

[54] CONNECTOR

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[73] Assignees: Western Electric Company, Incorporated, New York, N.Y. ; by said Hardesty; Bell Telephone Laboratories, Incorporated, Murray Hill, N.J. ; by said Krumreich, Mulbarger and Walden

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Related U.S. Application Data

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[52] U.S. Cl. 339/99 R, 339/107

[51] Int. Cl. H01r 9/08

[58] Field of Search 339/97-99, 220, 221, 103, 105, 107

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[57] ABSTRACT

The connector is adapted to terminate a cord having a multiplicity of insulated conductors arranged in a spaced linear array. The connector comprises a pair of shaped dielectric members that when joined together include means for clamping the cord therebetween and a multiplicity of ducts for respectively accommodating the individual insulated conductors exposed by the removal of the insulating jacket from the end of the cord. One of the connector members includes a ledge adjacent to the forward end of the ducts against which the ends of the conductors are trimmed. A multiplicity of openings exposed to the exterior of the connector respectively communicate with the ducts, and an individual blade terminal is inserted in each opening. Each blade terminal includes barbs that lock it in place and tangs that pierce the insulation of and make electrical contact with the conductor in the associated duct. An edge of each terminal is exposed to the exterior of the connector and serves as the external contact surface.

10 Claims, 5 Drawing Figures

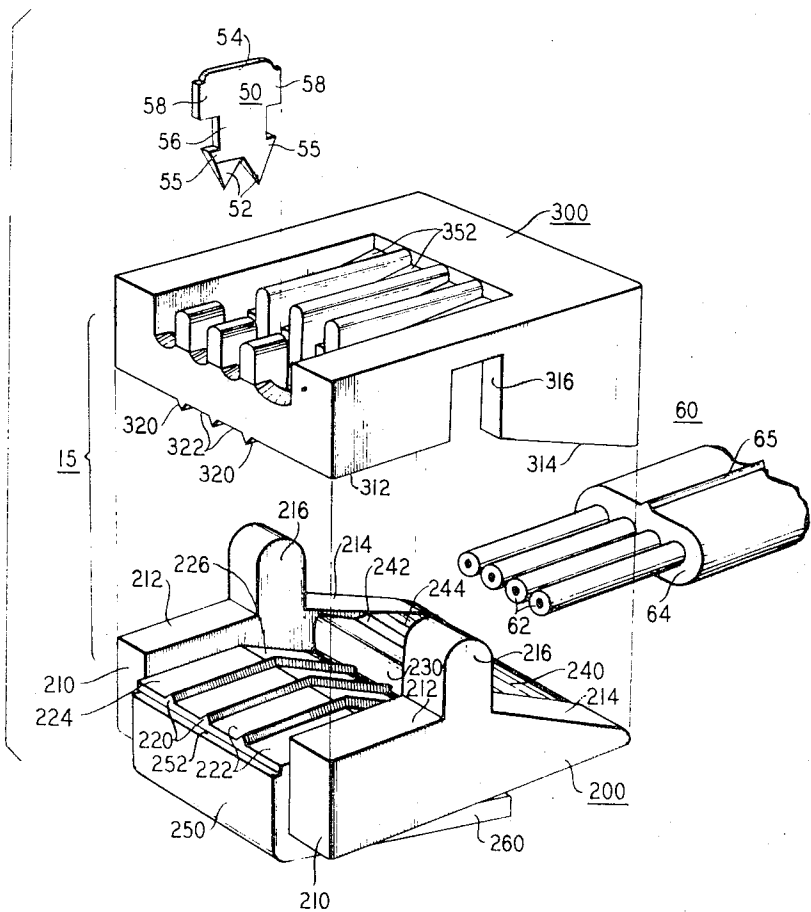
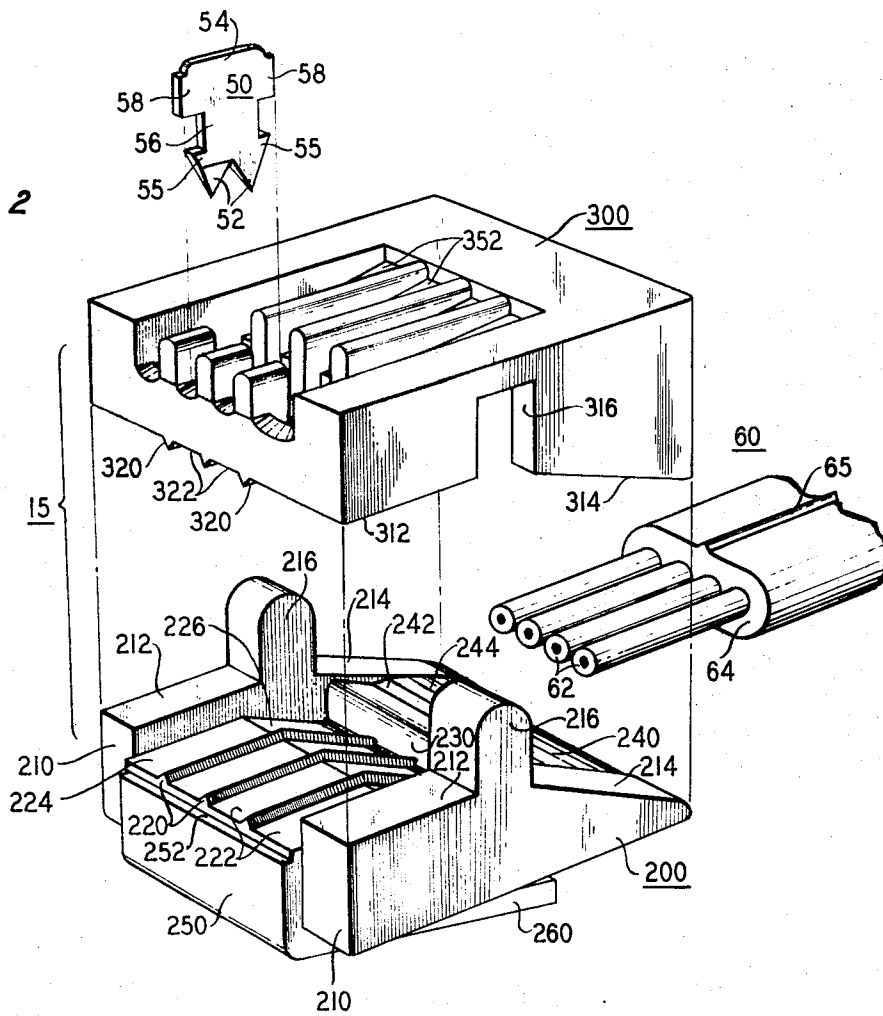


FIG. 2



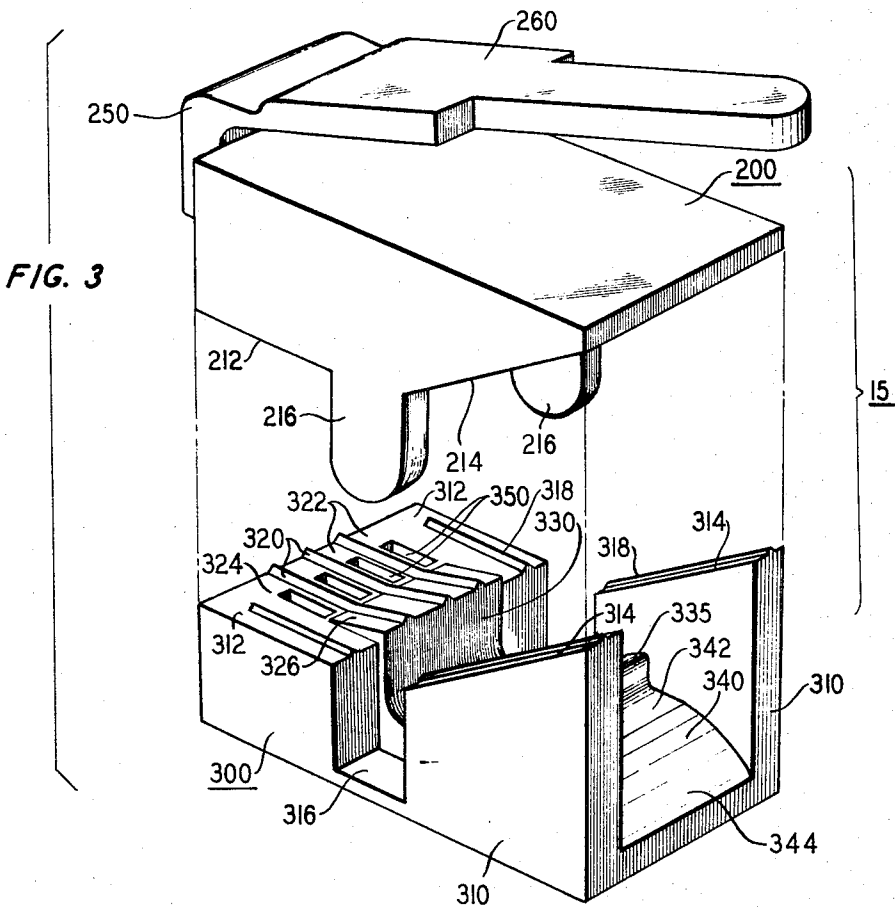


FIG. 5

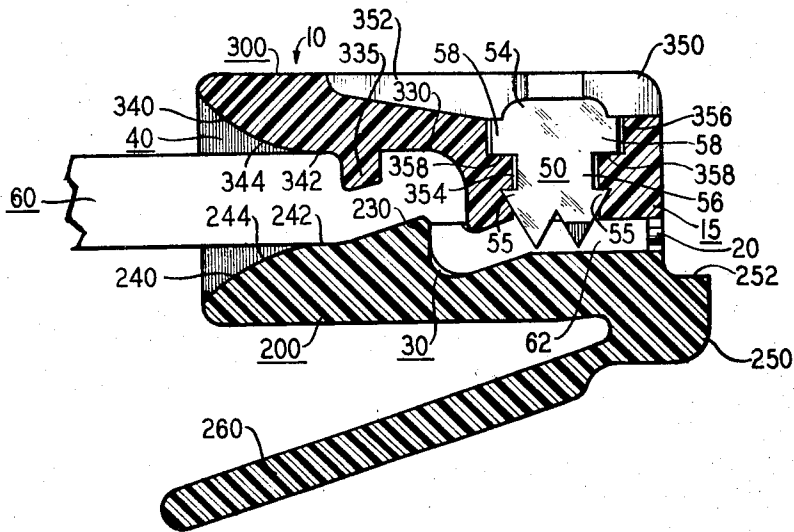
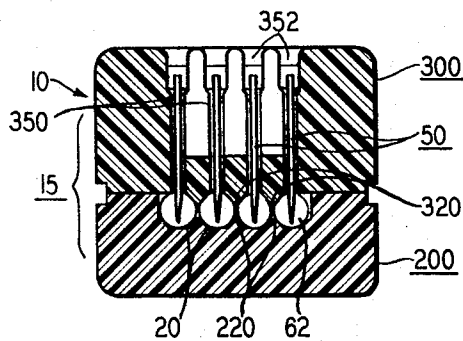


FIG. 4



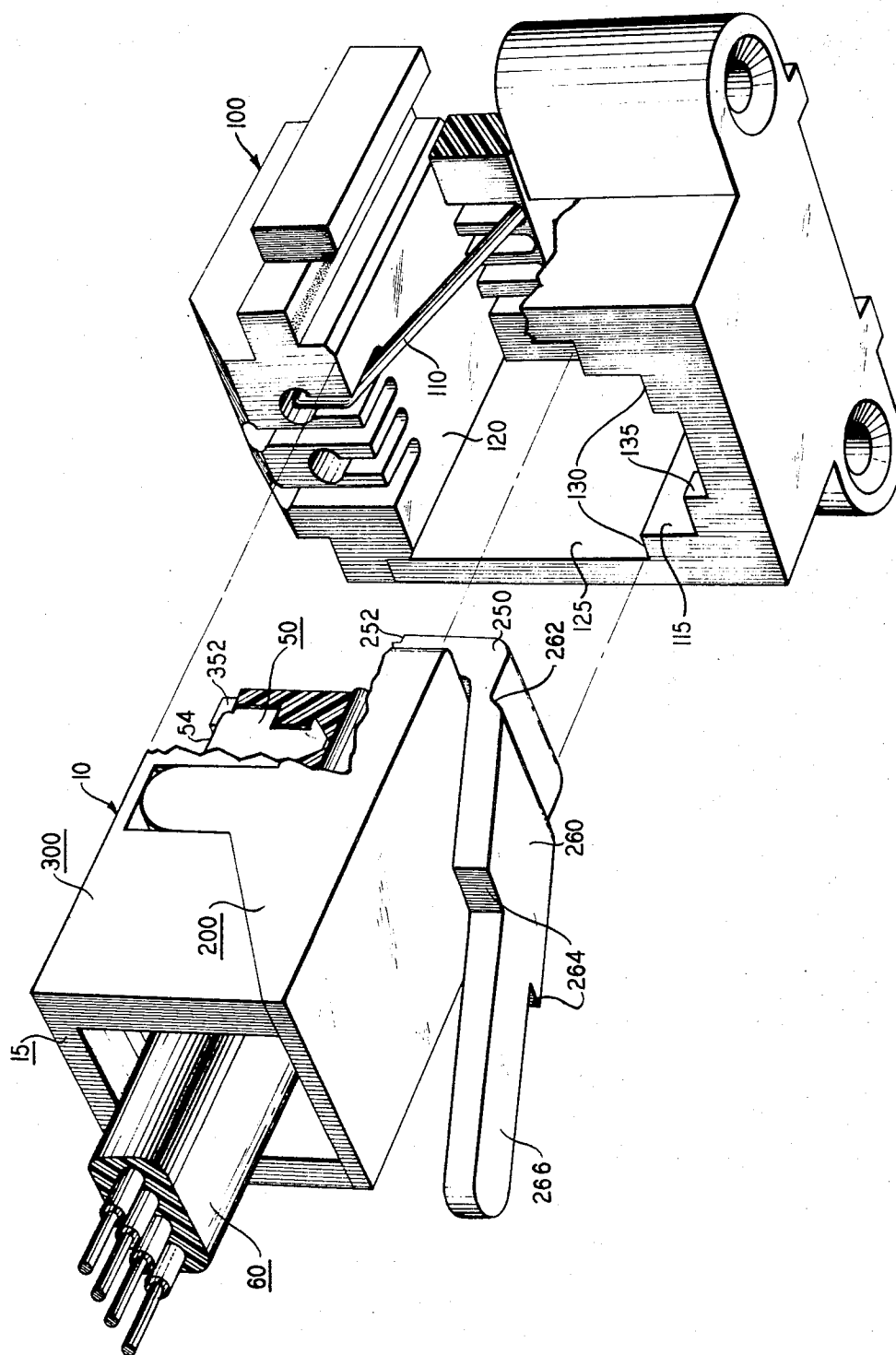


FIG. 1

CONNECTOR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 33,211 filed Apr. 30, 1970, and assigned to the same assignee as the present application.

FIELD OF THE INVENTION

This invention relates to the field of electrical connectors and within that field to the plug or male type of connector.

BACKGROUND OF THE INVENTION

The direction of the electrical technology today is toward smaller and smaller components, and this is no less true with respect to electrical connectors than it is with respect to other discrete components. However, one major problem in this movement toward miniaturization of connectors is manufacturability. As connectors become smaller, they typically become more difficult and consequently more expensive to manufacture.

SUMMARY OF THE INVENTION

The connector of the present invention lends itself to miniaturization, but in addition it is designed so that the elements of the connector can be assembled and the connector attached to the cord that it terminates by automated machinery even when the connector is so miniaturized.

The connector comprises a pair of shaped dielectric members that when joined together form an enclosure including (1) a multiplicity of ducts arranged in a spaced linear array for respectively accommodating the individual insulated conductors of the cord, (2) a constricted tortuous passageway for clamping the cord in place, and (3) a flared inlet for reducing the bending stress on the cord when it is flexed. The enclosure further includes a ledge protruding from the forward end thereof and a multiplicity of openings exposed to its exterior that respectively communicate with the conductor receiving ducts. An individual blade terminal is accommodated by each opening, and each terminal includes a barb on each side, a pair of tangs at one end, and a flat edge at the other end.

The elements of the connector are assembled to the cord by first removing the jacket from the end of the cord to expose the insulated conductors, the cord being formed to locate the insulated conductors in essentially the same spaced linear array as the ducts in the connector. The cord is then positioned with the jacketed portion of the cord located in the constricted tortuous passageway portion of the first of the shaped members. Because of their spacing, the insulated conductors are at the same time automatically located in the individual duct portions of the first member, the free ends of the conductors extending beyond the front end of the member.

The second shaped member is then placed into engagement with the first member, the members including guide elements that properly locate one with respect to the other, and the members are ultrasonically bonded together. At approximately the same time, the free ends of the conductors are trimmed off flush with the front ends of the ducts by a cutting edge moving against the protruding ledge, and the terminals are inserted into the accommodating openings. The barbs of each terminal lock it in place and the tangs pierce the

insulation of, and make electrical contact with, the conductor in the associated duct. The flat edge of each terminal is exposed to the exterior of the connector and serves as the surface that makes electrical contact with the mating connector.

DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective showing the male connector of this invention separated from a mating female connector, portions being broken away for greater clarity;

FIG. 2 is an exploded perspective view showing the enclosure members and blade contact and the cord terminated by the connector of this invention.

FIG. 3 is an exploded perspective view showing the enclosure members inverted from their position in FIG. 2; and

FIGS. 4 and 5 are sectional views taken along lines 4—4 and 5—5 respectively of FIG. 1, showing the relationship of the assembled elements of the connector.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1 of the drawing, the male connector 10 of this invention is shown in position to be inserted into a female connector 100 with which it mates. The connector 10 includes an enclosure 15 that comprises a pair of shaped members that for convenience of description will be referred to as a base 200 and a top 300. The base 200 and top 300 are advantageously molded as integral members, using conventional injection molding techniques, from a dielectric material such as polycarbonate molding compound.

As shown by reference to both FIGS. 1 and 2, the base 200 has spaced side walls 210 each of which includes a horizontal mating surface 212 to the front of and an inclined mating surface 214 to the rear of a tongue 126. Between the side walls 210, the interior surface of the base 200 has three spaced ridges 220, and the ridges in conjunction with the side walls define four troughs 222 that include a horizontal portion 224 at the forward end of the base and an inclined portion 226 of the rear of the horizontal portion. The inclined portion 226 terminates at an upstanding protuberance 230, and an inlet portion 240 is situated to the rear of the protuberance. The inlet portion 240 comprises a horizontal surface 242 joining a convex surface 244, the latter curving continuously from the horizontal surface toward the underside of the base 200.

The base 200 further includes a ledge 250 that protrudes from the forward end and underside thereof. The ledge 250 includes a flat surface 252 that underlies the forward end of the troughs 222 while a latch 260 extends rearwardly from the lower end of the ledges. The latch comprises an integral hinge portion 262, a pair of locking shoulders 264, and a tab 266. The latch 260 normally extends at an angle to the underside of the base 200, but the hinge portion 262 permits it to be deflected toward the underside by means of the tab 266.

Turning now to both FIGS. 2 and 3, the top 300 of the enclosure 15 has interior surfaces complementary to those of the base 200. Thus, the top 300 has spaced side walls 310 each of which includes a horizontal mating surface 312 to the front of and an inclined mating surface 314 to the rear of a notch 316. The inclined mating surfaces 314 extend at the same angle as the inclined mating surfaces 214 of the base 200, while the notches 316 are of a size to just accommodate the

tongues 216. Consequently, the mating surfaces 212, 312, and 214, 314 in conjunction with the tongues 216 and notches 316 serve to properly locate the top 300 on the base 200.

The interior surface of the top 300 between the side walls 310 includes three spaced ridges 320 that define four troughs 322. The size and configuration of ridges 320, the spacing between the ridges, and the position of the ridges with respect to the sides are the same as the ridges 220 in the base 200. Thus the size and location of the troughs 322 in the top 300 are the same as the troughs 222 in the base 200. In addition, the troughs 322 like the troughs 222 have a horizontal portion 324 at the forward end of the top 300 and an inclined portion 326 to the rear of the horizontal portion. The inclined portion 326 of the troughs 322 extend at approximately the same angle as the inclined portion 226 of the troughs 222, but the former is approximately half as long as the latter. Furthermore, the inclined portion 326 terminates at a channel 330 rather than at a protuberance as in the case of the inclined portion 226, the channel lying between the inclined portion and a transverse wall 335.

An inlet portion 340 comprising a horizontal surface 342 joined to a convex surface 344 is positioned to the rear of a transverse wall 335 and the convex surface curves continuously from the horizontal surface toward the oppositely facing surface of the top 300. The horizontal surface 342 is the same size as the horizontal surface 242 in the base 200 and has the same location with respect to the rear end of the top 300 as the horizontal surface 242 has with respect to the rear end of the base. In addition, the convex surface 344 has the same radius of curvature as the convex surface 244 of the base. Consequently, the inlet portion 340 of the top 300 has the same configuration and location as the inlet portion 240 of the base 200.

As a result of these relationships, when the top 300 is positioned on the base 200 the troughs 322 are in registration with the troughs 222 and they cooperate to form ducts 20 as shown in FIG. 4. The sides of the ducts 20 are not completely closed inasmuch as the crests of the ridges 220 and 320 are spaced from one another, but the troughs 222 and 322 are shaped so that the ducts are approximately the same size as the insulated conductors of the cord that the connector 10 terminates. As shown in FIG. 5, the forward ends of the ducts 20 are open, and the ducts extend horizontally from the forward end of the enclosure 15 and then incline toward the underside thereof.

Just to the rear of the ducts 20, the protuberance 230 of the base 200 cooperates with the channel 330 and the transverse wall 335 in the top 300 to form a constricted tortuous passageway 30. The passageway 30 includes two sharp turns and the opposing surfaces thereof are spaced closer together than the height of the cord positioned therein. Finally, at the rear end of the enclosure 15 the inlet portion 240 of the base 200 cooperates with the inlet portion 340 of the top 300 to form a flared inlet 40. The horizontal surfaces 242 and 342 are spaced from one another so that the narrow portion of the inlet 40 has approximately the same configuration as the cord accommodated thereby, while the convex surfaces 244 and 344 provide a continuously diverging orifice at the rear of the enclosure 15.

Turning now to FIGS. 2, 3, 4, and 5, the top 300 further includes four terminal-receiving openings 350,

each of which extends between the upper surface of the top and the side of an individual duct 20. As seen most clearly in FIGS. 4 and 5, each opening 350 comprises a groove 352 in the top surface that overlies and extends parallel to the associated duct 20, the entire length of the groove being exposed to the upper surface of and the end of the groove being exposed to the front surface of the top 300. Each opening 350 further comprises a slot 354 that communicates directly with the duct and a recess 356 intermediate the groove and the slot, the recess 356 being larger than the slot 354 and including abutments 358.

Turning now to both FIGS. 2 and 5, the terminals 50 respectively accommodated by the openings 350 comprise flat blade-like members that are advantageously formed from an electrically conductive resilient material such as phosphorbronze, and are gold plated. Each terminal 50 comprises a pair of tangs 52 at the lower end thereof, a crown 54 at the upper end thereof, and a pair of barbs 55, a stem 56, and a pair of shoulders 58 between the tangs and the crown.

The tangs 52 comprise the significant part of the internal contact portion of the terminal in that they pierce the insulation of and penetrate the conductor contained in the associated duct 20. To assure this penetration the tangs 52 are coined so that they diverge slightly away from one another when viewed from the side edge. The tangs 52 are of a size to pass through the slot 354 of the opening 350 but the ends of the barbs 55 are spaced slightly farther apart than the sides of a slot to provide an interference fit therewith. Similarly, the stem 56 is of a size to pass through the slot 354 while the shoulders 358 are of a size to substantially occupy the recess 356, and the engagement of the shoulders with the abutments 358 of the recess serves to properly locate the terminal 50 within the opening 350. The crown 54 serves as the external contact portion of the terminal 50 in that it is positioned within the groove 352 of the opening 350 and is therefore exposed to the exterior of the enclosure 15. The edge of the crown 54 is the surface that provides electrical connection with the contact of the mating connector.

The cord 60 terminated by the connector 10 comprises four insulated conductors 62 contained within a jacket 64. The jacket 63 holds the insulating conductors 62 in a linear array in which the spacing therebetween is essentially the same as the spacing between the ducts 20. Furthermore, the jacket 64 advantageously has a spine 65 extending lengthwise along a single side thereof to facilitate identification of the individual conductors should the insulation on the conductors not be color coded.

Referring still to FIGS. 2 and 5, in the assembly of the connector 10, the jacket 64 is first stripped far enough from the end of the cord 60 so that the length of the insulated conductors 62 thereby exposed is somewhat greater than the length of the ducts 20. The cord 60 is then oriented so that the insulated conductors 62 lie in the same plane as the troughs 222 in the base 200, and the jacketed end of the cord is positioned between the tongues 216 of the base. Because the insulated conductors 62 have approximately the same spacing as the troughs 222, this placement of the cord 60 automatically positions the insulated conductors in alignment with the troughs.

The top 300 is thereafter positioned so that the horizontal mating surfaces 312 and inclined mating sur-

faces 314 thereof are respectively oriented in the same manner as the horizontal mating surfaces 212 and inclined mating surfaces 214 of the base 200, and the top is placed on the base. The interaction of the tongues 216 in the base 200 with the notches 316 in the top 300 guides the top into proper registration with the base whereby the troughs 322 are juxtaposed with the troughs 222, the channel 330 is juxtaposed with the protuberance 230, and the inlet portion 340 is juxtaposed with the inlet portion 240.

As the top 300 is moved down on the base 200, the transverse wall 335 of the top presses into the cord 60 to hold it in place and the ridges 320 cooperate with the ridges 220 to properly locate each insulated conductor 62 within the duct 20 formed by the associated troughs 322 and 222. The free ends of the insulated conductors 62 extend beyond the forward end of the ducts 20, and they are advantageously trimmed off as the top 300 is moving down. This is because as the top 300 moves into full engagement with the base 200 the snubbing action of the inclined portion 326 of the troughs 322 on the insulated conductors 62 serves to retract the conductors from the ends of the ducts 20. Thus, if the free ends are cut off flush with the ends of the ducts 20 before full engagement of the top 300 with the base 200, any possibility of exposed electrical conductors is eliminated. The trimming of the free ends of the insulated conductors 62 is advantageously achieved by a cutting edge moving down against the flat surface 252 of the ledge 250.

The top 300 is advantageously joined to the base 200 by ultrasonic bonding, and energy directors 318 (FIG. 3) are provided on mating surfaces 312 and 314 of the top to facilitate this operation. With the top 300 and base 200 joined, the constricted tortuous passageway 30 thereby formed tightly grips the cord 60 so that any longitudinal tension on the cord is not transmitted to the conductors 62 in the ducts 20. Furthermore, the flared inlet 40 prevents any sharp flexure of the cord 60 from being transmitted to the portion of the cord located within the constricted tortuous passageway 30.

The joining of the top 300 to the base 200 also acts to trap each insulated conductor 62 within the associated duct 20, and consequently the terminals 50 are respectively inserted into the terminal receiving openings 350 at the same time as or subsequent to this joining. Each terminal 50 is simply pressed down into an opening 350 until the shoulders 58 engage abutments 358 of the recess 356. The tangs 52 pierce the insulation of and penetrate the conductor contained within the associated duct 20 while the barbs 55 bite into the wall of the slot 354 to lock the terminal 50 in place. The crown 54 of the terminal 50 is situated in the groove 352 and is thereby exposed to the exterior of the enclosure 15.

Turning now to FIG. 1 the female connector or jack 100 with which the connector 10 mates includes four wire spring contacts 110 that extend rearwardly cantilever fashion from the mouth of the jack. As the connector 10 is inserted into the jack 100, the lower end of the ledge 250 is received by an opening 115 in the front of the jack, while the remainder of the enclosure 15 is accommodated between a top surface 120, side walls 125, and side ledges 130. Further movement of the connector 10 into the jack 100 results in each wire spring contact 110 being captured within a groove 352 in the connector and the latch 260 being received by the opening 115.

As insertion of the connector 10 continues, the upper edge of the crown 54 of each terminal 50 engages the side of the associated wire spring contact 110, slides along its length, and deflects it upward. The wiping action of the contact surfaces of both the terminal 50 and the wire spring contact 110 in combination with the contact pressure generated by the deflection of the wire spring contacts produces a good electrical connection therebetween. At the same time, the latch 260 is deflected upward by its engagement with the bottom of the opening 115, and when the connector 10 is fully inserted into the jack 100, the locking shoulders 264 of the latch move behind a notched wall 135 to lock the connector within the jack. Removal of the connector 10 from the jack 110 is achieved by deflecting the tab 266 of the latch 260 upward so as to move the locking shoulders 264 from behind the notched wall 135.

Although the ducts 20 in the connector 10 are formed by the positioning of troughs in the base 200 and top 300 in registration with one another, the ducts could also be formed by the positioning of a relieved continuous surface (i.e., a surface relieved to the same depth as the troughs but uninterrupted by ridges) in one member in registration with troughs in the other member or by the positioning of an unrelieved surface in one member in registration with troughs of greater depth in the other member. These and other modifications be made without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. A connector for terminating a cord including a plurality of insulated conductors, the connector comprising:
 - a dielectric enclosure having a plurality of ducts for receiving individual conductors therein and a plurality of openings for receiving individual terminals therein, each opening communicating with an individual duct and including a groove in the exterior of the enclosure; and
 - a plurality of electrically conducting terminals, each terminal being positioned within an individual terminal receiving opening and comprising a flat blade-like member including an internal contact portion extending into the associated duct and having means for piercing the insulation of and making electrical engagement with the individual conductor positioned therein, each terminal further including an external contact portion entirely contained within the associated groove, the contact surface of each external contact portion consisting of an edge facing outwardly from the associated groove.
2. A connector as in claim 1 wherein the ducts in the enclosure are arranged in essentially the same spaced array as the conductors accommodated thereby are arranged in the cord that the connector terminates.
3. A connector as in claim 1 wherein the external contact portion of each terminal is recessed within the associated groove.
4. A connector as in claim 1 wherein each terminal is held on edge within the associated terminal receiving opening, the external contact portion of each terminal extending parallel to the length of and being approximately centered between the sides of its associated groove.

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5. A connector as in claim 1 wherein the ducts extend parallel to one another along their length, are located adjacent to a forward end of the enclosure and extend to and are open at that end.

6. A connector as in claim 5, further including a ledge protruding from the forward end of the enclosure, the ledge including a flat surface adjacent to the open ends of the ducts.

7. A connector as in claim 5 wherein the rear portion of the enclosure includes a flared inlet in which the cord terminated by the connector is positioned, the inlet comprising a pair of opposed arcuate surfaces that at their closest point are spaced approximately the same distance apart as the height of the cord and diverge continuously from this point to the rear end of the inlet.

8. A connector as in claim 7 wherein the inlet further includes a pair of planar surfaces spaced approximately the same distance apart as the height of the cord and the opposed arcuate surfaces diverge continuously from the planar surfaces.

9. A connector for terminating a cord including a plurality of insulated conductors, the connector comprising:

a dielectric enclosure having

a plurality of ducts for receiving individual conductors therein, the ducts extending parallel to one another along their length and being arranged in essentially the same spaced array as the conductors accommodated thereby are arranged in the cord that the connector terminates, the ducts

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being located adjacent to one end of the enclosure and extending to and being open at that end, and

a plurality of openings for receiving individual terminals therein, the terminal entrance to each opening comprising a groove in the exterior of the enclosure and the other end of each opening communication with an individual duct; and

a plurality of electrically conducting terminals, each terminal being positioned within an individual terminal receiving opening and comprising a flat blade-like member including an internal contact portion extending into the associated ducts and having means for piercing the insulation of and making electrical engagement with the individual conductor positioned therein, each terminal further including an external contact portion entirely contained and recessed within the associated groove and being approximately centered between the walls defining the groove, the contact surface of the external contact portion consisting of an edge facing outwardly from the groove.

10. A connector as in claim 9 further including a flared inlet at the other end of the enclosure from the ducts for accommodating the cord terminated by the connector, the inlet comprising a pair of opposed arcuate surfaces that at their closest point are spaced approximately the same distance apart as the height of the cord and diverge continuously from this point.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,761,869 Dated September 25, 1973

Inventor(s) E. Hardesty-C. Krumreich-A. Mulbarger and S. Walden

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

Column 2, line 36, change "126" to --216--;

line 52, change "ledges" to --ledge--.

Column 3, line 42, change "2o" to --20--.

Column 4, line 45, change "jacket 63" to --jacket 64--.

Column 6, line 9, change "th" to --the--;

line 33, change "includng" to --including--.

Column 7, Claim 6, line 5, take out the period after the number 5.

Column 8, line 13, change "cuts" to -- duct --.

Signed and sealed this 21st day of May 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents