) are stranded together and insulated with a plastic material 31 to provide an insulated conductor 32. The insulated conductors 22-22 may be disposed side-by-side in a planar array and are enclosed in a common jacket 34 (see FIG. 1) made of a suitable plastic material. The final cord configuration has a cross-section with parallel sides and semi-circular end and is referred to as a flat cord.

The cord 20 may be connected to a telephone handset, to a telephone base, or to a wall terminal by inserting a plug 23 into a jack (not shown). The jack is typically that shown in U. S. Patent No. 3,990,764. The jack includes a cavity and a plurality of spaced-apart wire-like contact elements which protrude angularly into the cavity of the jack in which is received the modular plug.

As can be seen in FIGS. 1 and 2, the modular plug 23 constructed in accordance with the principles of this invention includes a housing 41 (see also FIG. 4), which is made from a dielectric material, and a plurality of terminals 42-42. The terminals 42-42 are destined to connect electrically the conductors 22-22 of the cord which are housed within the plug 23 and electrical components of telephone apparatus such as, for example, the wire-like contact elements of the jack. The terminals 42-42 are mounted within the housing 41 to be engageable by the contact wires in the jack.

The plug housing 41 is a unipartite rigid housing (see FIGS. 1, 2 and 4) made from a plastic material such as polycarbonate. The housing 41 includes a so-called free or termination end 46 which is closed. Further, the housing 41 includes a cord input end 47, a terminal-receiving side 48 and a side 49 opposite the terminal-receiving side. The cord input end 47 of the housing 41 is formed with a flared cord input aperture (not shown) which opens to a plurality of conductor-receiving troughs 56-56.

The conductor-receiving troughs 56-56 are constructed to provide a plurality of individual duct-like com-

partments which are disposed in one tier for receiving the conductors of a cord 20. They extend longitudinally from the vicinity of the free end 46. Each of the compartments is of sufficient size to accept one of the insulated conductors of the cordage 21.

An assembler removes a sufficient length of the cordage jacket 34 to permit insertion of the insulated conductors into the troughs 56-56. Then the assembler installs the jacketed portion of the cordage 21 into the cord-input aperture with the insulated conductors extending farther along into the troughs 56-56.

The plug 23 of this invention includes a plurality of partitions 61-61 (see FIG. 1). In the plug 23, the portion of each partition 61 which extends to and which is coplanar with the terminal-receiving side 48 may extend for only a fraction of the distance between the ends of a well 62 (see FIGS. 1 and 2). When a plug 23 is inserted into a jack, each wire-like contact member is received between adjacent ones of the partitions 61-61 adjacent to the free end of the plug or between a partition and a side-wall of the well 62.

Each terminal 42 is adapted to be received in a terminal-receiving slot 64-64 (see FIG. 2). Each of the terminal-receiving slots 64-64 opens to a surface 66 and connects the well 62 with an associated one of the conductor-receiving troughs 56-56. The terminal-receiving slots 64-64 extend parallel to the troughs 56-56 and include end walls 68 and 69. As can be seen in FIG. 2, the end walls 68 and 69 are oriented toward the free end 46 and the cord input end 47, respectively, of the housing 41.

Each of the terminals 42-42 is flat and blade-like and is made from a strip of an electrically conductive material such as, for example, brass or Phosphor-bronze alloy. As can best be seen in the drawings and particularly FIGS. 1 and 2 thereof, each terminal 42 includes a body portion 74 defined by flat faces 75-75 which are spaced apart by end edge surfaces 77 and 78. The end surfaces 77 and 78 are interrupted by cutouts 79-79 to form shoulders 76-76. The terminal has an overall height of about 0.38 cm, an overall length of about 0.34 cm and a thickness of about 0.03 cm.

Internal contact portions in the form of triangularly shaped tangs 82-82 extend from a lower portion of the body 74 of the terminal 42. When the terminals 42-42 are seated fully within the housing 41 (see FIG. 5), the tangs 82-82 pierce through the insulation of and engage electrically the current carrying portions such as, for example, the tinsel ribbons of the insulated conductors 22-22. When the terminal 42 is in the fully seated position, the tangs 82-82 extend through an aligned associated insulated conductor and become embedded slightly, e. g. about 0.010 cm, in the bottoms of the conductor-receiving facilities of the housing. This supplements side edge support of the terminals 42-42 in the housing 41 to prevent unintended movement of the terminals.

The terminal 42 also includes two sets of side edge barbs. One set of barbs 83-83 are disposed adjacent to

the tangs 82-82. Another set of side barbs 85-85 are disposed between the barbs 83-83 and shoulder portions 76-76. The out-to-out distance of the side barbs 85-85 is about 0.27 cm. As the terminals 42-42 are seated in the housing 41, the barbs 83-83 and the barbs 85-85 dig into the end walls 68 and 69 of the housing 41 to anchor the terminals in the slots 64-64. The plastic housing 41 cooperates with the edge surfaces of the terminal 42 to support the terminals in an inserted position.

Each terminal 42 has an externally facing portion in the form of a reference edge surface 90 (see FIGS. 1-2 and 6-7). The reference edge surface 90 extends from the end edge surface 78 toward the other end edge surface 77. Because the reference edge surface 90 is spaced a predetermined distance from the tangs 82-82 which engage the plastic material of the housing 41, it becomes a datum or reference surface for internal and external contact portions of the terminal 42.

In order to engage an external component such as a jack wire, the terminal 42 includes an external contact portion. The external contact portion is exposed to an outer surface of the housing to engage an aligned external component such as a wire-like contact element of a jack into which the plug is inserted to complete an electrical circuit from the cord to the jack.

In a preferred embodiment, the external contact portion is configured to include a fin-shaped protrusion 94 (see FIGS. 1, 2, 6, and 7) which extends from the body portion 74 along the exposed reference edge surface 90 of the terminal. As can be seen, the protrusion 94 is disposed asymmetrically of the body portion 74 and is closer to the end surface 77 than to the end surface 78. When the terminal 42 is positioned in the housing 41, the protrusion 94 is adjacent to the termination end 46 of the housing 41.

The outermost portion of the protrusion is spaced a predetermined distance above the reference surface 90. This insures that it is within a range of distance, i.e. about 0.046 to 0.071 cm, below the outer edge surfaces of the partitions 61-61 when the tangs 82-82 are embedded in the bottoms of the troughs 56-56.

Going now to FIGS. 8-9 and FIGS. 10-12 there are shown views of a filamentary core 25 with three tinsel ribbons 27-27, for example, wrapped thereabout which as mentioned hereinbefore may be the structure of one of the insulated cord conductors 22-22. Each of the tinsel ribbons has a thickness of about 0.063 cm and a width of about 0.05 cm. In FIG. 10 is shown the ideal wrapping of the three ribbons, the ribbons being designated 101, 103 and 105. As can be seen, the ribbon 101 is wrapped about the core 25 so that it is in continuous engagement with the core. On the other hand, the ribbon 103 is wrapped to cause a portion 107 thereof to overlap a trailing portion of the next successive turn of the ribbon 101. Also, as can be seen, the ribbon 105 is wrapped so that a trailing portion 108 of each turn overlaps a leading portion of an adjacent turn of the ribbon 101 and so that a leading portion 109 thereof overlaps a trailing portion of

an adjacent turn of the ribbon 103.

It has been found that the wrapping of the ribbons is carried out so that the arrangement appears more nearly as shown in FIG. 11. There, it is seen that the ribbons 101 and 105 are substantially in engagement with the core 25. The third one of the ribbons i.e., ribbon 103, is stacked on the ribbon 101 to be congruent therewith. Also from FIG. 11, it can be observed that gaps 111 may exist between turns of adjacent ribbons. Further, at diametrically opposed locations along the core 25, a stack of turns of the ribbons 101 and 103 oppose and are aligned with a single turn of the ribbon 105.

Still another wrapping arrangement of the ribbons is possible in the cordage. This is depicted in FIG. 12. In it, both of the ribbons 101 and 105 are in substantial engagement with the core 25. The ribbon 103 is would to overlap a trailing end portion of each turn of the ribbon 105 and a leading portion of the ribbon 101.

Viewing now FIGS. 13, 14 and 15, there are shown front elevational views of a prior art blade-like terminal 120, of a presently used terminal 122 and of a terminal 42 of this invention, respectively. One of the differences among the terminals is that portions of the terminal which form the side edge barbs in FIG. 15 are configured differently from those in FIGS. 13 and 14. A broken line 124 in each of FIGS. 13-15 represents an outer topmost portion of the tinsel ribbon arrangement of an insulated tinsel conductor 22 positioned in a trough 56 of a plug housing 41, as viewed in FIGS. 13-15.

More importantly, the arrangement and configuration of the tangs which penetrate the tinsel conductors is different among the terminals. As can be seen in FIG. 13, tangs 125-125 of the terminal 120 have a width, w_1 , as measured in the plane of the drawings along the line 124 of a tinsel conductor terminated by the terminal 120. The width, w_1 , is the maximum width of the tang 125 as seen by a tinsel ribbon of the conductor 22 penetrated thereby. In FIG. 14, because of the shape of tangs 126-126 of the terminal 122, the maximum width of penetration of the tinsel ribbons by a tang 126, w_2 , is measured in a direction parallel to the line 124 but slightly therebelow. For the terminal 42 shown in FIG. 15, the width of penetration or shear of a tang 82 is labelled w_3 and is taken along the line 124 at the outer top of the tinsel wrap.

It should be apparent from a comparison of FIGS. 13-15 and also of FIGS. 8 and 9, that the widths w_1 and w_2 of prior art and presently used terminals is substantially greater than the width w_3 of the terminal of the plug of this invention. As a result, substantially less width of a tinsel ribbon is sheared by the tangs of the terminal in FIG. 15 than those in FIGS. 13 and 14. In fact, so much of the width of a tinsel ribbon or of a stranded conductor terminated by the terminal of FIG. 13 or of FIG. 14 is sheared, that subsequent movement of the cordage such as, for example, by a customer, may cause the tinsel ribbon to be separated into separate portions along the line of shear. In fact, as is seen in FIG. 9, the width w_2 of presently used terminals is greater than the dis-

tance across a tinsel ribbon as measured parallel to an axis of the conductor.

This may become particularly acute in the ribbon arrangement of FIG. 11. Should one of the tangs be centered on a stack of turns of the ribbons 101 and 103, the tang also will penetrate the aligned turn of the ribbon 105. With tang widths of the terminals of FIGS. 13 and 14, substantially the entire distance across the ribbon as measured in a direction parallel to the axis of the insulated conductor for all of those aligned turns will be penetrated.

This problem may be seen best by viewing FIGS. 10, 11 and 12 which depict the ribbon wrap arrangements with a terminal superimposed thereon. As can be seen in FIGS. 11 and 12, it becomes possible for the tangs of the terminals to penetrate all three of the ribbons after they have been driven into the plastic beds of the conductor-receiving troughs during the assembly of the terminals with the plug housing. Should this occur, particularly with the terminal widths shown in FIGS. 13 and 14, each of the ribbons may separate into portions and be rendered inoperative.

Of course, the foregoing may not be a problem to continued service of the cordage because of the use of three or more tinsel ribbons in each conductor. It had been thought that at least one of the ribbons would remain intact. This may not always be true because of the relationship which exists among the spacing of the tangs of the prior art terminals and the lay length of each of the helically wound ribbons.

Furthermore, a tang of a terminal may become positioned in a gap 111 (see FIG. 11) between congruent turns of ribbons 101 and 103 and an adjacent ribbon 105. This also may occur with a gap 113 of the arrangement shown in FIG. 12. These gaps may be substantially wider than shown so that edge surfaces of adjacent ribbons may not engage or may not maintain electrical engagement with the terminal. Worse, if the spacing between the tangs corresponds to the lay length of the ribbons such as with the terminal 122 in the ribbon arrangement of FIG. 11, both tangs may be received in such gaps.

This problem has been overcome with the modular plug of this invention. Not only does the terminal 42 of the modular plug 23 have tangs of substantially less width as measured in a direction parallel to longitudinal axes of the conductors than those of prior art and presently used terminals, but also, the spacing between the tangs differs from the lay length of each of the ribbons (see FIGS. 2, 6 and 10-12). In one embodiment, the center-to-center distance between the tangs is about one and one half times as long as that in prior art terminals.

As is seen in FIGS. 10-12, the terminal tangs do not coincide with the gaps between successive turns of the ribbons. Furthermore, insertion of the terminals does not result in the tangs thereof penetrating through substantial portions of the ribbons. As a result, there is a substantially greater probability of sustained electrical contact between the terminal tangs and the ribbons.

It should also be observed particularly from FIGS. 6, 15 and 16 that a portion 130 each tang 82 is coined, preferably, equally from each major side of the terminal 42. Coining of the portions 130-130 facilitates the insertion of the terminals, allowing, for example, the tangs to move between strands of a conductor such as that shown in FIG. 3. Also, because of the coining, somewhat less metal is penetrated than in the use of prior art terminals.

For the most part, the foregoing description has been with respect to a tinsel ribbon conductor. It should be realized that should the insulated conductor be a stranded conductor such as that shown in FIG. 3, the terminals 42-42 of this invention also will result in the penetration of a lower percent of the individual wire-like conductors than occurs with a prior art terminal. As a result, stranded conductors terminated with terminals of this invention have enhanced reliability and sustained integrity over those terminated with terminals of the prior art.

Although the invention has been described in terms of a terminated cordage wherein the cordage includes stranded conductors or three tinsel ribbons, it should be understood that the invention includes terminated cordage which includes less than or more than that number of ribbons. For example, a cord conductor may include four ribbons wrapped helically about a filamentary core such that two stacks of two each are provided. In another, a fifth ribbon which spans the two helically wrapped stacks may be added.

Claims

1. A terminated cordage (21) which comprises:

a length of cordage (21) which comprises a plurality of insulated conductors (22-22) each of which includes:

a longitudinally extending core member (25),

at least one extending electrically conductive ribbon (27) which is wound helically with a lay length in a plurality of turns about said core member (25) and

an insulation material (31) which covers said at least one ribbon (27) and

a modular plug (23) which terminates an end of said length of cordage (21), said plug (23) comprising:

a housing (41) which includes a cavity for receiving said conductors (22-22) of said cordage (21);

a plurality of slots (64-64) which communicate with said cavity and with an externally facing surface of said housing (41) with each of said slots (64-64) being associated and aligned with one of said conductors (22-22); and

a plurality of blade-like electrically conductive terminals (42-42) each of which includes two

adjacent spaced insulation piercing tangs (82-82) along one edge surface thereof and each of which is disposed in one of said slots (64-64) such that portions of said tangs (82-82) penetrate the at least one ribbon (27) of an aligned associated conductor (22) to establish electrical engagement therewith characterised in that said portions of said tangs (82-82) of each terminal (42) which are in engagement with the at least one ribbon (27) of the aligned associated conductor (22) each have a width as measured in a direction parallel to the longitudinal axis of the aligned associated conductor (22) which width is less than the width of a turn of said at least one ribbon (27) as measured in a direction parallel to the longitudinal axis of the aligned conductor (22) to minimize the amount of said at least one ribbon (27) which is penetrated by the terminal (42) when the terminal (42) is inserted and in that said tangs (82-82) are spaced apart a distance which is such that one of the two adjacent tangs (82-82) penetrates a substantially greater portion of the width of a turn of the at least one ribbon (27) as measured in a direction parallel to the longitudinal axis of the aligned conductor (22) than does the other one of the two adjacent tangs (82-82) of the width of another turn.

2. The terminated cordage of claim 1, wherein each tang of each terminal in a plane generally parallel to a longitudinal axis of a conductor is triangularly spaced with a base attached to a body of the terminal and an apex being embedded in the housing and wherein the thickness of each tang of each terminal decreases in a direction from said body of said each terminal to said apex of said each tang of said each terminal.

3. The terminated cordage of claim 1, wherein each conductor includes a longitudinally extending core member, at least one extending electrically conductive ribbon which is wound helically with a lay length about said core member; and an insulation material which covers said at least one ribbon; and wherein said plug includes a plurality of blade-like electrically conductive terminals each of which includes insulation-piercing tangs along one edge surface thereof and each of which is disposed in one of said slots such that said tangs penetrate the at least one ribbon of an aligned associated conductor to establish electrical engagement therewith, said tangs of each terminal each having a width as measured in a direction parallel to the longitudinal axis of the aligned associated conductor in portions of the tangs which are in engagement with the at least one ribbon of the aligned associated conductor which minimizes the amount of said at least one ribbon which is pene-

trated by the terminal when the terminal is inserted and said tangs being spaced apart a distance which is other than a multiple of the lay length of said at least one ribbon.

4. The terminated cordage of claim 1, wherein said tangs of each terminal are spaced apart a distance which differs from an even multiple of said lay length.

5. The terminated cordage of claim 4, wherein said cordage includes three ribbons with each turn of each ribbon engaging the core and having a longitudinal edge portion which is in engagement with a longitudinal edge portion of each of two adjacent ribbons.

6. The terminated cordage of claim 4, wherein said cordage includes three ribbons with turns of one of the ribbons substantially being superimposed on another one of the ribbons and with turns of the third ribbon being interposed between adjacent turns of the superimposed ribbons.

7. The terminated cordage of claim 4, wherein successive turns of two of the ribbons alternate with successive turns of each other and wherein each successive turn of the third ribbon is out of engagement with the core and overlies a portion of the adjacent turns of the two ribbons.

8. A modular plug assembly comprising a length of cordage (21) and a modular plug (23) which terminates an end of said length of cordage, (21) which includes a plurality of insulated conductors (22-22) each of which includes a core (25) and a plurality of electrically conductive ribbons (27-27) which are wrapped helically in a plurality of turns about the core (25) with each ribbon (27) having a lay length, said plug (23) including:

a housing (41) which includes a cavity for receiving said conductors (22-22) of said cordage (21);

a plurality of slots (64-64) which communicate with said cavity and with an externally facing surface of said housing (41) each of said slots (64-64) adapted to be aligned and associated with a conductor (22); and

a plurality of blade-like electrically conductive terminals (42-42) each of which includes two adjacent spaced insulation-piercing tangs (82-82) along one edge surface thereof and each of which is disposed in one of said slots (64-64) such that said tangs (82-82) penetrate the aligned associated conductor (22) to establish electrical engagement therewith, characterised in that said tangs (82-82) of each terminal (42) each have a width as measured in a direc-

tion parallel to the longitudinal axis of the aligned associated conductor (22) in the portions of the tangs (82-82) which are in engagement with the ribbons (27-27) which width is less than the width of a turn of a ribbon (27) as measured in a direction parallel to the longitudinal axis of the aligned associated conductor (22) to minimize the amount of each ribbon (27) which is sheared by the terminal (42) when the terminal (42) is inserted and in that said tangs (82-82) are spaced apart a distance which is such that one of the two adjacent tangs (82-82) penetrates a substantially greater portion of the width of a ribbon (27) as measured in a direction parallel to the longitudinal axis of the aligned conductor (22) than does the other one of the two adjacent tangs (82-82) of the width of another turn.

9. The modular plug assembly of claim 8, wherein the cordage terminated thereby includes a plurality of insulated conductors each of which includes a core and a plurality of electrically conductive ribbons which are wrapped helically about the core with each ribbon having a lay length, and wherein said tangs being spaced apart a distance which is other than multiple of the lay length of any of the ribbons.

10. The modular plug assembly of claim 9, wherein each tang of said terminal in a plane generally parallel to a longitudinal axis of a conductor is triangularly shaped with a base attached to a body of the terminal and an apex being embedded in the housing and wherein the thickness of each tang of said terminal decreases in a direction from said body of said terminal to said apex of said each tang of said terminal.

Patentansprüche

1. Abgeschlossene Kabelschnur (21) mit folgenden Merkmalen:

ein Stück Kabelschnur (21) umfaßt eine Mehrzahl von isolierten Leitern (22-22), die jeweils umfassen:

ein sich länglich erstreckendes Kernteil (25), mindestens ein sich erstreckendes elektrisch leitfähiges Band (27), das mit einer Schlaglänge in mehreren Windungen um das Kernteil (25) schraubenförmig gewickelt ist, und Isolationsmaterial (31), welches mindestens ein Band (27) bedeckt;

ein modularer Stecker (23) schließt ein Ende des Stückes der Kabelschnur (21) ab und umfaßt:

ein Gehäuse (41), welches einen Hohlraum zur Aufnahme der Leiter (22-22) der Kabelschnur

(21) aufweist,

eine Mehrzahl von Schlitzten (64-64), die mit dem Hohlraum und mit einer Außenoberfläche des Gehäuses (41) in Verbindung stehen, wobei die jeweiligen Schlitzte (64-64) jeweils einem Leiter (22-22) zugeordnet und zu diesem ausgerichtet sind, und

eine Mehrzahl von klingenartigen elektrisch leitfähigen Klemmen (42-42), die entlang einer Kantenfläche jeweils zwei benachbarte und im Abstand voneinander angeordnete, die Isolierung durchdringende Dorne (82-82) aufweisen und die jeweils in einem der Schlitzte (64-64) angeordnet sind, derart, daß Teile der Dorne (82-82) durch mindestens ein Band (27) eines zugeordneten ausgerichteten Leiters (22) hindurchdringen, um den elektrischen Kontakt herzustellen,

dadurch gekennzeichnet,

daß die Teile der Dorne (82-82) jeder Klemme (42), die in Eingriff mit mindestens einem Band (27) des zugeordneten ausgerichteten Leiters (22) stehen, jeweils eine Breite aufweisen, gemessen in einer Richtung parallel zur Längsachse des zugeordneten ausgerichteten Leiters (22), die kleiner als die Breite einer Wicklung des mindestens einen Bandes (27) ist, gemessen in Richtung parallel zur Längsachse des ausgerichteten Leiters (22), um den Betrag des mindestens einen Bandes (27) klein zu halten, der von der Klemme (42) durchdrungen wird, wenn die Klemme (42) eingefügt wird,

und daß die Dorne (82-82) um einen solchen Abstand voneinander angeordnet sind, daß eine der beiden benachbarten Dorne (82-82) einen im wesentlichen größeren Teil der Breite einer Wicklung von mindestens einem Band (27) durchdringt, gemessen in Richtung parallel zur Längsachse des ausgerichteten Leiters (22), als dies der andere der beiden Dorne (82-82) hinsichtlich der Breite der anderen Wicklung tut.

2. Abgeschlossene Kabelschnur nach Anspruch 1, dadurch gekennzeichnet, daß jeder Dorn der jeweiligen Klemme in einer Ebene generell parallel zur Längsachse eines Leiters dreieckförmig gestaltet ist, wobei eine Basis an einem Körper der Klemme befestigt und ein Scheitelpunkt in dem Gehäuse eingebettet ist, und daß die Dicke des jeweiligen Dorns der jeweiligen Klemme in Richtung von dem Körper der jeweiligen Klemme zu dem Scheitelpunkt des jeweiligen Dorns der jeweiligen Klemme abnimmt.

3. Abgeschlossene Kabelschnur nach Anspruch 1, dadurch gekennzeichnet, daß jeder Leiter ein sich längs erstreckendes Kernelement, mindestens ein sich erstreckendes elektrisches leitfähiges Band,

welches mit einer Schlaglänge um das Kernelement schraubenförmig gewickelt ist, und Isolationsmaterial umfaßt, welches das mindestens eine Band bedeckt, und daß der Stecker eine Mehrzahl von klingenartigen elektrisch leitfähigen Klemmen umfaßt, die jeweils entlang einer Kantenoberfläche isolationsdurchdringende Dorne umfassen und die jeweils in einem der Schlitze angeordnet sind, so daß die Dorne das mindestens eine Band eines zugeordneten ausgerichteten Leiters durchdringen, um den elektrischen Eingriff mit diesen zu bilden, wobei die Dorne der jeweiligen Klemme eine Breite, gemessen in Richtung parallel zur Längsachse der zugeordneten ausgerichteten Leiter in Teilen der Dorne aufweisen, die in Eingriff mit dem mindestens einem Band des zugeordneten ausgerichteten Leiters stehen, so daß der Betrag des mindestens einen Bandes minimiert wird, der von der Klemme durchdrungen wird, wenn die Klemme eingefügt, und wobei die Dorne um einen solchen Abstand voneinander angeordnet sind, der von dem Vielfachen der Schlaglänge des mindestens einen Bandes abweicht.

4. Abgeschlossene Kabelschnur nach Anspruch 1, worin die Dorne jeder Klemme um einen Abstand voneinander angeordnet sind, die von einem ganzzahligen Vielfachen der Schlaglänge abweicht.

5. Abgeschlossene Kabelschnur nach Anspruch 4, worin die Kabelschnur drei Bänder umfaßt, wobei jede Windung jedes Bandes am Kern anliegt und eine Längskante aufweist, die mit einer Längskante von zwei benachbarten Bändern in Berührung steht.

6. Abgeschlossene Kabelschnur nach Anspruch 4, worin die Kabelschnur drei Bänder umfaßt, wobei die Windungen eines der Bänder im wesentlichen auf einem anderen der Bänder aufliegt und die Windungen des dritten Bandes zwischen benachbarten Windungen der übereinanderliegenden Bänder gefügt ist.

7. Abgeschlossene Kabelschnur nach Anspruch 4, worin aufeinanderfolgende Windungen von zwei der Bänder mit abwechselnden Windungen voneinander abwechseln und worin jede abwechselnde Windung des dritten Bandes außer Berührung mit dem Kern ist und über einem Teil der benachbarten Windungen der beiden Bänder liegt.

8. Modulare Steckeranordnung umfassend ein Stück Kabelschnur (21) und einen modularen Stecker (23), der ein Ende des Stückes der Kabelschnur (21) abschließt, welche eine Mehrzahl von isolierten Leitern (22-22) aufweist, die jeweils einen Kern (25) und eine Mehrzahl von elektrisch leitfähigen Bändern (27-27) umfassen, die schraubenförmig in

einer Mehrzahl von Windungen um den Kern (25) gewickelt sind, wobei jedes Band (27) eine Schlaglänge aufweist, mit folgenden Merkmalen des Steckers (23):

ein Gehäuse (21), welches einen Hohlraum zur Aufnahme der Leiter (22-22) der Kabelschnur (21) umfaßt,

eine Mehrzahl von Schlitzen (64-64), die mit dem Hohlraum und mit einer nach außen blickenden Oberfläche des Gehäuses (21) in Verbindung stehen, wobei die Schlitze (64-64) dazu ausgebildet sind, mit einem zugeordneten Leiter (22) ausgerichtet zu werden;

eine Mehrzahl von klingenartigen, elektrisch leitfähigen Klemmen (42-42), die jeweils zwei benachbarte und voneinander beabstandete Isolationsdurchdringungsdorne (82-82) entlang einer Kantenfläche aufweisen und die jeweils in einem der Schlitze (64-64) angeordnet sind, so daß die Dorne (82-82) den zugeordneten ausgerichteten Leiter (22) durchdringen, um den elektrischen Kontakt mit diesem herzustellen, dadurch gekennzeichnet, daß

die Dorne (82-82) der jeweiligen Klemme (42) jeweils eine Breite, gemessen in Richtung parallel zur Längsachse des zugeordneten ausgerichteten Leiters (22), in Teilen der Dorne (82-82) aufweisen, die in Eingriff mit den Bändern (27-27) stehen, welche Breite geringer als die Breite einer Windung eines Bandes (27) ist, gemessen in Richtung parallel zur Längsachse des zugeordneten ausgerichteten Leiters (22), um den Betrag jedes Bandes (27) zu minimieren, der durch die Klemme (42) durchtrennt wird, wenn die Klemme (42) eingefügt wird, und daß

die Dorne (82-82) um einen solchen Abstand voneinander angeordnet sind, daß eine der beiden benachbarten Dorne (82-82) einen wesentlich größeren Teil der Breite eines Bandes (27), gemessen in Richtung parallel zur Längsachse des ausgerichteten Leiters (22) durchdringt, als dies der andere Dorn der beiden benachbarten Dorne (82-82) hinsichtlich der Breite einer anderen Windung tut.

9. Modulare Steckeranordnung nach Anspruch 8, dadurch gekennzeichnet, daß die abgeschlossene Kabelschnur eine Mehrzahl von isolierten Leitern umfaßt, die jeweils einen Kern und eine Mehrzahl von elektrisch leitfähigen Bändern umfassen, die schraubenförmig um den Kern gewickelt sind, wobei jedes Band eine Schlaglänge aufweist, und daß die Dorne um einen solchen Abstand voneinander angeordnet sind, der von einem Vielfachen der Schlaglänge einer der Bänder abweicht.

10. Modulare Steckeranordnung nach Anspruch 9, dadurch gekennzeichnet, daß der jeweilige Dorn der jeweiligen Klemme in einer Ebene generell parallel zur Längsachse eines Leiters dreieckförmig gestaltet ist, wobei eine Basis mit einem Körper der Klemme verbunden und ein Scheitelpunkt in dem Gehäuse eingebettet ist, und daß die Dicke des jeweiligen Dorns der Klemme in Richtung von dem Körper der Klemme zu dem Scheitelpunkt des jeweiligen Dorns der Klemme abnimmt.

Revendications

1. Un câble (21) terminé par une fiche, qui comprend :

une longueur de câble (21) qui comprend un ensemble de conducteurs isolés (22-22), chacun d'eux comprenant :

une âme (25) s'étendant en direction longitudinale,

au moins un ruban allongé conducteur de l'électricité (27) qui est enroulé en hélice avec un certain pas, en un ensemble de spires autour de l'âme (25), et

un matériau isolant (31) qui recouvre le dit au moins ruban (27) et

une fiche modulaire (23) qui termine une extrémité de la longueur de câble (21), cette fiche (23) comprenant :

un corps (41) qui comprend une cavité destinée à recevoir les conducteurs (22-22) du câble (21);

un ensemble de fentes (64-64) qui communiquent avec la cavité et avec une surface du corps (41) faisant face vers l'extérieur, chacune de ces fentes (64-64) étant associée et alignée avec l'un des conducteurs (22-22); et

un ensemble de bornes conductrices de l'électricité (42-42), semblables à des lames, chacune d'elles comprenant deux dents de perçage d'isolant (82-82) adjacentes et espacées, se trouvant le long d'une surface de bord de la borne, et chaque borne étant disposée dans l'une des fentes (64-64), de façon que des parties des dents (82-82) pénètrent dans ledit au moins un ruban (27) d'un conducteur associé aligné (22), pour établir une liaison électrique avec celui-ci, caractérisé en ce que les parties des dents (82-82) de chaque borne (42) qui sont en liaison avec le dit au moins un ruban (27) du conducteur associé aligné (22) ont chacune une largeur, mesurée dans une direction parallèle à l'axe longitudinal du conducteur associé aligné (22), qui est inférieure à la largeur d'une spire du dit au moins un ruban (27), mesurée dans une direction parallèle à l'axe longitudinal du conducteur aligné (22), pour minimiser la quan-

tité de laquelle le dit au moins un ruban (27) est pénétré par la borne (42), lorsque la borne (42) est insérée, et en ce que ces dents (82-82) sont mutuellement espacées d'une distance qui est telle que l'une des deux dents adjacentes (82-82) pénètre dans une partie notablement supérieure de la largeur d'une spire du dit au moins un ruban (27), mesurée dans une direction parallèle à l'axe longitudinal du conducteur aligné (22), comparée à la partie de la largeur d'une autre spire dans laquelle pénètre l'autre dent parmi les deux dents adjacentes (82-82).

2. Le câble terminé de la revendication 1, dans lequel chaque dent de chaque borne, dans un plan qui est de façon générale parallèle à un axe longitudinal d'un conducteur, a une forme triangulaire, avec une base fixée à une partie principale de la borne et un sommet enfonce dans le corps, et dans lequel l'épaisseur de chaque dent de chaque borne diminue dans une direction allant de la partie principale de chaque borne vers le sommet de chaque dent de chaque borne.

3. Le câble terminé de la revendication 1, dans lequel chaque conducteur comprend une âme s'étendant en direction longitudinale, au moins un ruban allongé, conducteur de l'électricité, qui est enroulé en hélice avec un certain pas autour de l'âme; et un matériau isolant qui recouvre le dit au moins un ruban; et dans lequel la fiche comprend un ensemble de bornes conductrices de l'électricité, semblables à des lames, chacune d'elles comprenant des dents de perçage d'isolant le long d'une surface de bord de la borne, et chaque borne étant disposée dans l'une des fentes de façon que les dents pénètrent dans le dit au moins un ruban d'un conducteur associé aligné, pour établir une liaison électrique avec celui-ci, les dents de chaque borne ayant chacune une largeur, mesurée dans une direction parallèle à l'axe longitudinal du conducteur associé aligné, dans des parties des dents qui sont en liaison avec le dit au moins un ruban du conducteur associé aligné, qui minimise la quantité de laquelle ledit au moins un ruban est pénétré par la borne, lorsque cette dernière est insérée, et les dents étant mutuellement espacées d'une distance qui est différente d'un multiple du pas du dit au moins un ruban.

4. Le câble terminé de la revendication 1, dans lequel les dents de chaque borne sont mutuellement espacées d'une distance qui diffère d'un multiple pair du pas.

5. Le câble terminé de la revendication 4, dans lequel ce câble comprend trois rubans, avec une configuration dans laquelle chaque spire de chaque ruban est en contact avec l'âme et a une partie de bord

longitudinal qui est en contact avec une partie de bord longitudinal de chacun des deux rubans adjacents.

6. Le câble terminé de la revendication 4, dans lequel ce câble comprend trois rubans avec une configuration dans laquelle des spires de l'un des rubans sont pratiquement superposés sur un autre des rubans, et des spires du troisième ruban sont interposées entre des spires adjacentes des rubans superposés. 5 10
7. Le câble terminé de la revendication 4, dans lequel des spires successives de deux des rubans alternent avec des spires successives de chaque autre ruban, et dans lequel chaque spire successive du troisième ruban n'est pas en contact avec l'âme et recouvre une partie des spires adjacentes des deux rubans. 15 20
8. Un assemblage à fiche modulaire comprenant une longueur de câble (21) et une fiche modulaire (23) qui termine une extrémité de cette longueur de câble (21), comprenant un ensemble de conducteurs isolés (22-22), chacun d'eux comprenant une âme (25) et un ensemble de rubans conducteurs de l'électricité (27-27) qui sont enroulés en hélice en un ensemble de spires autour de l'âme (25), chaque ruban (27) ayant un certain pas d'hélice, cette fiche (23) comprenant : 25 30
 - un corps (41) qui comprend une cavité destinée à recevoir les conducteurs (22-22) du câble (21);
 - un ensemble de fentes (64-64) qui communi- 35
 - quent avec la cavité et avec une surface du corps (41) faisant face vers l'extérieur, chacune des fentes (64-64) étant adaptée pour être alignée et associée avec un conducteur (22); et
 - un ensemble de bornes conductrices de l'élec- 40
 - tricité (42-42), semblables à des lames, cha- cune d'elles comprenant deux dents de perçage d'isolant (82-82) adjacentes et espacées, le long d'une surface de bord de la borne, et cha- que borne étant disposée dans l'une des fentes 45
 - (64-64), de façon que les dents (82-82) péné- trent dans le conducteur associé aligné (22) pour établir une liaison électrique avec celui-ci, caractérisé en ce que les dents (82-82) de cha- que borne (42) ont chacune une largeur, mesu- 50
 - rée dans une direction parallèle à l'axe longitu- dinal du conducteur associé aligné (22), dans les parties des dents (82-82) qui sont en liaison avec les rubans (27-27), qui est inférieure à la largeur d'une spire d'un ruban (27), mesurée 55
 - dans une direction parallèle à l'axe longitudinal du conducteur associé aligné (22), pour minimi- ser la qualité de laquelle chaque ruban (27) est

coupée par la borne (42) lorsque la borne (42) est insérée, et en ce que les dents (82-82) sont mutuellement espacées d'une distance qui est telle que l'une des deux dents adjacentes (82-82) pénètre dans une partie notablement supérieure de la largeur d'un ruban (27), mesu- rée dans une direction parallèle à l'axe longitu- dinal du conducteur aligné (22), comparée à la partie de la largeur d'une autre spire dans laquelle pénètre l'autre dent parmi les deux dents adjacentes (82-82).

9. L'assemblage à fiche modulaire de la revendication 8, dans lequel le câble qui est ainsi terminé com- prend un ensemble de conducteurs isolés, chacun d'eux comprenant une âme et un ensemble de rubans conducteurs de l'électricité qui sont enroulés en hélice autour de l'âme, avec un pas d'hélice pour chaque ruban, et dans lequel les dents sont mutuel- lement espacées d'une distance qui est différente d'un multiple du pas d'un ruban quelconque .
10. L'assemblage à fiche modulaire de la revendication 9, dans lequel chaque dent de la borne, dans un plan qui est de façon générale parallèle à un axe longi- tudinal d'un conducteur, a une forme triangulaire avec une base fixée à une partie principale de la borne et un sommet enfoncé dans le corps de la fiche, et dans lequel l'épaisseur de chaque dent de la borne diminue dans une direction allant de la par- tie principale de la borne vers le sommet de chaque dent de la borne.

FIG. 1

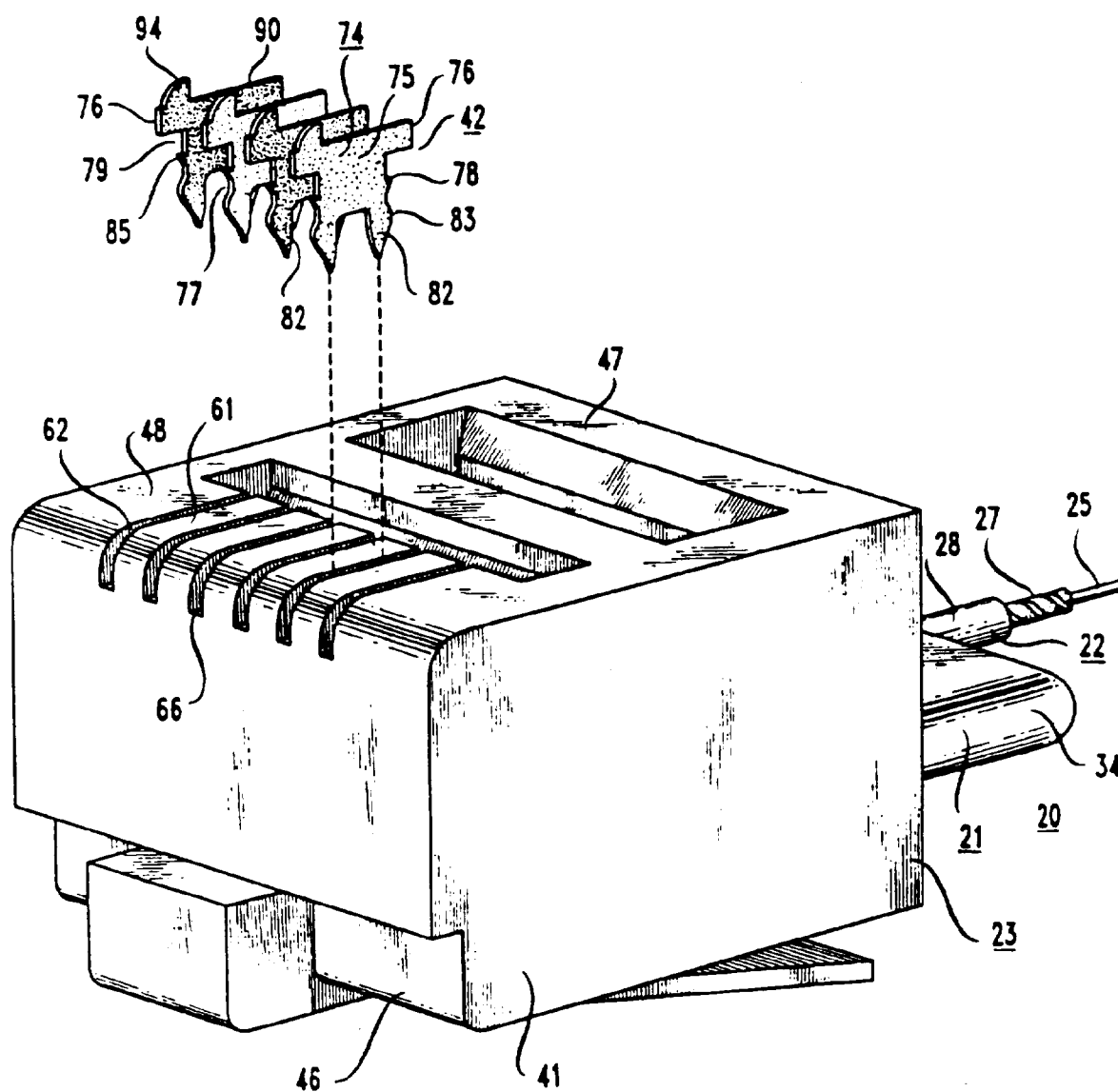


FIG. 2

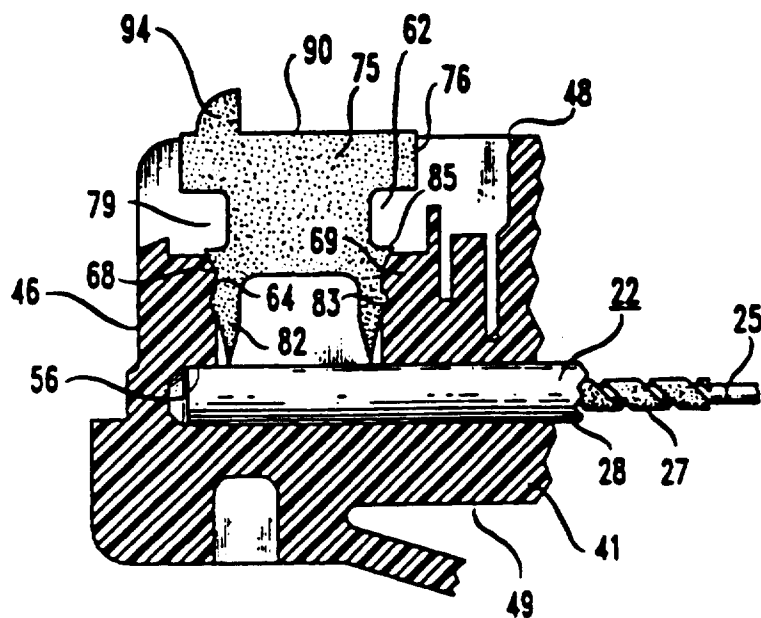


FIG. 4

(PRIOR ART)

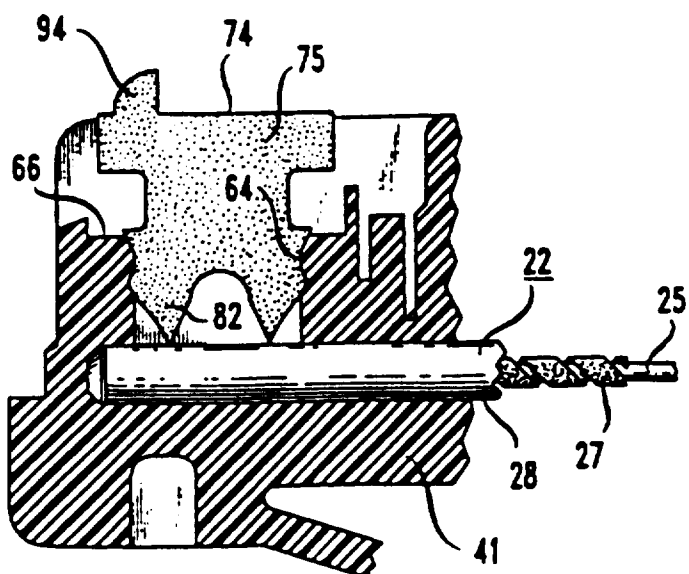


FIG. 3

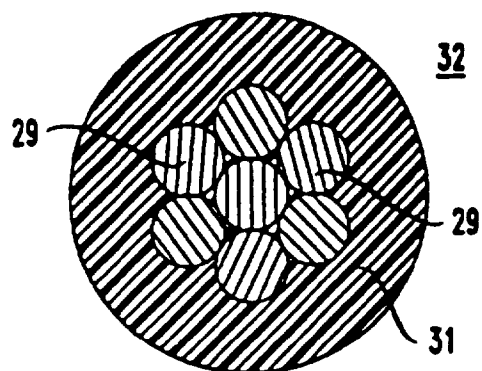


FIG. 5

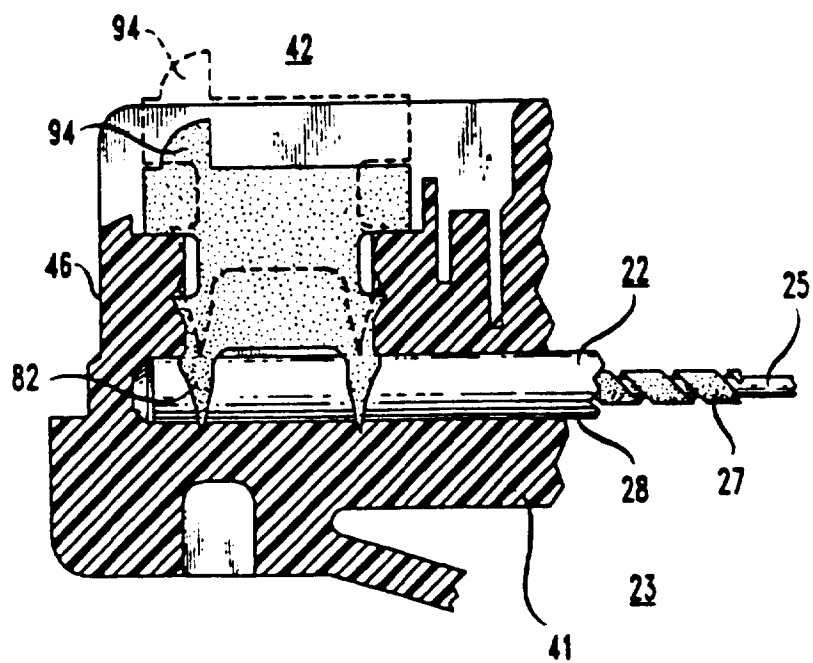


FIG. 6

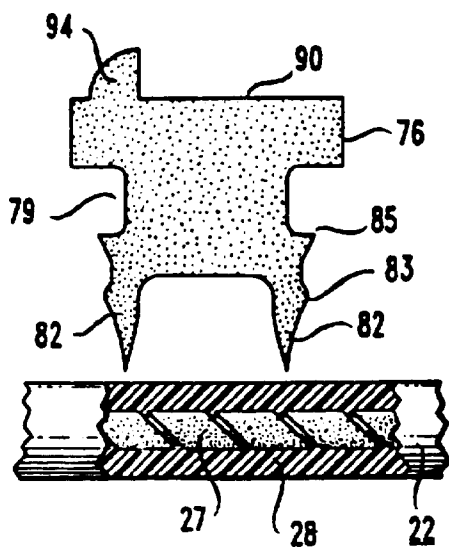


FIG. 7
(PRIOR ART)

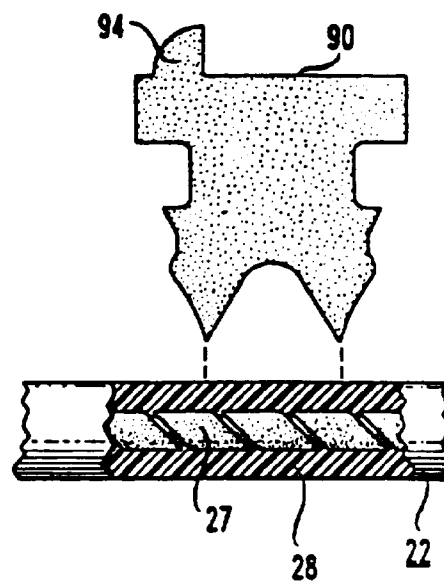


FIG. 8

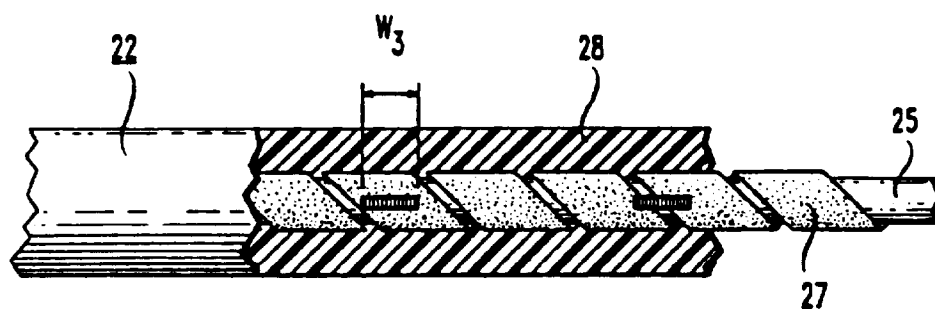


FIG. 9
(PRIOR ART)

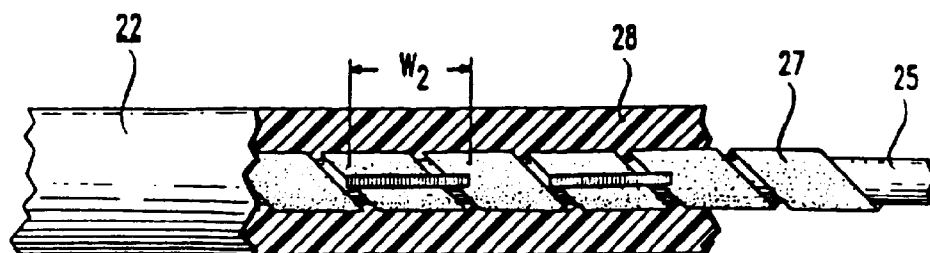


FIG. 10

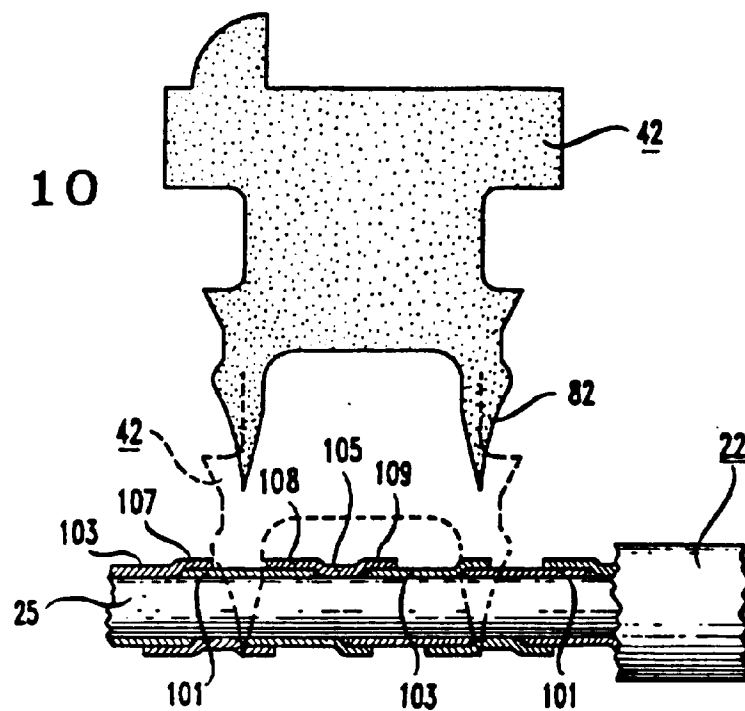


FIG. 11

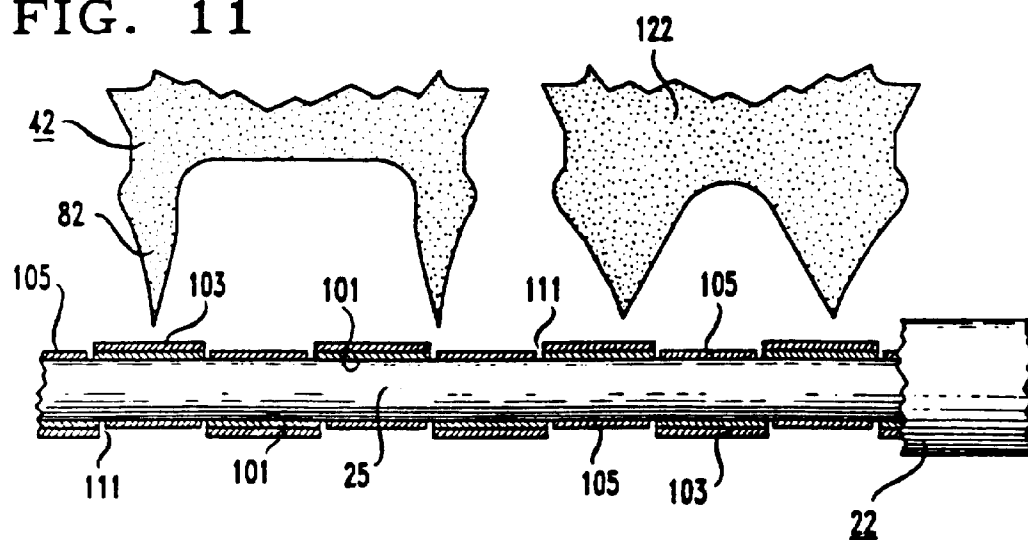


FIG. 12

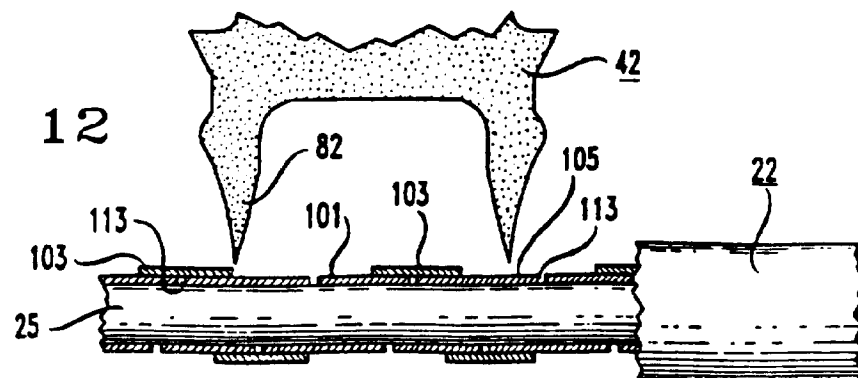


FIG. 13

(PRIOR ART)

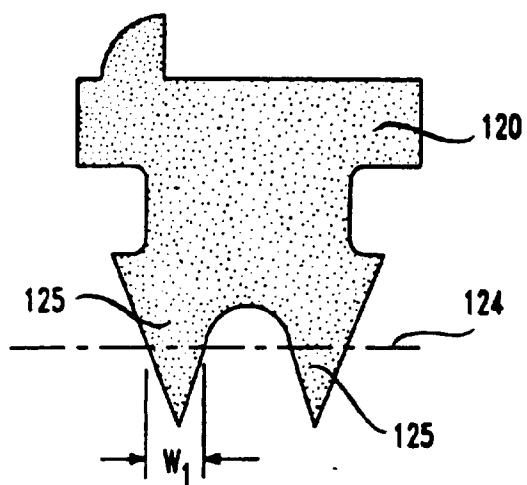


FIG. 14

(PRIOR ART)

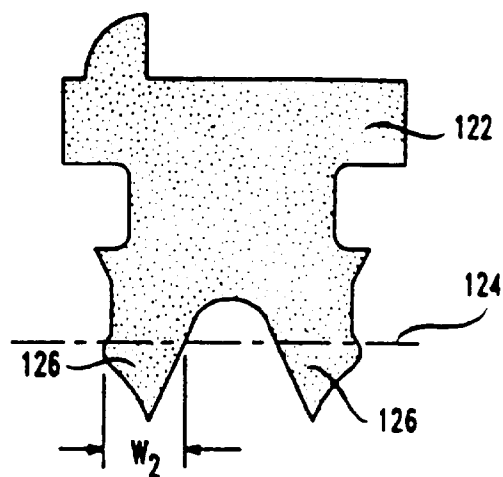


FIG. 15

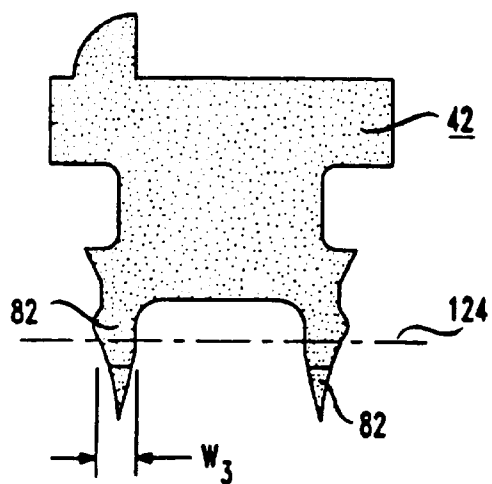


FIG. 16

