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Hardesty

[11] **3,835,445**

[45] **Sept. 10, 1974**

[54] **ELECTRICAL CONNECTING DEVICES FOR TERMINATING CORDS AND METHODS OF ASSEMBLING THE DEVICES TO CORDS**

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[73] Assignee: **Western Electric Company, Incorporated,** New York, N.Y.

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[52] **U.S. Cl.** ..... **339/99 R,** 339/105, 29/629

[51] **Int. Cl.** **H01r 9/08,** H01r 13/58

[58] **Field of Search** 339/97–99, 339/105; 29/629

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3,369,214	2/1968	Krumreich et al.	339/105
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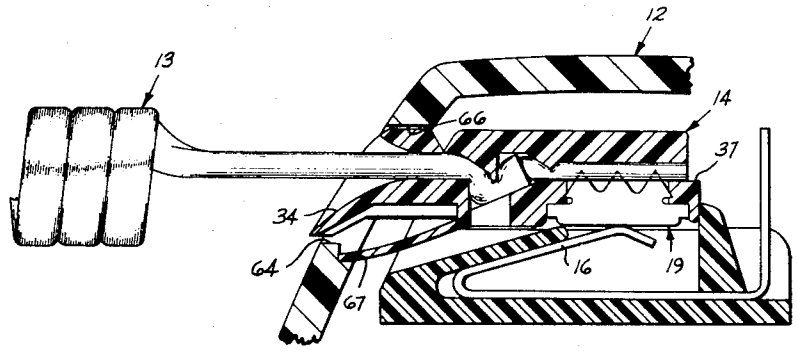
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Primary Examiner—Bobby R. Gay
Assistant Examiner—Lawrence J. Staab
Attorney, Agent, or Firm—E. W. Somers

[57] **ABSTRACT**

A one piece plug for terminating a cord to connect electrically the cord to components in a telephone apparatus is constructed with features advantageous to the assembly of the cord with the plug. The plug has a base molded with a cover hinged integrally to one end of the base and in an open position. This avoids the alignment of the cover with the base during assembly with the cord. Also, the base is formed with a cord-input aperture in the one end and which advantageously circumscribes substantially the cord periphery to maintain the cord within the plug during assembly operations. A leading portion of the cord is inserted into the aperture and extended past the other end of the plug. The jacket is removed from the leading portion to expose individually insulated conductors. Then the cord is retracted and the conductors fanned out into associated troughs having the same spacing as the components. The cover is closed and bonded to the base to confine the conductors and prevent unintended lateral and longitudinal movement. Flat terminals are inserted into the base to move internal contacting portions thereof into engagement with the conductors. External contacting portions of the terminals engage associated components of the telephone apparatus when the plug is inserted thereinto.

13 Claims, 10 Drawing Figures



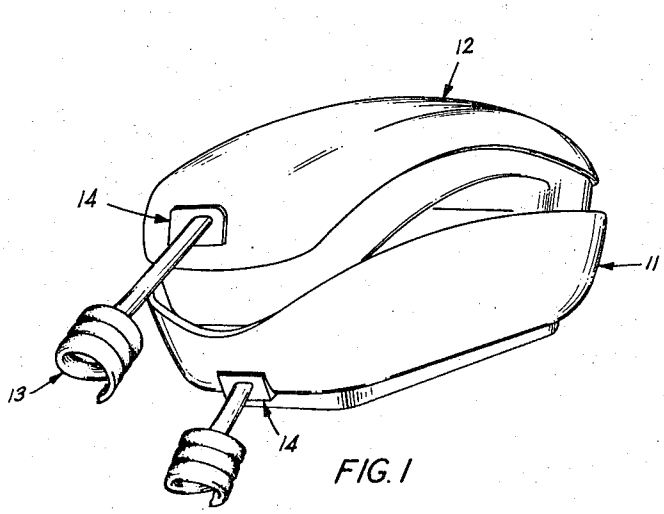


FIG. 1

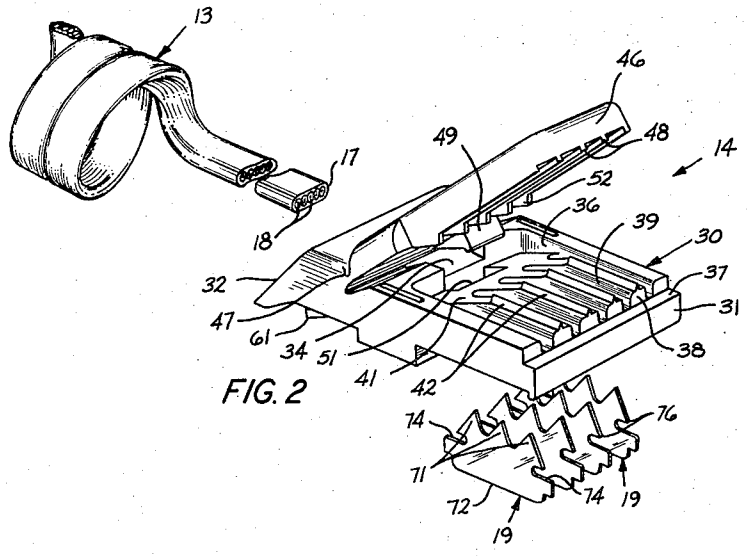


FIG. 2

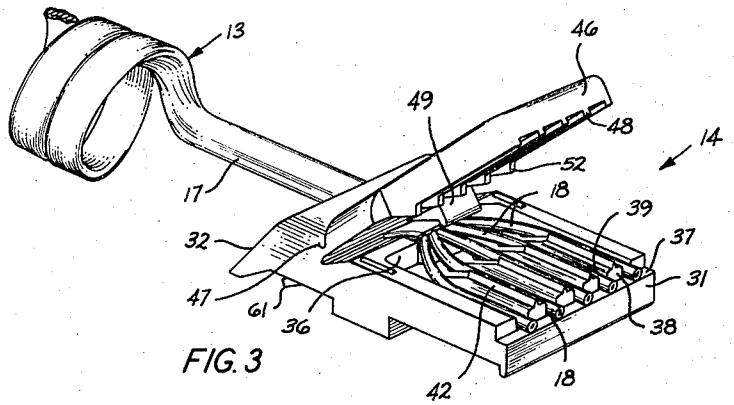


FIG. 3

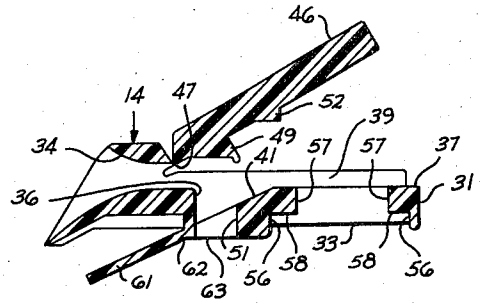


FIG. 4A

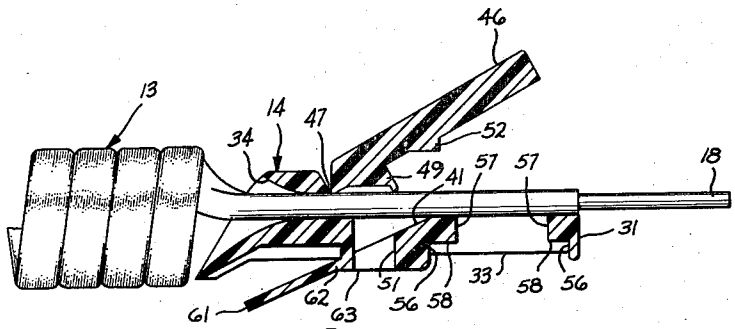


FIG. 4B

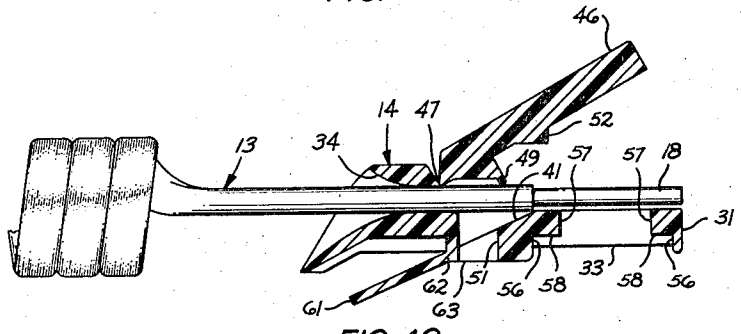


FIG. 4C

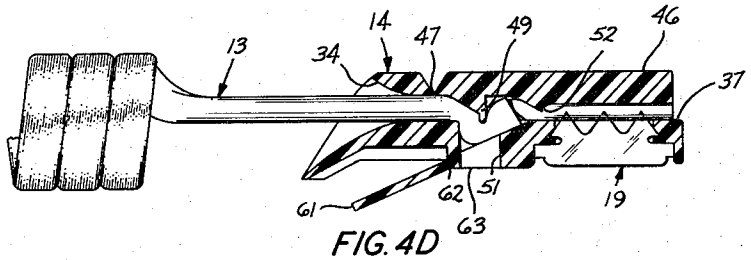


FIG. 4D

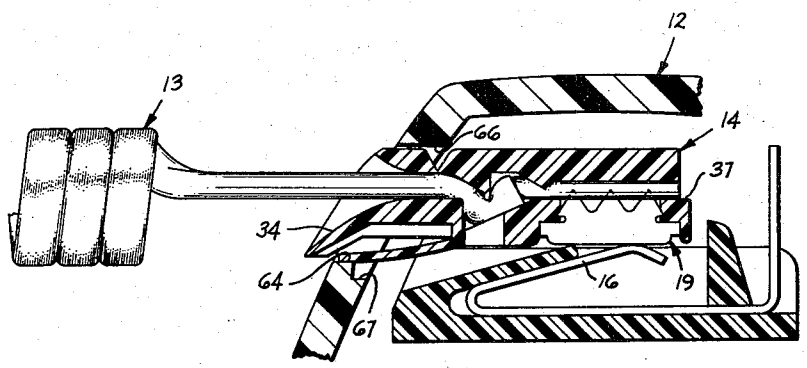


FIG. 5

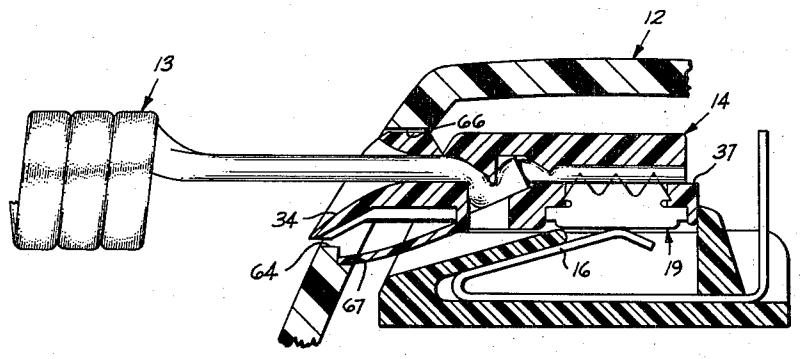


FIG. 6

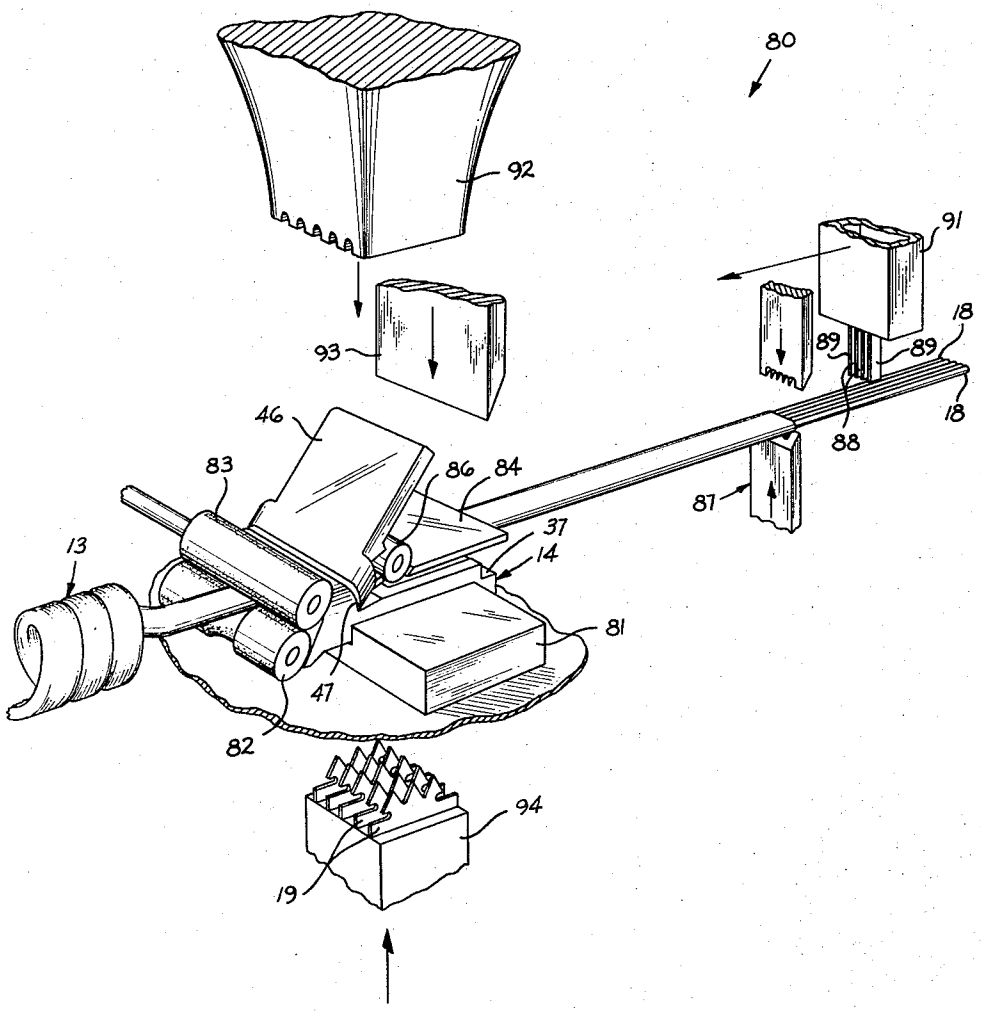


FIG. 7

ELECTRICAL CONNECTING DEVICES FOR TERMINATING CORDS AND METHODS OF ASSEMBLING THE DEVICES TO CORDS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to devices for making electrical connections and to methods of making such connections, and more particularly, to devices for making electrical connections between a cord comprising flexible conductors and terminals wherein conductive terminals are combined with dielectric members to form plugs and methods of assembling the cord and the devices.

2. Description of the Prior Art

In the telephone industry, increasing use is being made of plug-type connectors on straight and retractile handset and line cords which are used between a base and a handset of a telephone and between the base and a terminal. In the presently used plugs, a terminal is applied to each of a plurality of insulated conductors contained within a jacketed length of retractile cordage. These terminals are mounted within a dielectric structure which is attached securely to the associated cordage. The dielectric portions of the plugs, which are mounted on both ends of a length of the cordage, cooperate with receptacles in the handset and the base of the telephone to properly align the terminals of the plug with mating terminals within the components of the telephone.

One presently used plug is disclosed in U.S. Pat. No. 3,699,498 issued on Oct. 17, 1972. Conductors are confined in conductor-receiving troughs formed in a dielectric base by a cover bonded to the base. Flat terminals are inserted into individual grooves in the base in a side-by-side arrangement with contact portions thereof extending into engagement with the conductors. When the plug is inserted into a jack in a telephone handset, portions of terminals in the jack are received in associated ones of the grooves to engage side portions of the plug terminals.

The provisions in the just-identified plug for contacting the external component may be changed to that described in a continuation-in-part application filed on Mar. 8, 1972 in the names of E. C. Hardesty, C. L. Krumreich, A. E. Mulbarger, Jr. and S. W. Walden. There, the external contact portions of the terminal consists of an edge exposed to the exterior of a dielectric enclosure.

Of course, the terminals in the plugs are aligned with the contact elements in the telephone handset. The cord conductors in the just-described system are aligned with the terminals. In some systems, the conductors of the cord may not be spaced the same as the contact elements in the telephone. Provisions must be made for spreading out the conductors to be engaged by terminals which are aligned with the external contact elements.

A presently used plug incorporating provisions for spacing out the conductors is disclosed in U.S. Pat. No. 3,617,982 issued on Nov. 2, 1971. In this plug, a plurality of conductors are led into a back end of the plug, then the conductors are passed over the front end of the plug and connected to end portions of terminals seated on the underside of the plug.

The recent trend to the use of plug in type conductors in telephone handsets as exemplified by that shown in U.S. Pat. No. 3,617,982 has been accompanied by the use of flat telephone cords. The use of flat cords lends toward increased manufacturing economies provided that the plug is designed with regard for a flat cord system. Also, recent advances in terminal design in plugs may be adapted for use with flat cords on a production line basis.

The prior art related to connecting electrically a plug to conductors held together in a flat configuration is shown for example in U.S. Pat. No. 2,929,043. There a twin-lead antenna cable is led in through an opening formed between a body and a separate hinged cover plate. The cover plate is provided with facilities for engaging and pressing the cable into electrical contact with converging toothed contact plates.

Also available is a solderless wire connector (U.S. Pat. No. 3,576,518) containing a slotted resilient metal contact plate. The plate is transversely supported within a base contoured to support conductors to be connected. The base has a hinged cover and a collar which cooperates with a collar on the cover to provide strain relief for the conductors when the cover is closed.

SUMMARY OF THE INVENTION

This invention provides a device for making electrical connections. The device can be fabricated by using conventional molding techniques and can be assembled to a cord before the cord is heat treated to achieve retractile properties. Methods are provided for assembling plugs to conductors and for establishing electrical connections between the conductors and associated terminals.

An electrical connecting device which embodies the invention is molded to include a base with a cover hinged integrally with the base and in an open position. The base is formed with a plurality of conductor-receiving troughs. A leading end of a cord is inserted through an opening in the base which circumscribes substantially the periphery of the cord and which is adjacent the hinge and advanced to extend the leading end beyond the plug. The jacket is removed from a leading portion of the cord and the cord is retracted to fan out and position each conductor in a trough. Then, the cover is closed and bonded to the base to confine each conductor in a trough and to engage a portion of the jacket to provide strain relief therefor. Individual strain relief is also provided for each conductor. Flat blade-like terminals are inserted from an external face of the base into terminal-receiving grooves which are aligned with and which communicate with associated ones of the troughs. The terminals have tangs which extend into the troughs to make electrical contact with associated ones of the conductors.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features of the present invention will be more readily understood from the following detailed description of specified embodiments thereof when read in conjunction with accompanying drawings, in which:

FIG. 1 is a perspective view of a telephone set showing the inventive plugs inserted into a handset and a base portion thereof;

FIG. 2 is a perspective view of one of the plugs with a cord and terminals prior to assembly with the plug for

purposes of clarity and further showing a hinged dielectric portion of the plug in an open position;

FIG. 3 is a perspective view of the plug shown in FIG. 2 with the conductors of the cord fanned out and received in associated ones of a plurality of conductor-receiving troughs;

FIGS. 4A–4D are a sequence of views in elevation partially in section and showing the assembly of the plug with the cord and terminals in accordance with the principles of this invention;

FIG. 5 is a view showing the relationship between the plug illustrated in FIG. 2 being inserted into a handset portion of the telephone illustrated in FIG. 1;

FIG. 6 is a view similar to that of FIG. 5 but at a later time with the plug being seated and locked within the handset portion of the telephone; and

FIG. 7 is a perspective view of an apparatus which may be used to carry out the steps of the methods of this invention.

DETAILED DESCRIPTION

OVERALL

Referring now to FIG. 1, there is shown a telephone, designated generally by the numeral **10,** which includes a base portion, designated generally by the numeral **11,** and a handset portion, designated generally by the numeral **12.** A retractile cord, designated generally by the numeral **13,** interconnects the base portion **11** and the handset portion **12.** The retractile cord **13** is provided with a plug, designated generally by the numeral **14,** at the handset and thereof and at the base end thereof. The plug **14** has facilities for establishing an electrical connection between the cord **13** and internal contacting components **16—16** of the telephone **10** (see FIG. 5).

Referring now to FIG. 2, a more detailed view of the structure of the retractile cord **13** can be seen. The retractile cord **13** includes a jacket **17** and a plurality of insulated conductors **18—18.** The free end portion of each of the conductors **18—18** is designed to be connected to an associated one of a plurality of terminals **19—19.**

Miniature plugs disclosed in the prior art may be advantageously used in many telephone environments where the insulated conductors **18—18** have the same spacing (0.037 inch) as the external components **16—16** with which the plug **14** makes contact. There are some telephone apparatus having external components which are spaced further apart (0.125 inch) than conductors **18—18** in the cord **13** to be connected thereto. This requires a fanning out of the conductors **18—18** in assembling the cord **13** to the plug **14** which is not feasible with some of the heretofore discussed prior art plugs. Plugs constructed in accordance with the present inventions permit the fannout out of the conductors **18—18** to be aligned with terminals which are aligned with external contact components.

DIELECTRIC PORTION

The detailed construction of the plug **14** is shown in FIGS. **2, 3,** and **4.** A rigid, dielectric base, designated generally by the number **30,** is designed to be easily molded by using conventional injection-molding techniques. The rigid, dielectric base **30** has a free end **31,** a cord-input end **32** and a terminal-side **33** (see FIG. 4A).

It may be observed from FIGS. **3** and **4D** that the base **30** is formed with a cord-input aperture **34** which circumscribes substantially the portion of the jacket **17** of the cord **13** extending therethrough. As can best be seen in FIG. 4A, the cord-input aperture **34** is formed entirely in the base **30** of the plug **14** and has a flared entrance to facilitate insertion of a leading end of the cord **13.** The cord-input aperture **34** opens into a cavity **36** which terminates in a ledge **37** at the free end **31** of the base **30.** This facilitates the automatic assembly of the plug **14** to the cord **13.**

As has been noted, the formation of the cord-input aperture **34** entirely in the base **30** and sized to substantially circumscribe the cord **13** is advantageous during the assembly of the cord to the plug **14.** This holds the cord **13** while other operations are performed by automated equipment. This is unlike prior art connectors having separate base and cover. In those, a portion of a conductor-access opening is formed in the base and a portion in a lid which is later bonded thereto. The cord **13** is generally positioned in the portion of the opening in the base and then the cover is applied. This will not suffice to hold the cord **13** in the base during assembly without additional steps and equipment.

A plurality of longitudinally extending partitions **38—38** are molded with the dielectric base **30** and extend into the cavity **36.** A plurality of conductor-receiving troughs **39—39** (FIG. 2) are formed between the partitions **38—38** and open to the free end **31.** The conductor-receiving troughs **39—39** are designed to receive associated ones of the conductors **18—18.** Each of the troughs **39—39** is dimensioned so that the conductor **18** therein cannot move laterally therein. This is necessary to insure that during the insertion of the terminals **19—19,** the terminals remain aligned with the conductors **18—18** to make electrical engagement therewith.

It may be observed from FIG. **2** that the bottoms of the troughs **39—39** are substantially coplanar with the top surface of the ledge **37.** This facilitates the use of the ledge **37** for conductor cut-off during the assembly of the plug **14** to the cord **13.**

The partitions **38—38** are discontinued somewhat short of the conductor access opening **34** and emerge into a sloping surface **41** formed adjacent the access opening. Attention is also directed to energy directors **42—42** formed longitudinally along the partitions **38—38.** The energy directors **42—42** are dimensioned to provide for adequate bonding of a cover **46** to the base **30** of the plug **14** in accordance with the specifications provided by manufacturers of commercial ultrasonic equipment. For example, see D. J. Kolb "Designing Plastic Parts for Ultrasonic Assembly" in the Mar. 16, 1967 issue of *Machine Design.*

The cover **46** is molded integrally with the dielectric base **30** and is mounted pivotally along a plastic hinge **47** (see FIGS. **2, 3,** and **4**). The plastic hinge **47** extends transversely along the dielectric base **30.**

The use of the hinged cover **46** offers certain advantages. Since it is pre-attached to the base **30,** alignment problems on closure are circumvented. Also, by molding the cover integrally with the base **30** in a open position, the step of hingeing a separate part to the base is saved. Moreover, molding the cover in an open position presents the plug in a ready-for-assembly condition with no additional preparation necessary.

As can also be seen in FIG. 2, the cover 46 has a plurality of spaced parallel ribs 48—48 projecting therefrom toward the base 30. The ribs 48—48 are positioned to be intermediate the partitions 38—38. Also, the ribs 48—48 extend from the cover 46 a sufficient distance so that when the cover is closed and bonded to the base 30, the ribs will engage and confine the associated ones of the conductors 18—18. In this way, when the cover 46 is closed, the ribs 48—48 engage the conductors 18—18 received in the troughs 39—39 to secure the conductors within the troughs.

The ability to be able to precisely confine the conductors 18—18 is especially important. Prohibition against movement is necessary in order to cause the terminals 19—19 to penetrate the nylon-insulated conductors 18—18. The terminals 19—19 must be inserted with sufficiently high forces imparted thereto to penetrate the insulation. If the conductors 18—18 were free to move laterally, the terminals 19—19 may very well slice into the insulation on either side of the conductive elements and fail to establish engagement therewith.

The plug 14 also has provisions to alleviate strain relief on the cord jacket 17 during customer use. The cover 46 has a cord anchoring lug 49 (see FIG. 4A) projecting from the underside thereof. As can be seen in FIG. 4D, the cord anchoring lug 49 is spaced along the underside of the cover 46 so that when the cover is closed, the anchoring lug is aligned with a well 51 formed in the base 30. The well 51 communicates the exterior of the plug 14 with the cavity 36. When the cover 46 is closed (see FIG. 4D) with the cord 13 being inserted into the plug 14, the anchoring lug 49 engages the jacket 17 and urges a portion of the cord 13 into the well 51. The cord 13 assumes a tortuous configuration around the anchoring lug 49.

Strain relief is also provided for the individual conductors 18—18. As is shown in FIG. 2, a plurality of conductor anchoring teeth 52—52 are formed on the underside of the cover 46 intermediate the hinge 47 and the free end thereof. The teeth 52—52 are aligned with the conductor-receiving troughs 39—39. When the cover 46 is closed on the base 30 with the conductors 18—18 received within the troughs 39—39, the teeth 52—52 engage associated ones of the conductors (see FIG. 4D) and deform the insulation thereof to secure the conductors within the plug 14.

In this way, the terminals 19—19 function only to make electrical contact with the conductors 18—18 and are not required to retain the conductors and resist the forces imparted to the conductors during customer use. These forces occur notwithstanding the anchoring of the cord 13. This is due to the jacket having a much greater elongation than the core of the cord 13. If strain relief were not provided for the conductors 18—18, desirably on an individual basis, pull-out of one or more of the conductors may occur during use of the telephone.

As can best be seen in FIG. 4A, the plug 14 is formed with a plurality of spaced parallel terminal-receiving openings in the form of grooves 56—56 which are aligned on a one-to-one basis with associated ones of the conductor-receiving troughs 39—39. Each of the terminal-receiving grooves 56—56 is of a length substantially equal the overall length of a terminal 19. Each of the terminal-receiving grooves 56—56 communicates with the associated conductor-receiving trough 39 through a slot 57. The slot 57 is shorter than the associated terminal-receiving groove 56 and is of a length slightly less than the out-to-out distance of that portion of a terminal 19 which is to be received therein. The shortening of the slots 57—57 from the terminal-receiving grooves 56—56 forms abutments 58—58 (see FIG. 4A for example).

Formed integrally with the dielectric portion 30 is a resilient locking tab 61. The locking tab 61 is approximately 0.035 inch thick, 0.300 inch wide, 0.500 inch long, and is molded so that its longitudinal axis is oriented at an angle of approximately 15° with respect to the plane of the terminal-inserting side 33. A hinge end 62 of the locking tab 61 is molded into one side of a bridge projection 63, substantially in the middle of the projection.

The combined height of the bridge projection 63, thickness of the locking tab 61 and resilience of the locking tab permits insertion of the plug 14 into the handset 12 between opposing surfaces 64 and 66 (see FIG. 5). The tab 61 can be deflected inwardly of the dielectric base 30 to become substantially coplanar with the outermost surface of the bridge projection (see FIG. 5) and be moved slidably in engagement with the surface 64.

After being released, the locking tab 61 will resume its originally molded shape and orientation because of its natural resilience. Proper resilience to provide the desired flexing properties can be incorporated into the locking tab 61 when it is molded from polycarbonate with the aforementioned dimensions. The return of the tab 61 to its originally molded shape causes the free end of the tab to be urged downwardly into seating engagement with a ledge 67 (see FIG. 6) formed in the handset 12 and the base 11. This locks the plug 14 to the handset 12 and insures integrity of the connection during customer use.

TERMINALS

As can best be seen in FIG. 2, each one of the terminals 19—19 is made from a generally flat strip of electrically conductive resilient material such as Phosphor bronze. Moreover, each one of the terminals 19—19 includes at least one contact or insulation-piercing tang 71 which provides electrical connection between the conductive portion of the conductor 18 and the associated one of the terminals 19—19.

Each of the blade-like terminals 19—19 also has a flat contact portion 72 which is utilized to complete the connection between the associated conductor 18 and an associated internal-contacting component 16 illustrated in FIG. 5, and positioned in the telephone 10.

Provisions are also made for seating properly the terminals 19—19 within the associated terminal-receiving grooves 56—56. Each of the terminals 19—19 is formed with positioning shoulders 74—74. These shoulders 74—74 engage with the end faces of the grooves 56—56 to locate the terminals 19—19 properly longitudinally within the grooves. The shoulders 74—74 also engage with the abutments 58—58 to seat the terminals 19—19 within the grooves properly with respect to depth. This insures that the terminals 19—19 are seated at a distance spaced from the conductor such that the tangs 71—71 engage with the conductive portion of the conductor. If spaced excessively, the tangs 71—71 may not extend to the conductive portions; and if spaced too closely, there may be a deforming of the tangs or of the conductor.

There are also provisions for retaining the terminals **19—19** within the terminal-receiving grooves **56—56.** Each of the terminals **19—19** is formed with barbs **76—76** which extend from end ones of the tangs **71—71.** These penetrate the material of the plug which define the terminal-receiving grooves **56—56** when the terminals are assembled therewith. The barbs **76—76** dig into the end walls of each of the slots **57—57** to securely anchor the terminal within the plug **14.**

METHOD OF ASSEMBLING PLUG WITH CORD

The construction of the plug **14** is especially adapted to be used with flat cordage. Moreover, the plug **14** is easily adapted to automated high speed manufacturing. In describing the assembly of the plug **14** and the cord **13,** reference will be made to FIGS. **4A–4D** which depict the steps of the method. Reference will also be made to FIG. **7** which illustrates an apparatus, designated generally by the numeral **80,** which is exemplary of apparatus which may be used to carry out the steps of the method.

One of the plugs **14—14** with the cover **46** thereof in the open position is positioned in a workholder **81** (see FIG. **7**). Then a leading end of the jacketed cord **13** is inserted between a grooved roller **82** and a drive roller **83.** The groove in the roller **82** is constructed so that when the cord **13** is positioned therein, portions of the cord extend above the periphery of the roller. The drive roller **83** is mounted adjacent the grooved roller **82** so as to engage the portions of the cord **13** exposed above the groove. The drive roller **83** is turned to advance the leading end of the cord **13** through the plug **14** until it extends well beyond the free end **31** of the plug (see FIG. **4B**).

A plate **84** and a spring-biased rod **86** are positioned between the base **30** and the cover **46** prior to the advancement of the leading end of the cord **13** through the plug **14.** The cord **31** is advanced between the plate **84** and the tops of the partitions **38—38.** Since the outside diameter of the cord **13** is significantly greater than the width of each of the troughs **39—39,** successive sections of the cord are maintained in engagement with the top surfaces of the partitions **38—38.** The plate **84** is of assistance in maintaining the path of the leading end of the cord **13** in a predetermined direction to facilitate further processing.

It is advantageous to construct the base **30** with the cord-input aperture **34** which circumscribes substantially the cord **13.** This provides total lateral support for the cord **13** intermediate the convolutions and the free end thereof during its assembly with the plug **14.** This is unlike prior art devices wherein only the base may include a U-shaped opening. In assembling those devices, the cord **13** must be held within the opening during the arrangement of the conductors **18—18** within the base and the assembly of a lid thereto.

In the next step of the inventive method, a stripping device **87** is controlled to remove a length of the jacket **17** from the cord **13.** This exposes individual ones of the conductors **18—18** which have their own primary insulative covering. The stripping device **87** is then returned to an initial position.

Then the rotation of the drive roller **82** is reversed to withdraw the leading end portion of the cord toward and at least partially within the plug (see FIG. **4C**). The cord **13** is retracted until the exposed individual conductors **18—18** extend to a point which will be intermediate the anchoring lug **49** and the anchoring teeth **52—52** (see FIG. **4D**) when the cover is closed.

A combing head **91** is moved along a path spaced above and aligned with that of the cord. Simultaneously with the retraction of the cord **13,** the conductors **18—18** are fanned out and received separately in associated ones of the conductor-receiving troughs. The fanning out of the conductors **18—18** simultaneous with the retraction of the cord **13** is accomplished by controlling a plurality of selectively movable camming blades **88** and **89** (see FIG. **7**) which are mounted in the head **91.**

To describe the fanning out operation, it is assumed that the cord **13** includes five conductors **18—18,** a center conductor, two intermediate conductors and two outside conductors. As the cord **13** is retracted, the blades **88—88** are moved downwardly between the center and immediate conductors. Then the blades **88—88** are turned rotatably within the head **91** to space apart the center and intermediate conductors. Simultaneously therewith, the blades **89—89** are moved downwardly between the intermediate and outer conductor **18—18** and turned. This causes the conductors **18—18** to be spaced apart and permit the plate **84** to cause the conductors to be moved into the troughs **39—39.**

This is accomplished by controlling the rod **86** to urge the plate **84** into engagement with the top surfaces of the partitions **38—38.** This causes the jacketed portions of the cord **13** extending from the cord input aperture **37** to be urged into engagement with the sloping surface **41.** Also, the individual conductors **18—18** are moved into associated ones of the troughs **39—39** and maintained therein by the plate **84.**

Because the cord **13** is flat and because of the assembly process, the conductors **18—18** are spaced in a prearranged order in the troughs **39—39.** It is unnecessary for an operator to identify the conductors **18—18** prior to the electrical connection with ones of the terminals **19—19.** The order in the cord **13** is maintained in the plug **30** to correspond to the order of engagement with the external contacting components **16—16.**

In a next step of the method which embodies the principles of this invention, an ultrasonic bonding tool **92** is moved downwardly into engagement with the dielectric cover **46.** The bonding tool **92** is moved further downwardly to apply forces to the cover **46** to move pivotally the cover about the hinge **47** and to engage the cover with the base **30** (see FIG. **4D**). Simultaneously, the rod **86** is moved toward the free end **31** of the base while maintaining pressure against the plate **84.** This maintains the plate **84** in engagement with the top surfaces of the partitions **38—38** to maintain the conductors **18—18** within the troughs **39—39** while the cover **46** is being closed.

As this is done, the anchoring lug **49** engages the jacketed portion of the cord **13** while the anchoring teeth **52—52** engage the individual conductors **18—18.** This arrangement provides strain relief for both the cord **13** and for the individual conductors **18—18.** With these provisions for strain relief, the maintenance of electrical continuity is greatly enhanced. Notwithstanding the very great difference in elongation characteristics between the jacket material and the individual conductors, the individual clamping of each conductor **18** will maintain the conductors in the troughs when

subjected to forces imparted thereto during customer use.

As the cover **46** is moved pivotally to a closed position, the plate **84** is withdrawn slidably toward the free end **31** of the plug **14.** During withdrawal, the plate **84** is maintained in engagement with portions of the top surfaces of the partitions **38—38.** After the plate **84** and rod **86** are withdrawn completely and the cover **46** closed, the ultrasonic bonding tool **92** is controlled to bond the cover to the base **30.**

The advantages of the cover **46** being integrally hinged with the base **30** should be apparent. Additional assembly steps and apparatus therefor are unnecessary. Also, tedious alignment problems of miniature bases and separate covers prior to bonding are overcome.

Moreover, the construction of the plug with the cord-input aperture **34** totally within the base **30** and with the cover **46** hinged to the base **30,** facilitates the fanning out of the conductors **18—18.** Since the cord **13** is held laterally at the cord-input aperture **34,** additional holding facilities are unnecessary and only the facilities for fanning out the conductors **18—18** are required.

It should also be noted that as the cover **46** is closed on the base **30** and bonded ultrasonically thereto, the ribs **48** are received between associated conductors **18—18** to complete the lateral confinement thereof in the associated throughs **39—39.**

The free end portions of the conductors **18—18** are trimmed off with a cutting device **93** and using the ledge **37** as a bearing surface. The extension onto the ledge **37** and the cut off is necessary to compensate for the snubbing action of the closing of the cover **46** on the conductors. Had the conductors **18—18** been retracted to precisely align the ends thereof with the ends of the troughs, then when the cover is closed, the snubbing action would cause the conductors to move longitudinally within the troughs. Also, the paths of the conductors **18—18** within the plug **14** vary. Presizing the conductors **18—18** would result in outside ones of the conductors being withdrawn in the troughs **39—39.** This could possibly result in the loss of electrical contact of the outer ones of the terminals **19—19** with the outer conductors, i.e., those conductors adjacent the sides of the base **30.**

The above-described arrangement is easily adaptable to an automation process. The flat cord **13** has the conductors **18—18** in an ordered predetermined sequence which are to be received in the same order in the troughs **39—39.** The retraction of the length of the cord **13** back into the dielectric portion **30** maintains the conductors in the same order and no further identification is required.

In order to complete the assembly of the plug **14** to an end of the cord **13,** five of the terminals **19—19** are inserted into the plug. The blade-like terminals **19—19** are inserted from the terminal-receiving face **33** of the plug **14** into associated ones of the terminal-receiving grooves **56—56** until the positioning shoulders **74—74** seat into engagement with the abutments **58—58** (see FIG. 4D). At that time, the contact tangs **71—71** extend through the aligned slots **57—57** and into the associated troughs **39—39.** The tangs **71—71** penetrate the insulation of the conductors **18—18** confined in the troughs **39—39** and establish electrical contact with the conducitve elements thereof.

Also, the barbs **76—76** are caused to become embedded in the portion of the dielectric base **30** which defines the slots **57—57.** This anchors the terminals **71—71** against movement or inadvertent removal from the base **30.**

In use, the lower edge portion of each of the blade-like terminals **19—19** engages electrically with an associated external contacting portion **16** (see FIG. **5**).

Of course, apparatus other than the apparatus **80** may be used to practice the methods of this invention. For example, the assembly of the plug **14** to the cord **13** could be accomplished by using a turntable (not shown) with facilities for inserting the cord, stripping the cord etc. arranged about the periphery of the turntable. Successive cords **13—13** and associated plugs **14—14** are moved with the turntable (not shown) through the work stations.

It is to be understood that the above-described arrangements are simply illustrative of the invention. Other arrangements may be devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. An electrical connector for terminating a cord including a plurality of insulated conductors and for making electrical contact external to the connector, which comprises:

a base, which includes a cord-input end having an aperture for receiving and substantially circumscribing the cord, the base also including a portion having conductor-receiving troughs and a plurality of terminal-receiving openings extending generally parallel to and communicating with the troughs and the exterior of the connector, the inverts of the troughs to which the terminal-receiving openings communicate being in substantially the same plane as a portion of the wall of the cord-input opening, the base being formed with a well between the cord-input end and the conductor-receiving troughs for receiving the portion of the jacketed cord, the base being formed with a ramp extending from the well to the troughs to facilitate the advance of a leading end of a cord from the cord input end beyond the troughs;

a plurality of electrically conductive blade-like terminals positioned within the base each of which includes:

an internal contact portion extending into the trough for piercing the insulation of and making electrical engagement with the conductor in the trough; and

an external contact portion positioned within the associated terminal-receiving opening for making electrical contact external to the connector; and

a cover having one end formed integrally with the base along a web portion which is substantially less in thickness than the cover or the walls of the base defining the cord-input aperture, the web portion being adjacent the cord-input end and moveable with respect thereto to cause a portion thereof to engage the portion of the base having the conductor-receiving troughs to confine the conductors and to prevent lateral movement thereof to insure that the positioning of the terminals within the openings cause the internal contact portions of the terminals to engage electrically the associated insu-

lated conductors, the cover also being formed with an anchoring lug extending from the underside thereof and which engages the jacketed portion of the cord after the cord has been inserted into the cord-receiving opening and the cover closed, the portion of the cord engaged by the anchoring lug being formed along a tortuous path around the anchoring lug and extending into the well to provide strain relief for the cord during use thereof.

2. The electrical connector of claim **1,** wherein the cover is formed with a plurality of conductor-engaging teeth on the underside thereof and extending toward the base, each of the teeth being aligned with an associated conductor-receiving trough, so that when the cover is closed on the base, each of the teeth engages the insulation of the conductor positioned in the associated conductor-receiving trough to provide strain relief for the individual conductors during use.

3. The electrical connector of claim **1,** wherein the free end of the base extends beyond the cover when the cover is in a closed position to provide a bearing surface for cutting off exposed end portions of the conductors which extend beyond the free end of the cover.

4. The connector of claim **1,** wherein the terminal-receiving openings include a plurality of spaced grooves opening to an external surface of the connector and associated slots communicating the grooves with associated ones of the troughs, each of the slots being of a size to permit the internal contact portion of a terminal to pass therethrough.

5. The connector of claim **4,** wherein the internal contact portions of each terminal includes a plurality of contact tangs which extend through the slots and into electrical engagement with the conductor in the associated trough.

6. The connector of claim **5,** wherein each of the terminals is formed with barbs extending from portions of the tangs which are positioned within the slots and an overall longitudinal dimension thereof is slightly greater than the longitudinal dimension of the slot which communicates the associated groove and trough to facilitate the end barbs of the terminal becoming embeded in the walls of the slot when the terminals are inserted to anchor the terminals within the base.

7. The connector of claim **4,** wherein each of the grooves of each terminal-receiving opening is formed to extend beyond the ends of each associated slot to form an abutment at each end of the groove.

8. The connector of claim **7,** wherein each of the terminals includes a shoulder at each end thereof for engaging the abutments of the associated terminal-receiving groove to seat the terminal properly within the opening.

9. The connector of claim **1,** wherein the cord-input aperture has an inner portion approximately the same cross-section of the cord with the walls of the aperture diverging continuously from the inner portion to the cord-input end of the connector and forming a flared inlet to facilitate insertion of the leading end of the cord.

10. A method of assembling a device to a cord for connecting electrically individual conductors which comprise the cord to associated components external to the device, the device including a base having a cord-input aperture which circumscribes and is in engagement substantially with the periphery of a section of the cord extending therethrough, the base further having conductor-receiving troughs and terminal-receiving openings communicating with associated troughs and a cover hinged integrally to the base adjacent the cord-input aperture and adapted to mate with the base, which includes the steps of:

holding the base with the cover hinged open therefrom;

inserting the leading portion of the cord into the cord-input aperture;

causing relative motion between the device and the cord to advance the leading portion of the cord beyond the base;

exposing the individual insulated conductors of a predetermined length of the leading portion of the cord by removing the jacket therefrom;

retracting at least a section of the leading portion of the cord within the base; while

positioning the individual ones of the conductors within associated ones of the troughs;

causing the cover to be closed on and secured to the base to confine the conductors within the associated troughs and prevent unintended lateral and longitudinal movement thereof; and

inserting and seating terminals in the terminal-receiving openings such that internal contact portions thereof extend into the troughs and pierce the insulation of the associated conductors to establish an electrical connection with the conductors and to expose external contact portions thereof for engagement with the external components.

11. The method of claim **10,** wherein the cord is inserted into the device with the conductors arranged in a specific orientation such that when jacket is removed from leading portion of the cord, the orientation of the conductors corresponds to that of the associated conductor-receiving troughs thereby obviating identification of the individual conductors before placement thereof in the associated troughs.

12. The method of claim **10,** wherein the spacing of the troughs corresponding to the spacing of the external components is greater than that of the conductors within the jacketed cord and positioning of the conductors in the troughs includes fanning out the conductors while the cord is being retracted to align the conductors with the associated troughs.

13. The method of claim **10,** wherein the cord is retracted so that leading portions of the individual conductors extend beyond a free end of the device opposite that end having the cord-input aperture and the method includes the further step of severing those portions of the conductors extending beyond the device subsequent to the closing of the cover.

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