United States Patent [19]

Friend

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[54] **INSULATION PIERCE TYPE CONNECTOR**

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[52] **U.S. Cl.** ..... **339/99 R,** 339/176 MF

[51] **Int. Cl.** **H01r 13/38**

[58] **Field of Search** 339/97–99, 339/176

[56] **References Cited**

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Primary Examiner—Richard E. Moore

Attorney, Agent, or Firm—Thomas Hooker

[57] **ABSTRACT**

A pierce type connector for a ribbon cable or the like having a body and a pair of contact tines extending from the body. The tines diverge laterally of each other away from the body. The tines have insulation pierce tips at the free ends and include conductor engaging corners diverging outwardly of the body. The terminals pierce the ribbon cable insulation and expose the conductors therein for contact with the conductor engaging corners.

18 Claims, 16 Drawing Figures

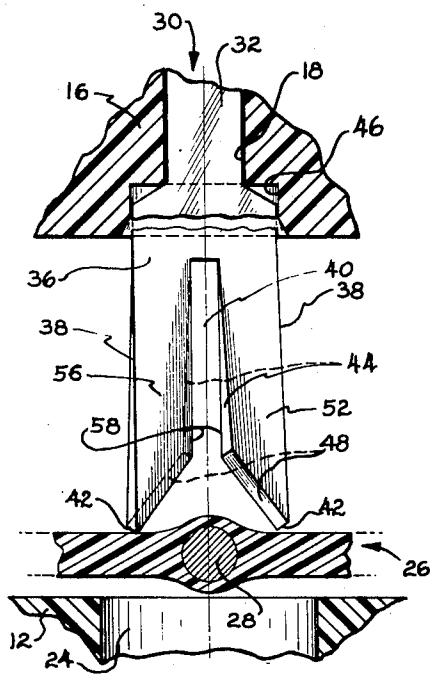


Fig. 1

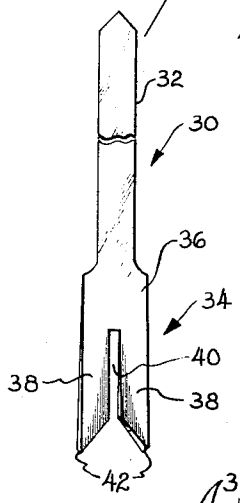
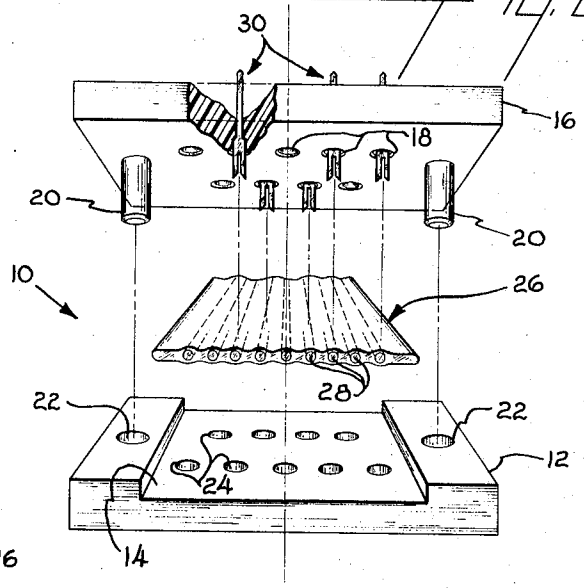


Fig. 2



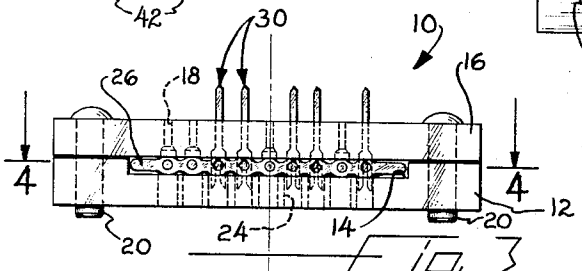
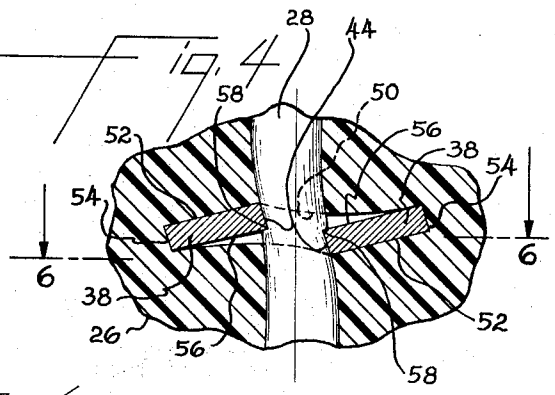


Fig. 3

Fig. 4



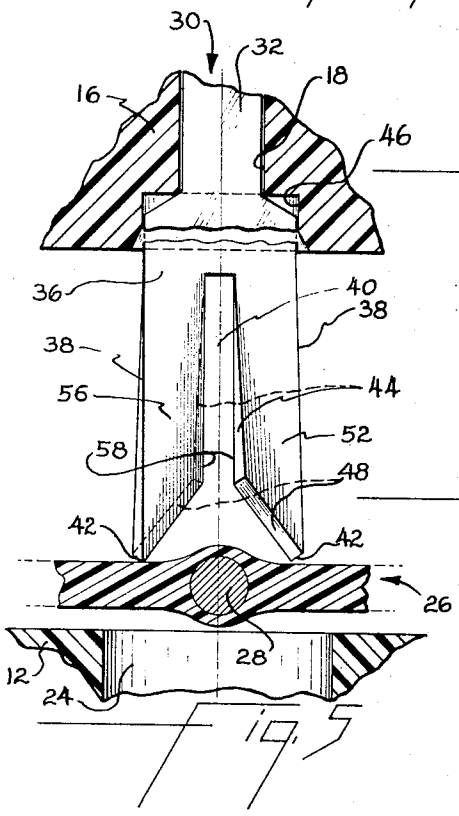


Fig. 5

Fig. 6

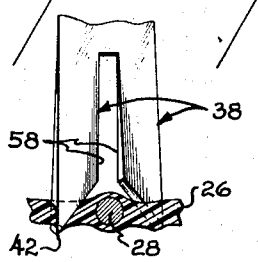


Fig. 7

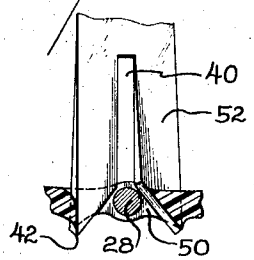


Fig. 8

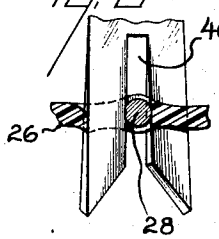
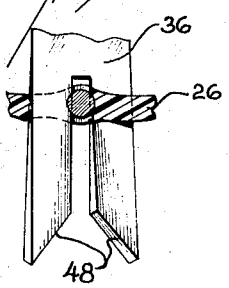


Fig. 9



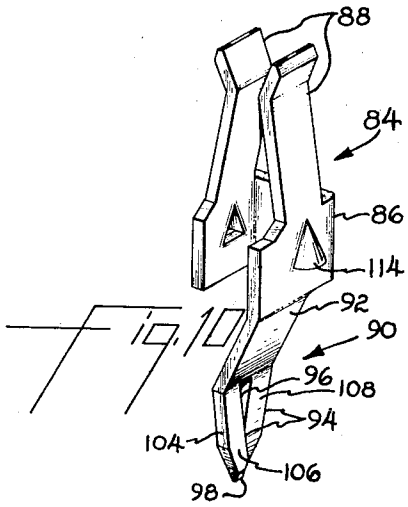


Fig. 10

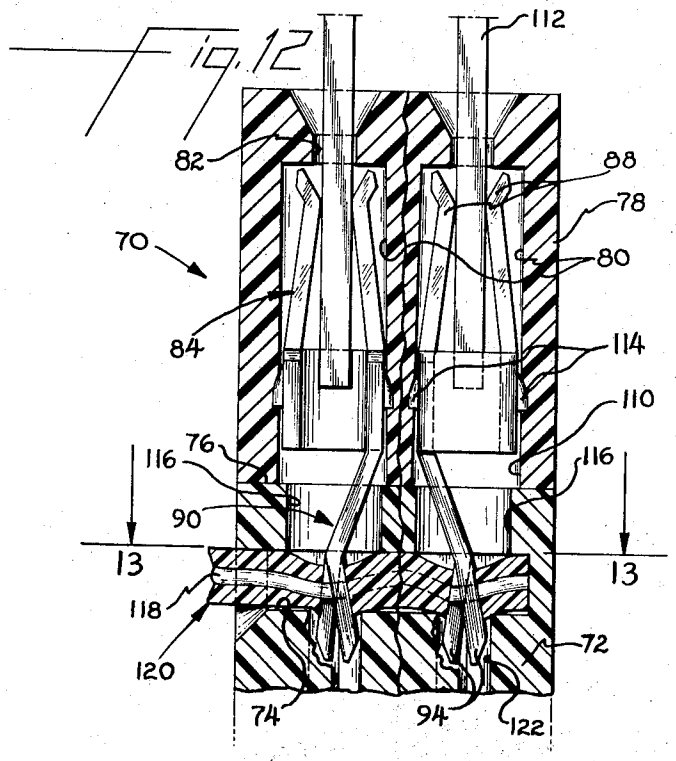


Fig. 12

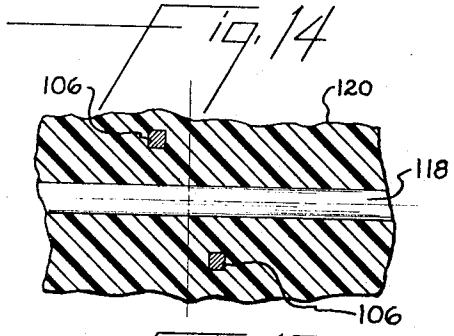


Fig. 14

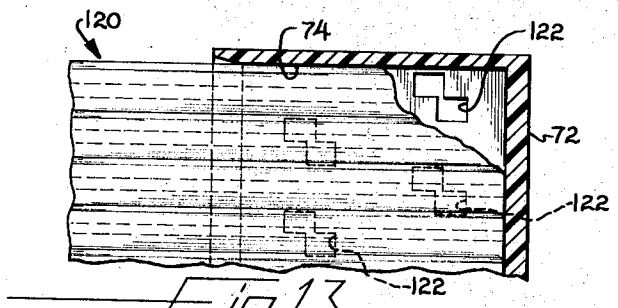


Fig. 13

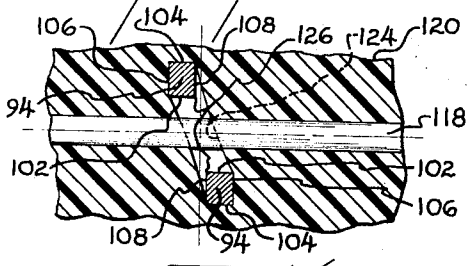


Fig. 15

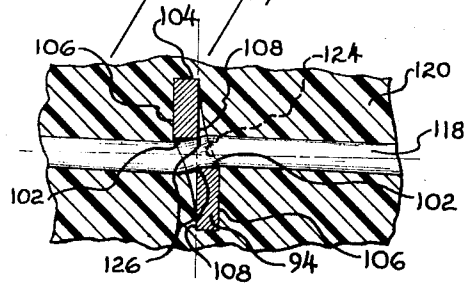


Fig. 16

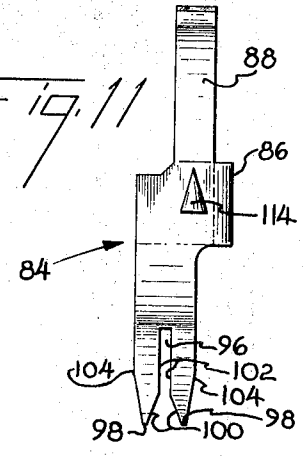


Fig. 11

INSULATION PIERCE TYPE CONNECTOR

The invention relates to pierce type connector blocks for forming electrical connections with insulated conductors in ribbon cables or the like. The connector block includes a base for receiving and holding the ribbon cable and a cover holding a number of bifurcated pierce type contact terminals which, when the base and cover are assembled, extend into the insulation on either side of each conductor to form electrical connections with the conductors. Connector blocks of this type are disclosed in U.S. Pat. Nos. 3,012,219, 3,434,093, 3,444,506 and 3,680,032.

In the improved contact terminals of the present invention the tines of each terminal are laterally offset or bent to opposite sides of the base from which they extend. In one embodiment the tines are twisted to opposite sides of the base and in another embodiment the tines are bent at the base to provide the offset.

When inserted into a ribbon cable or insulating body surrounding a conductor, pierce points at the end of the tines puncture the cable or insulation and stress the insulation between the tines and diagonally across teh conductor so that further insertion into the insulation results in the formation of a slit in the insulation extending between the tines and across an exposed portion of the conductor. The offset tines spread the slit open. Continued insertion brings contact corners on the tines into engagement with the exposed conductor to form a high pressure and wiped electrical connection therebetween. The tines bite into the conductor sufficiently to assure a reliable connection. Because the connection is formed between the tines and the exposed conductor within the slit in the insulation, the insulation does not become trapped between the tines and the conductor and impair the electrical connection.

The connectors disclosed in U.S. Pat. Nos. 3,012,219, 3,434,093, 3,444,506 and 3,680,032 utilize pierce type bifurcated contacts for forming an electrical connection with an insulated conductor. In these patents the tines are not offset along the length of the conductor with the result that upon insertion of the contacts over the conductor, the insulation surrounding the conductor may become drawn between the tines and the conductor and thereby impair the connection.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, of which there are two sheets.

IN THE DRAWINGS:

FIG. **1** is a side view of a terminal used in the pierce type connector;

FIG. **2** is a view of a connector according to the invention prior to closing;

FIG. **3** is a front view of the connector of Figure a after closing;

FIG. **4** is a sectional view taken along line **4—4** of FIG. **3** and illustrating the contact between one of the terminals in the block and a conductor in the cable;

FIG. **5** is a sectional view illustrating the relationship between the terminal and the cable during closing of the block;

FIGS. **6** through **9** are views similar to that of FIG. **5** illustrating the terminal piercing the cable and establishing electrical connector with a conductor therein;

FIG. **10** is a side view of a pierce type terminal of a different embodiment of the invention;

FIG. **11** is a side view of the terminal of FIG. **10**;

FIG. **12** is a sectional view taken through a pierce type connector block utilizing terminals as in FIG. **10** and showing the terminal in engagement with conductors in the ribbon cable;

FIG. **13** is a sectional view taken along line **13—13** of FIG. **12** illustrating the position of the ribbon cable in the connector block prior to closing the block; and

FIGS. **14** through **16** are sectional views similar to FIG. **4** illustrating movement of the terminal of FIG. **10** through the thickness of a cable and into electrical connection with a conductor therein.

Connector block **10** illustrated in FIG. **2** includes a base **12** formed of insulating material and having a cable receiving recess **14** therein and cover **16** which is provided with a number of terminal receiving holes **18** extending through the thickness thereof. Pins **20** project from the cover **16** and upon closing of the connector extend into guide holes **22** in the base. A number of holes **24** are formed in the bottom surface of cable recess **14** with each hole **24** beneath a hole **18** in the cover. Tape cable **26** includes an elongate insulating body with a number of metal conductors **28** confined therein. The conductors extend along the length of the cable. The cable fits snugly within recess **14** with each conductor **28** located above one of the holes **24.** As illustrated in FIG. **2,** the holes **18** and **24** are staggered with respect to the width of the cover and base to provide separation between the holes for adjacent conductors in the cable.

Terminal **30** illustrated in FIG. **1** is preferably stamp formed from relatively thin sheet metal stock and includes a terminal tail portion **32** adapted to mate with a female disconnect contact or to form a support for a wire wrap type connection. Bifurcated contact **34** is located on one end of the tail and includes a base **36** joining tail **32** and a pair of spaced tines **38** extending from the base away from the tail. Slot **40** separates the tines. Pierce points **42** are located on the outside edges of the tines. The contact portion **34** has two sides, with the slot **40** extending between the sides. FIGS. **1** and **5** through **9** show one side of the portion **34.**

As illustrated best in FIG. **5,** the ends of the tines **22** are twisted relative to the flat base **36** so that the respective edges **44** facing slot **40** are bent away from each other and to either side of the base. Prior to twisting the edges **44** defining the slot **40** are parallel and the slot **40** has a uniform width. After twisting the edges are separated adjacent the ends of the tines and the width of the slot defined by the minimum separation between the tines, decreases from the open end of the slot to the closed end at base **36.** The terminal **30** is preferably punch formed with square corners on the tines.

A terminal **30** is seated in each hole **18** in cover **16** with the tines projecting outwardly of the cover. As indicated in FIG. **5** the tail portion **32** is seated snugly within the hole **18** and the expanded width base **36** is fitted within enlarged seat **46.**

The cable **26** is positioned within recess **14** of base **12** and the connector **10** is then closed to establish electrical connection between each terminal **30** and a conductor **28** in the ribbon cable **26.** Each conductor **28** is positioned above a hole **24.** As the connector closes, pilot pins **20** fit within holes **22.** This occurs prior to en-

gagement between the tines **38** and cable **26.** After the pins are positioned in the holes to assure that each terminal **30** is positioned above a conductor **28** and hole **24** in the base, the cover is forced down upon the base so that the terminal contact portions **34** pierce the cable and form electrical connections with the conductors **28.** FIGS. **4** through **9** illustrate the relationship between the terminals and conductors during closing of the block **10.**

FIG. **5** shows the position of a terminal above the tape cable immediately prior to engagement therewith. The conductor **28** in the tape cable extends across hole **24** in base **12.** Tines **38** of the terminal **30** located above the hole **24** are positioned above conductor **28** with insulation pierce tips **42** spaced to either side of the conductor. The relatively wide spacing between the pierce tips assures that if a conductor **28** offset somewhat to one side of the center line of the terminal **30** will be picked up and guided into the slot **40.** This is important because in the manufacture of tape cables there is a relatively large tolerence for the position of the individual conductors.

Further closing of the connector block forces the pierce tips or points **42** through the insulation of the ribbon cable **26** as illustrated in FIG. **6.** The sharp points puncture the cable. Note that the wire is confined between lead in edges **48** on the ends of the tines. With continued closing of the block the tines are forced through the tape cable insulation. The continued movement through the tape cable stresses the insulation between the two punctures in the cable and opens a diagonal slit **50** extending across conductors **28** and between the two tines. The twisted or spread tines open the slit to expose the conductor **28** as shown in FIG. **7.** Outer tine sides **52** and outer tine edges **54** are maintained in engagement with the insulation of the tape cable and hold the slit open. Inner tine sides **56** and lead in edges **48** and slot edges **44** are within the slit **50** and are free of the insulation.

Movement of the tines **38** down over the conductor **28** after formation of the slit **50** forces the conductor into slot **40.** As the conductor moves into the slot tine corners **58** engage the sides of the conductor. Because the tines are bent the corners **58** diverge away from the bottom of slot **40** at base **36.** Thus, as the conductor is forced into the slot the sharp corners bite into the conductor and move closer to each other along the axis of the conductor. The edges **44** and inner tine sides **56** adjacent the corners **58** are also brought into intimate engagement with the conductor. Engagement between the conductor and the tines upon movement of the conductor into the slot **40** is illustrated in FIGS. **8** and **9.** FIG. **4** illustrates the position between the conductor and tines when the block **10** is fully closed. The corners **58** define the minimum separation or width of the slot.

Tension slit **50** is formed in the insulation of the ribbon cable prior to engagement between corners **58** and the conductor, thus assuring that the insulation is moved from the contact area. In this manner the reliability of the connection is increased over that of conventional pierce type connector blocks of the type disclosed in the United States patents previously mentioned.

The connection between the tines and the conductor is also improved because the tine corners **58** and adjacent contact areas are moved laterally along the axis of the conductor a slight distance thereby providing a desired wiping action which breaks up any oxide coatings on the mating apparatus. The corners **58** bite into the conductor **28** a slight distance, further assuring that there is a desired low resistance connection.

As the tines **38** are forced down over the conductors **28,** the engagement between the corners **58** and conductors exerts a bending moment on the conductors and may impart a shallow S-shaped bend to them. When block **10** is assembled, the terminal tines **38** extend freely into holes **24** in base **12.** As illustrated in FIG. **5** the holes **24** are considerably larger than the tines.

FIGS. **10** through **16** illustrate a modified connector block **70** according to the invention. Block **70** includes a base **72** having an elongate tape cable receiving slot **74** formed therein beneath the top surface **76.** Cover **78** is provided with a number of terminal receiving cavities **80** spaced in two rows thereon. A lead opening **82** extends into each cavity **80** from the top of the cover. A terminal **84** illustrated in FIGS. **10** and **11,** is seated in each cavity **80.**

Terminals **84** each include a U-shaped body **86** with a pair of cantilever contact arms **88** extending to one side of the body. A bifurcated contact **90** extends from one of the legs of body **86** and includes a base **92** extending laterally from the contact arm halfway toward the other arm with a pair of tines **94** spaced apart by slot **96.** As with terminal **30** the terminal **84** is preferably stamp formed from thin sheet metal stock with the edges of the contact **90** extending perpendicularly to the side surfaces. The contact **90** is also two-sided with slot **96** extending between the sides. FIG. **11** illustrates one side of the contact.

Flat tines **94** are bent to either side of the end of base **92** as illustrated best in the side view of the contact **90** illustrated in FIG. **12.** Tines **94** include pierce points **98,** lead in edges **100,** interior edges **102** facing slot **96,** outer tine edges **104,** outer tine sides **106** and inner tine sides **108.**

Terminals **84** are inserted in cavities **80** in cover **78** through openings **110** so that the contact arms **88** are in position to form electrical connection with lead **112** inserted through openings **82** into cavities **80.** Bifurcated contact portions **90** extend outwardly of cavities **80** through openings **110.** Barbs **114** may be formed on the outer surfaces of U-shaped bodies **86** to engage the side walls of cavity **80** and confine terminals **84** therein.

A number of circular openings **116** are formed through the top of base **72** and communicate with slot **74.** As with openings **24** in base **12** of connector **10,** openings **116** of base **72** are each located above a conductor **118** in the end of a ribbon cable **120** positioned in slot **74.** The cable fits snugly within the slot so as to assure that the conductors are located accurately with respect to the openings **116.** Openings **122** are formed in the bottom of slot **74** immediately beneath each opening **116.** These openings are somewhat smaller than openings **116** and receive contact tines **94** of terminals **84** upon closing of the block, as illustrated in FIG. **12.** These openings are considerably larger than the tines.

FIGS. **14, 15** and **16** illustrate engagement between the contact tines **94** and the ribbon cable **120** during closing of the conductor **70.** The connector is provided with appropriate locating means, such as the pins **20**

and alignment holes **22** of connector **10,** to assure that the base **72** and cover **78** are properly oriented during closing. In this position each terminal **90** is located above an opening **116** in the base with a conductor **118** positioned between tines **94** and opening **122.**

Upon closing of the block **70** tine pierce points **106** pierce the ribbon cable insulation to either side of conductor **118** as illustrated in FIG. **15.** Further movement of the tines into the cable stresses the insulation between the tines and forms a slit **124** extending between the tines. A bared portion of conductor **118** extends through the slit. The divergent tines spread the slit. Tine outer edges **104** and outer sides **106** are in engagement with the ribbon cable insulation while slot edges **102** and inner sides **108** are within the slit and free of the insulation. The lead contact corners **126** defined by the intersection of sides **108** and inner edges **102** are located within the slit.

Since the pierce points **106** straddle the conductor **118,** further movement of the tines into the ribbon cable forces the conductor into slot **96** and into engagement with the corners **126.** Because the tines are bent the corners diverge from the bottom of the slot so that as the connector **70** is closed the corners bite more deeply into the conductor **118** and move toward each other along the longitudinal length of the conductor to form a reliable electrical connection therewith. The corners **126** define the minimum separation or width of the slot.

The nature of the electrical connection between conductor **118** and the bifurcated contact **90** of terminal **84** is essentially identical to the connection formed between the contact portion **34** of terminal **30** and conductor **28.** In each case the insulation is spread from the contact area prior to engagement between the tines and the conductor and there is a desired wiping and limited coating engagement therebetween. In both cases the conductor may be bent through a shallow S curve as illustrated in FIGS. **4** and **18.**

Upon closing of block **70** as illustrated in FIG. **12,** each terminal **84** engages an individual conductor **118** in the cable **20.** The cover **78** and base **72** may be held together by suitable conventional latch means. As illustrated in FIG. **12,** the ends of the tines **94** project freely into the holes **122** beneath slot **74.**

While both connector blocks **10** and **70** have been disclosed in connection with forming electrical contacts with ribbon cables having solid conductors therein, the bifurcated contacts **34** and **90** may also be used for forming electrical connections with stranded or other conductors having sufficient internal strength to withstand the contact pressures during movement of the tines over the conductor.

The width of the slit in the insulation extending between the ends of the tines in terminals **34** and **84** is increased because of the offset of the tines with respect to the axis of the conductor. While the resistance of the insulation to being spread bows the plastic inwardly at the edges of the slit between the tines as illustrated in FIGS. **4** and **15,** the offset tines maintain the width of the slit sufficiently to assure that the insulation is removed from the contact areas. Because the pierce points engage the insulation at locations longitudinally offset from the contact areas between the tines and the conductor, it is not possible for insulation to be dragged along the lead in surfaces extending from the points to the slots and be caught in the contact area.

While I have illustrated and described preferred embodiments of my invention, it is understood that these are capable of modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

What I claim as my invention is:

1. A pierce-type connector block for forming electrical connections with elongate conductors confined within a ribbon cable or the like, comprising a support for a ribbon cable, recess means in said support located beneath conductors in the cable, a cover, and two-sided pierce type terminals mounted in said cover for piercing the cable, engaging the conductors therein and extending into said recess means, each terminal including a base, a slot extending between the sides of the terminal to define a pair of spaced contact tines extending from the base outwardly of the cover for engagement with a conductor in the cable and into said recess means, each tine including an outer side on one side of the terminal, an inner side on the other side of the terminal, an edge joining said sides at the slot, and a contact corner at the junction of the edge and the inner side, said corners extending along opposite terminal sides away from the bottom of the slot and defining the minimum width of the slot, such minimum width increasing away from the bottom of the slot so that the corners diverge outwardly from the bottom of the slot, and insulation pierce means on the ends of the tines for piercing the cable and forming a slit in the insulation extending across the conductor as the terminal is pushed into the cable, whereby upon positioning of a ribbon cable between said cover and support the tines of each terminal pierce the cable insulation to either side of a conductor and extend into said recess means and said corners wipe along opposite sides of the conductor to form an electrical connection therewith.

2. A connector block as in claim **1** wherein said tines are generally flat and extend away from the base in diverging directions.

3. A pierce-type connector block for forming electrical connections with elongate conductors confined within a ribbon cable, recess means in said support located beneath conductors in the cable, a cover, and pierce-type terminals mounted in said cover for piercing the cable engaging the conductors therein and extending into said recess means, each terminal including a base, a pair of spaced contact tines extending from the base outwardly of the cover for engagement with a conductor in the cable and into a said recess means, said tines diverging away from the terminal base to define a diverging slot therebetween, said tines being twisted in opposite directions along the slot, insulation pierce points on the ends of the tines away from the slot for forming a slit in the insulation extending across the conductor as the terminal is pushed into the cable, lead-in surfaces extending from pierce points to the slot, contact surfaces on opposing edges of the slot for forming an electrical connection with one conductor in the cable and slit spreading means for opening the slit and exposing a portion of the conductor to the contact surfaces free of the insulation.

4. A pierce-type connector block for forming electrical connections with elongate conductors confined within a ribbon cable or the like comprising a support for a ribbon cable, a ribbon cable on the support, recesses in said support located beneath conductors in the

cable, a cover on the cable, and two-sided pierce-type terminals mounted in said cover engaging the conductors in the cable and extending into said recesses, each terminal including a base, a pair of spaced contact tines extending from the base outwardly of the cover and into a recess, said tines diverging outwardly of the terminal base in opposite directions along a conductor to define a diverging slot therebetween, insulation pierce points on the ends of the tines away from the slot and spaced along the conductor and on opposite sides thereof for forming a slit in the insulation extending across the conductor as the terminal is pushed into the cable, contact surfaces on diagonally opposing corners of the slot forming an electrical connection with the conductor in the cable, said corners diverging outwardly from the bottom of the slot and defining the minimum width of the slot, and slit spreading means for opening the slit and exposing the conductor to the contact surfaces free of insulation.

5. A connector block as in claim **4** wherein said slit spreading means comprises the outer side surfaces of said tines located on opposite sides of the terminal.

6. A pierce-type connector block for forming electrical connections with elongate conductors confined within a ribbon cable or the like comprising a support for a ribbon cable, a ribbon cable on the support, recess means in said support located beneath conductors in the cable, a cover on the cable, and pierce-type terminals mounted in said cover engaging the conductors in the cable and extending into said recess means, each terminal including a base, a pair of spaced contact tines extending from the base outwardly of the cover and into a recess, said tines diverging outwardly of the terminal base in opposite directions along a conductor to define a diverging slot therebetween, insulation pierce points on the ends of the tines away from the slot and spaced along the conductor and on opposite sides thereof for forming a slit in the insulation extending across the conductor as the terminal is pushed into the cable, contact surfaces on opposing edges of the slot forming an electrical connection with the conductor in the cable and slit spreading means for opening the slit and exposing the conductor to the contact surfaces free of insulation, the conductors including curved shallow S-shapes adjacent the terminals with the tines engaging the conductors at the centers of the curved shapes.

7. A connector block as in claim **6** wherein the tines are flat.

8. A connector block as in claim **6** wherein the tines are twisted along the slot.

9. A terminal as in claim **16** wherein said tines are generally flat and extend away from the base in diverging directions.

10. A terminal for piercing an insulating body and forming an electrical connection with an elongate conductor within the body comprising a base, contact means joining the base, and a pair of tines extending from the base and defining a slot therebetween, pierce points on the free ends of the tines away from the slot, contact surfaces on the tines adjacent the slot for engaging the conductor, said surfaces diverging from each other away from the bottom of the slot, and spreading surfaces for spreading open a slit formed in the insulation extending across the conductor whereby upon insertion of the terminal into the insulating body with the tines to either side of a conductor the pierce points form a slit in the insulation extending across the conductor and, with further movement of the terminal, the spreading surfaces open the slit and contact surfaces engage the conductor free of the insulating body, said tines being twisted in opposite directions along the slot.

11. The method of forming an electrical connection between an insulating conductor and a pierce-type terminal having a pair of tines comprising the steps of:

a. Positioning the terminal to one side of an elongate insulated conductor with the free ends of the tines to either side of the conductor and spaced apart in a direction along the axis of the conductor,

b. Moving the terminal toward the conductor and forcing the ends of the tines in the insulation to form a slit in the insulation extending between the ends of the tines and diagonally across the conductor,

c. Continuing to move the terminal toward the conductor while at the same time spreading open the slit so that the portion of the conductor between the tines is exposed free of the insulation, and then

d. Forming an electrical connection between the tines and the exposed portion of the conductor free of the insulation.

12. The method of forming an electrical connection between an insulating conductor and a pierce-type terminal having a pair of tines comprising the steps of:

a. Positioning the terminal to one side of the insulated conductor with the free ends of the tines to either side of the conductor,

b. Moving the terminal toward the conductor and forcing the ends of the tines in the insulation to form a slit in the insulation extending between the ends of the tines and across the conductor,

c. Continuing to move the terminal toward the conductor while at the same time spreading open the slit so that the portion of the conductor between the tines is exposed free of the insulation,

d. Forming an electrical connection between the tines and the exposed portion of the conductor, and

e. Wiping the tines in a longitudinal direction along opposite sides of the conductor.

13. A connector block as in claim **1** wherein said tines are twisted in opposite directions along the slot.

14. A connector block as in claim **1** wherein said tines are generally flat and the outer tine surfaces are spaced further away from each other than the inner tine surfaces.

15. A connector block as in claim **1** wherein said recess means comprises an opening in the support beneath each terminal having side walls free of said tines so that the tines extend into the opening without engaging said side walls.

16. A connector block as in claim **15** wherein said tines are generally rectangular in cross section and said recess means comprises an opening beneath each terminal having a pair of generally rectangular sections overlaping at adjacent corners.

17. A two-sided terminal for piercing an insulating body and forming an electrical connection with an elongate conductor confined within the body, said two-sided terminal comprising a base, a slot extending between the sides of the terminal to define a pair of spaced contact tines extending from the base for en-

gagement with the conductor, each tine including two sides, an edge joining said sides at the slot, and a contact corner at the junction of the edge and one side, the contact corners of said tines being located on opposite terminal sides and defining the minimum slot width and diverging apart from each other outwardly from the bottom of the slot, and insulation pierce means at the ends of the tines.

18. A two-sided terminal for piercing an insulating body and forming an electrical connection with an elongate conductor confined within the body, said two-sided terminal comprising a base, a slot extending between the sides of the terminal to define a pair of spaced contact tines extending from the base for engagement with the conductor, a contact corner extending along the tines at each side of the slot and defining the minimum slot width, said corners diverging apart from each other outwardly from the bottom of the slot, one side of each corner being located on opposite terminal sides, and insulation pierce means at the ends of the tines.

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