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ELECTRICAL CONNECTOR BODY AND CAP CONSTRUCTION  
WITH IMPROVED CONDUCTOR SECURING MEANS

3,020,516

Filed April 25, 1958

2 Sheets-Sheet 1

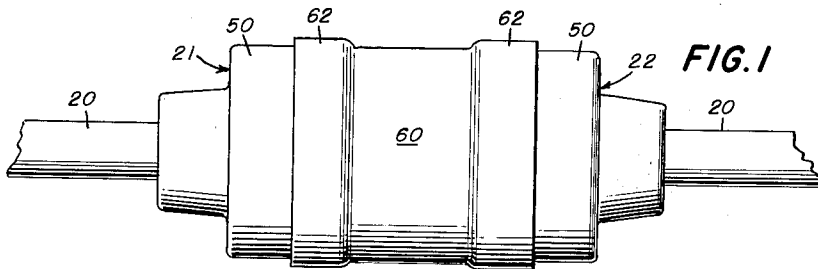


FIG. 2

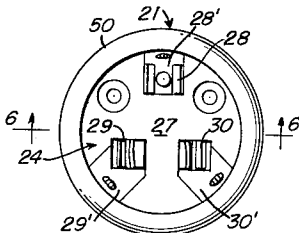
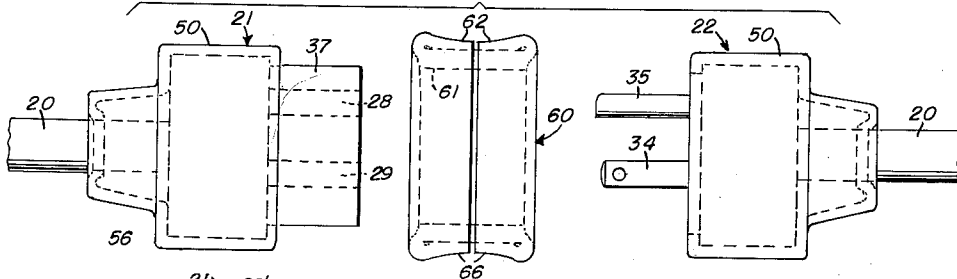


FIG. 3

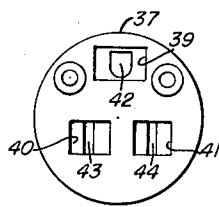


FIG. 4

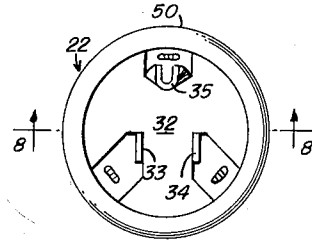


FIG. 5

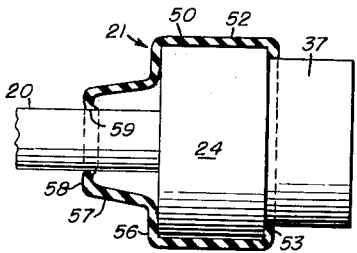


FIG. 6

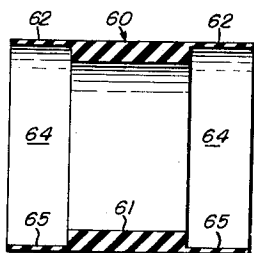


FIG. 7

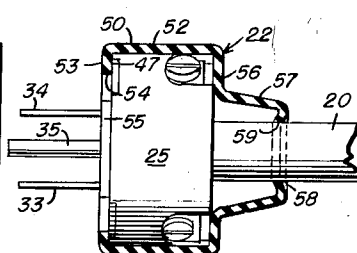


FIG. 8

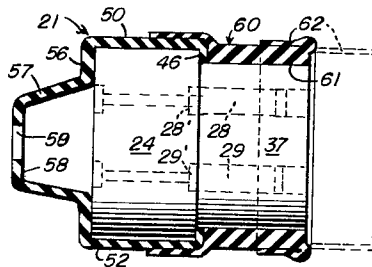


FIG. 9

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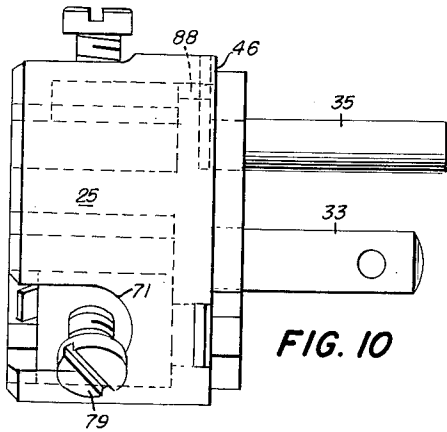


FIG. 10

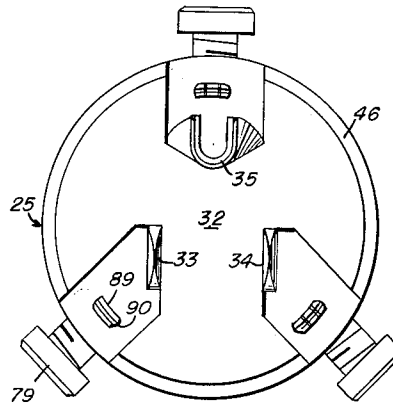


FIG. 11

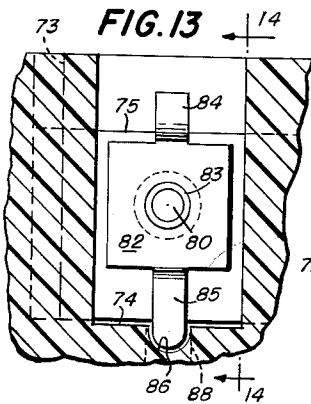


FIG. 13

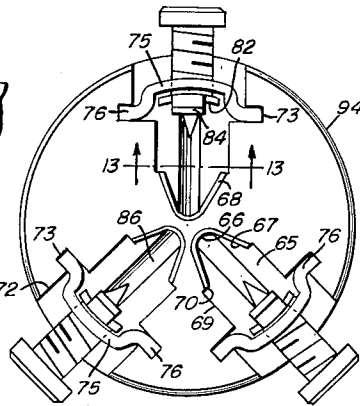


FIG. 12

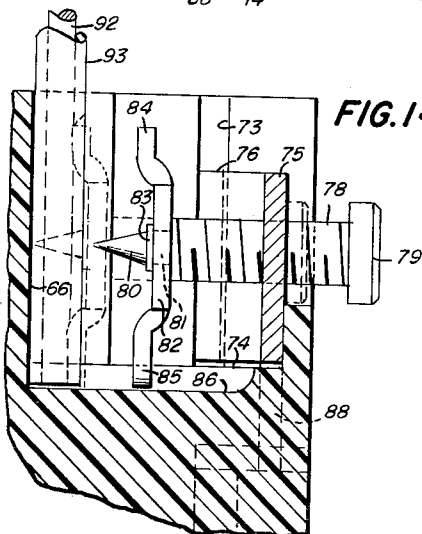


FIG. 14

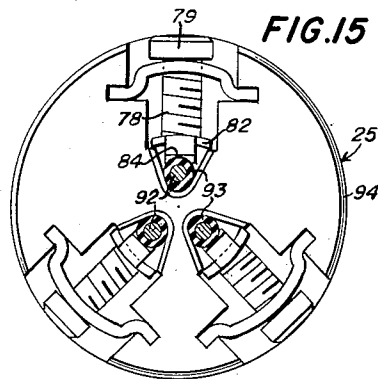


FIG. 15

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1

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## ELECTRICAL CONNECTOR BODY AND CAP CONSTRUCTION WITH IMPROVED CONDUCTOR SECURING MEANS

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11 Claims. (Cl. 339—101)

This invention relates to electrical connector body and cap construction and to improved conductor connecting and securing means therefor.

It is one of the general objects of the present invention to provide novel and improved electrical connector and cap construction.

Another general object of the invention consists in the provision of novel and improved combination conductor connecting and securing means which combine the functions of the usual screw terminals and strain relief devices.

More particularly the invention comprises connector body and cap construction in which each body and cap part includes a terminal base of insulation having connector contacts extending from one face thereof, a conductor connecting means buried in the base for and connected to each contact and a resilient, flexible shell enclosing the sides and opposite face of said base and closely fitting the cabled conductors leading from the connecting means.

An important object of the invention comprises the arrangement of a separate flexible and elastic sleeve adapted to partially encase the shells of a mated cap and connector body to secure them together and exclude moisture from the contacts and conductors thereof.

A specific feature of the connector sleeve includes a section intermediate the ends thickened to provide inner stop shoulders for centralization on the mated units and to provide thin end sections which can be turned back for ease of application over or removal from the rubber like shells on the individual units.

Another important object of the invention resides in the combination wire connector and conductor grip devices embedded in the bases and actuated each by a radially directed screw normally covered by the resilient shell.

Specific features of the combination connector and grip include a single screw for each threaded into a terminal plate having a tang passing through the block to connect to and mount one of the connector contacts, said screw having a tapered pin at its end adapted to penetrate the insulation of a stranded conductor and make electrical contact with the strands thereof and carrying behind said pin a clamp member adapted to engage the insulation of the stranded conductor above and below the pin engaged area and press it tightly into and against the walls of a groove in the material of the base to resist withdrawal in the direction of the conductor length, the arrangement being such that the clamping action takes place simultaneously with the pin penetration.

A still further object of the invention resides in the arrangement of the conductor confining grooves in a base to face radially outwardly from approximately the center thereof so that the several conductors of a multiwire cable are close together and are mutually supporting when urged toward the center by said clamp members.

Other and further objects and features of the invention will be more apparent to those skilled in the art upon a consideration of the following specification and the accompanying drawings wherein is disclosed a single exemplary embodiment of the invention with the understanding that such changes and modifications may be made therein

2

as fall within the scope of the appended claims without departing from the spirit of the invention.

In said drawings:

FIGURE 1 is an elevation of a complete connector assembly of body and cap, with connecting sleeve and conductor cable sections shown;

FIGURE 2 is an exploded view of the basic three components of the connector assembly of FIGURE 1 showing the connector sleeve with rolled back lips;

FIGURE 3 is a face view of the connector body portion with the resilient cover in place but with the contact cover block removed;

FIGURE 4 is a rear face view of the contact cover block;

FIGURE 5 is a face view of the connector cap shown with the resilient cover in place;

FIGURE 6 is a longitudinal central section through a connector body taken on line 6—6 of FIGURE 3 and showing the base and contact cover block in elevation;

FIGURE 7 is a longitudinal central section through the resilient, flexible cover sleeve;

FIGURE 8 is a view similar to FIGURE 6 but taken on line 8—8 of FIGURE 5 of the cap;

FIGURE 9 illustrates in longitudinal central section the sleeve mounted on the connector body and having its free lip rolled back to permit connecting the cap to the body;

FIGURE 10 is an enlarged side elevation of the connector cap with its elastic shroud removed and showing the wire clamping screws;

FIGURE 11 is a front view of the cap showing the clamping screws extended;

FIGURE 12 is a rear view of the cap illustrating the conductor grooves, clamps and penetrating pins arranged to accept conductors for fastening;

FIGURE 13 is a face view, on a still larger scale of the conductor clamp and associated parts taken on line 13—13 of FIGURE 12;

FIGURE 14 is a section taken on line 14—14 of FIGURE 13 and showing both the retracted (solid line) position and the clamping (dotted line) position of the conductor clamp and actuating screw; and

FIGURE 15 is a view similar to FIGURE 12 but showing the individual conductors of a cable connected electrically to the blades of and clamped to the insulation base of the cap.

Attachment plugs or caps and their cooperating components, connector bodies, are available in an amazing number of sizes, styles, capacities, types and the like, making the required stock of manufacturers and distributors run to well over 100 different items. The devices vary in the number of terminals, blades or contacts per unit, in the arrangements for polarization or non-polarization, the use of grounding terminals, special locking arrangements for preventing separation of the cap and connector body under strain, and the presence or absence of strain relief clamps for preventing pull on the cables or conductors from being transferred to the wire connecting means or terminals. When considering two wire, three wire, four wire and other combinations, with or without grounding terminals, polarized and non-polarized, and so on, the total number of sizes and combinations offered by some manufacturers runs to more than 125 styles, making the cost of carrying a full stock prohibitive and leading to the occurrence of errors in ordering and delivering.

The present invention proposes a simplification whereby approximately twenty-five different devices will perform the functions heretofore carried out by one hundred with no reduction whatsoever in current carrying ability, strain relief, waterproofness and the like. At the same time, the facility of wiring the devices is enhanced to such an extent that the time saving may run as much as fifty

to ninety percent of that normally consumed. At the same time, the construction is simplified, the number of parts materially reduced and the size and weight curtailed.

Referring now to the drawings, and particularly to FIGURES 1 to 9 inclusive, it will be noted in the first of these figures that cables 20, each of the multi-conductor type are connected in a separable manner by a connector body 21, and cap 22. Each of these components includes a cylindrical base, 24 for the connector body and 25 for the cap, each having plane top and bottom surfaces normal to the axis of the cylinder. The front face of base 24 is seen in FIGURE 3, at 27 supporting the grounding contact 28 and the two conductor contacts 29 and 30, in a two wire and grounding style of connector body which is used herein as representative. Each of these contacts is fitted with an integral foot 28', 29' and 30', set in base 24 flush with the surface 27 as seen, and preferably arranged so that the feet reach to the edge of the cylinder.

In a like manner base 25 of cap 22 has a front face 32 into which are recessed, somewhat deeper than in the case of base 24, the feet of plug blades 33 and 34 and of the U-shaped grounding plug prong 35, spaced thereon to mate with the corresponding female contacts on block 24.

To complete the connector body, the contacts are housed in a cylindrical insulation block 37, best seen in FIGURES 6 and 9 in side elevation and in rear elevation in FIGURE 4, where the chambers 39, 40 and 41, respectively, extending axially partially through the insulation are sized to loosely house the contacts 28, 29 and 30, and each has a small opening, 42, 43 and 44 respectively through the front face, sized to loosely receive the plug and prong blades, as seen in FIGURE 5. The block 37 is of less diameter than the base 24, as clearly indicated in FIGURE 9, providing an annular area 46 where the larger base extends out beyond the smaller block. A corresponding area is provided on the cap by having its base 25 slightly longer than the one in the connector body and grooved peripherally on its contact-blade carrying face to provide the annular area 47 corresponding in depth and width to 46 and leaving the same length of exposed cylindrical side wall.

In this manner the insulation base parts 24 and 25 of the cap and connector body are identically sized in length to receive each a similar waterproof cover or sheath 50 of flexible, resilient, material such as suitable natural or synthetic rubber, preferably one resistant to oil and similar liquids. Such a cover includes a cylindrical, tubular portion 52 sized to closely engage the cylindrical walls of block 24 or 25 and of just the same length. At its outer end it is provided with an intumed lip or annular ring 53 to overlap the annular area 46 or 47 previously described and have its inner facing edges 54 closely engaged against the cylindrical wall of contact cover block 37. When applied to the cap body 25 the lip fits in the annular area 47 previously referred to and its edge 54 engages against the smaller diameter short cylindrical portion 55 as seen in FIGURE 8.

The cover has at the rear edge of the cylindrical portion 52 an integral annulus 56 spaced from lip 53 just sufficiently to accommodate the length of block 24 or 25 between its annular reduced portion 47 and the rear face. The radial extent of part 56 is somewhat greater than that of 53 and attached integrally to its inner periphery is the frusto-conical or cup-like, portion 57 having at its outer end the annular member 58 centrally perforated as at 59 to closely engage over the sheath of cable 20 to form a water and dust tight joint. This opening is small enough to provide the desired tight fit with the cover of the smallest cable intended to be used with the unit, and, because of its resilience can be stretched over one many sizes larger, thus accommodating any of the cable diameters required to house conductors of a size and number usable with the connectors.

It will be appreciated that the flexible covers are accurately sized to tightly fit over block 24 or 25 so that when placed in position they completely house all but the small circular area on the face of the block which carries the various types of contacts. They protect the terminals, which will be later described, shield the insulation base against shocks and provide a finished appearance as well as a uniform exposed surface for receiving the connecting sheath shown at 60 in FIGURE 1, in section in FIGURE 7, with both lips rolled back in FIGURE 2, and applied to the connector body with one lip rolled back in FIGURE 9. This sleeve comprises a straight outer-walled tube of resilient flexible material such as that used in the covers, having a thick center portion as shown at 61, the inner diameter thereof being such as to fit easily over block 37, comprising the contact cover of the connector body, and having a length between shoulders 62 to extend from the lip 53 of sheath 50 to the outer face of block 37. At each end the thickened portion is provided with a thin lip section 64, the reduction in thickness being entirely from the interior leaving thin walls 65 which can be rolled or turned back, as shown at 66 in FIGURE 2, over the more rigid central section to facilitate the application to the covers of the connector body and cap.

Such attachment is effected by sliding the sleeve over block 37 until a shoulder 62 abuts the outer face of lip 53 and then rolling lip 64 over the cylindrical portion 52 of sheath 50, to the position illustrated in FIGURE 9, effecting a water and dirt tight connection but leaving the remaining lip turned back as at 62 for connection of the cap to the connector body in the usual manner by inserting the prong and blades thereon into the contacts housed in block 37. Then lip 64 is rolled over the cover of the cap so that the assembly appears symmetrical as seen in FIGURE 1. In each instance the lips 64 are substantially stretched over the covers 50 as seen in FIGURE 1, which operation is facilitated by the rolling process and a water and dust-tight connection insured. Thus no liquid or dirt can get between the cap and connector body nor none between the sheath of the cable 20 and the covers 50, whereby complete protection is offered against moisture and dirt or damage by dropping or engagement with hard objects.

FIGURES 10 to 15 inclusive illustrate the wire attaching features of the cap and connector body and since they are identical in construction and operation they have been illustrated only in connection with the cap to simplify the showing.

It is highly desirable that the individual conductors from the cable be spread as little as possible and enter the base block for connection to the terminals in a nearly axial direction. This is facilitated by the arrangement illustrated in FIGURES 12 and 15 where the rear face of the base is shown as intersected by a recess 65 for each conductor, identical in size and shape and symmetrically arranged about the cylinder axis. Each recess extends not quite to the center, where it has an arcuate wall 66 of somewhat less than 180° extent and of a radius which is a mean of those of the various size individual conductors to be used therewith measured with their individual insulation sheaths.

In general a cap or connector body of the so-called 10 ampere size or capacity is arranged to accept a 16 or 18 size wire, a 15 ampere size 16 and 14 wire, 20 ampere size 14 and 12 wire and 30 ampere size 12 and 10 wire. The carrying capacity of these size wires are commensurate with the current conducting capacity of the contacts in the caps and connector bodies.

Each recess 65 includes a pair of plane walls 67 which merge arcuate wall 66 and include an angle of approximately 50° between them. At the intersection of these and the arcuate wall with the rear face of block 25 chamfers 68 are provided to facilitate the entrance of multi-strand conductors of the type which must be used with

this construction, and to eliminate any possible abrasion of the insulation.

Parallel walls 69 slightly off-set at 70 form extensions of the V-channel just described and extend the chamber through the cylindrical wall of the base by way of parallel walls 72 somewhat wider spaced apart than walls 69 and transverse grooves 73 are arranged as the junction of the sets of parallel walls and extends clear to the flat bottom 74 of the chamber. This bottom does not extend through the cylindrical base wall but stops short of it. FIGURE 10 shows the U-shaped opening 71 through this wall.

Fitted in the cross channels 73 is a sturdy-terminal plate 75 of conductive metal extending against the bottom 74 but terminating considerably short of the outer face of the base as seen in FIGURE 14. It has a nearly flat central section and inwardly offset ends 76 which fit in the channels previously defined. On the horizontal, but slightly above the vertical center, the plate is drilled normally and the bore is internally threaded to closely receive the threads of the shank of screw 78 preferably having a filister head 79.

The end of screw 78 is reduced in diameter and then provided with a tapered or conical tip 80 at such a distance from the under face of head 79 that when this latter bears against plate 75 the tip 80 is just in engagement with arcuate surface 66 as seen dotted in FIGURE 14. The conical tip 80 is of a length approximately the outer diameter of the largest conductor which it will be required to penetrate. The tip springs from reduced diameter portion 81 terminated by a radial shoulder and extends through a loosely fitting bore in the square center section of clamping plate 82 which is held in position thereon by swaged collar 83. The plate 82 is provided with integral arms, 84 at the top and 85 at the bottom, which are forwardly offset as seen in FIGURE 14 so that a plane through their forward faces extends through the conical tip 80 of the screw somewhere intermediate its length. The lower arm 85 is longer and its outer end fits loosely in a radial channel or groove 86 in the bottom wall of the chamber, whose sides and bottom are parallel to the axis of the screw whereby the clamping plate is held against rotation with the screw.

Screw 78 is in electrical engagement with terminal plate 75 and the latter is connected to the foot of its corresponding blade or contact element by means of an integral tang 88, best seen in FIGURES 10 and 14. This passes through an appropriate passage in the base 25, and since each chamber 65 is directly above the recess for the foot of one of the connector blades, it enters this recess and passes through an aperture 89 in the foot and is swaged over as shown at 90 in FIGURE 11, completing the electrical connection between the two parts and mechanically holding each in its chamber or recess.

The facility for wiring the present device is one of its important points. All that is necessary is to cut the cable off squarely, pass it first through hole 59 in flexible sheath 50, which has been removed from the base, and then remove the outer covering and the jute fillers, which form the round shape of the cable, for a length of about one-half inch, after which the still insulated, individual, stranded conductors are inserted each in their respective compartments 65, the screws having been previously withdrawn to nearly the positions indicated in FIGURE 12. The conductors are pushed in until they bottom in their respective chambers and the screws are now tightened down. The respective cavities are shaped to center various diameters of wire and as the contact screw is threaded down the point begins to penetrate the insulation, centering the wire in the apex of the V. The point continues to pierce the insulation and spread the stranded group of conductors as it enters between them. The curved backing for the wire prevents the group of conductors from flattening even though at this time the strain relieving arms 84 and 85 are already beginning to press

on the surface of the insulation of the wire. This tends to compact the assembly and packs the individual strands tightly around the point of the screw assuring adequate electrical connection and current flow.

The combination of the pointed terminal screw and automatic clamp carried by the screw in the V-shaped cavity, insures practically perfect assembly and contact. The screw is run up until the under surface of its head locks tightly against the outer face of terminal plate 75 where friction insures against it being vibrated loose under any circumstances. The screw length may be adjusted so that the point enters slightly into the insulating material further adding to the strain relief action of the pressure arms which have flattened the wire to some extent above and below the entrance point of the conical screw tip as seen in FIGURE 14 (dotted). When the screw heads are tightened against the terminal plates they do not extend beyond the cylindrical surface of base 25, as seen in FIGURE 15, where the three conductors are shown at 92 as being formed of a plurality of relatively thin strands of copper wire surrounded and tightly compacted by the extruded plastic insulation cover 93. As is common in such constructions the twisted bundle of stranded wires is first bound together by a single layer of multiple threads arranged helically about it to maintain the shape of the bundle while the plastic insulation is extruded in position.

It will be obvious that the single operation of turning in one screw, per conductor, provides not only for making careful and adequate electrical contact therewith but also provides for clamping the conductor in two positions, one on either side of the penetrating point, to produce effective strain relief without the need for clamps or the like for the main body of the cable.

After the individual conductors have been secured in position as just described the sheath 50 is advanced along the wire and stretched over the base 25 until it achieves the position illustrated in FIGURE 8 when the device is ready for use. For the connector body section the operation is identical, right to the final assembly of the sheath or cover 50. Thereafter connecting sleeve 60 may be applied to the connector body section as described in connection with FIGURES 2, 6 and 7, and the circuit can now be completed between the two sections of cable by bringing the connector body and cap together in the usual manner to engage the blades and contacts, and then rolling the sleeve over if it is desired to effect a watertight connection which cannot readily be pulled apart by strain.

It will be obvious how the invention is adapted to handle a greater or a less number of individual conductors in accordance with the specific construction of the cap and connector body for any particular usage.

I claim:

1. In an electric connector device for use with various sized cables, each having a plurality of individually insulated stranded conductors in combination, a rigid cylindrical base of insulation material having contacts carried thereby, one for each conductor and extending from one end thereof, a recess opening through the opposite end of the base and partially through the side wall thereof for each contact, each recess having side walls converging to a fillet adjacent the axial center of said base, a rigid terminal plate electrically connected to each contact and having its ends inserted axially into channels in the walls of the corresponding recess so as to partially close the side wall opening thereof, means mounted by said plate to electrically connect one of said stranded conductors to said plate and mechanically hold it tightly into the recess fillet and axially of the base, and a flexible resilient cover for said base including a tubular sleeve closely engaging the side wall of said base, covering said terminal plates and recess openings in the cylindrical wall, having an integral annulus partially covering the recess openings in the said end wall and an integral axial sleeve adapted to

engage the cable and hold it in substantial alignment with the conductors in the fillets.

2. The device defined in claim 1 in which the means mounted by said plate is a terminal screw which extends radially of the base through each terminal plate toward the fillet beneath it, and means on each screw to penetrate the insulation of a multistrand conductor wire of said cable and electrically contact the wires thereof.

3. The device defined in claim 2 in which each screw is fitted behind the insulation penetrating means with arm means laterally extending therefrom and independent of the penetrating means to engage and automatically clamp the conductor against a recess wall to relieve the screw-wire connection of strain.

4. The device defined in claim 3 in which said means is a clamp bar arranged to engage the insulation cover of the multistrand conductor at two positions spanning the said connection.

5. The device as defined in claim 1 in which each terminal plate has ends engaged in axially disposed slots in the wall of its recess so spaced radially that the said cover engages the outer end of the screw to prevent undesired loosening.

6. A combined electrical connector for a stranded conductor and mechanical attachment therefor including in combination, a base block of rigid insulating material having a recess therein with converging walls connected by an arcuate wall of a curvature of the order of that of the insulation covering of a stranded conductor for use therewith, means in said block having a threaded hole therein with its axis directed toward said arcuate wall, a screw threaded in said hole having a pointed end for advancement to penetrate the insulation and contact the strands of said conductor, a plate swiveled on said screw behind said point, and arms on said plate positioned to engage the insulation of said conductor above and below the screw end penetration to clamp it against said arcuate wall.

7. The construction of claim 6 in which said arms have clamping surfaces substantially parallel to the center of curvature of said arcuate surface and lying in a plane intersecting said screw intermediate the length of said pointed end.

8. The arrangement of claim 7 in which one wall of said recess has guide means parallel to the axis of said screw and means on one of said arms cooperating therewith to prevent rotation of said swiveled plate.

9. An electrical connector for attaching a stranded conductor to a separable contact, in combination, a substan-

tially cylindrical base block of rigid insulating material having flat ends parallel to each other, contacts each having a foot on one end of said block, a recess for each contact in the opposite end of said block opening also through the side of the block, a terminal plate for each recess mounted in slots to position it nearly parallel to said side and at least partially closing said opening, means integral with each plate extending through said insulation and secured to the corresponding foot for mutual support on said block and electrical connection, the inner side walls of each recess converging toward the block center at an acute angle, a fillet connecting said walls of each recess short of their intersection, and a radially disposed screw threadedly engaged in each terminal plate and having a pointed end and a head positioned to engage with said plate just as the point engages said fillet.

10. The device of claim 9 in which said screw point is conical and the screw shank is reduced in diameter behind the point, a plate having a central bore swiveled on said diameter and oppositely disposed arms on said plate offset toward said point to clamp a conductor against said fillet on opposite sides of the area penetrated by said screw point.

11. The device of claim 10 in which one of said arms prevents the plate from rotating with the screw, a groove in a wall of said recess parallel to said screw, the side walls of said groove engaging said one arm to prevent said rotation.

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