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(54) IMPROVEMENTS IN AND RELATING TO ELECTRICAL CONNECTORS FOR FLAT CONDUCTOR CABLE

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to electrical connectors for crimp connection to the flat conductors of flat conductor cables and also to electrical connections between electrical connectors and the flat conductors of flat conductor cables.

According to one aspect of the present invention, an electrical connector for crimp connection to a flat conductor of a flat conductor cable comprises a ferrule portion including a pair of spaced opposed side walls extending in the same direction from opposite sides of a web, the web and the side walls together defining a substantially U-shaped channel in transverse cross-section, the free edges of the side walls being adapted to pierce the insulation of the cable, and at least one lance struck out from the web and extending into the channel towards one side wall with the free edge of the or each lance proximate to and parallel with the one side wall so that in the crimped condition, the one side wall overlies said free edge of the lance or lances.

According to a further aspect of the present invention, in an electrical connection between an electrical connector and a flat conductor of a flat conductor cable the connector has a ferrule portion including a pair of spaced, opposed side walls extending in the same direction from opposite sides of a substantially flat web, the side walls extending through the cable on

opposite sides of the flat conductor and being bent inwardly towards each other and into a common plane, which plane is parallel to the plane occupied by the web, the side walls engaging the cable and overlying a portion of a first surface of the flat conductor and at least one lance struck out from the web and extending towards one side wall so that the free edge of the or each lance is proximate to and parallel with the one side wall, the free edge of the or each lance extending through the insulation of the cable to engage an opposite second surface of the flat conductor, the said one side wall overlying the free edge of the or each lance.

Embodiments of the invention will now be described, by way of example, reference being made to the Figures of the accompanying diagrammatic drawings in which:—

Figure 1 is a perspective view of an electrical connector;

Figure 2 is a perspective view of two flat conductor cables butt spliced together by three electrical connectors as shown in Figure 1;

Figures 3, 4 and 5 are details, partly in section, illustrating various stages during the crimping of a connector as shown in Figure 1 to a flat conductor of a flat conductor cable;

Figure 6 is a perspective view of an alternative electrical connector;

Figure 7 is a perspective view of a further electrical connector;

Figure 8 is an exploded, perspective view of an electrical assembly; and

Figure 9 is an exploded, perspective view of a socket outlet and a base plate.

As shown in Figures 1 to 5, an electrical connector 1 for crimp connection to a flat conductor 2 of a flat conductor cable 3 includes a pair of ferrule portions 4 arranged one at each end of a flat shank 5. The 90

ferrule portions 4 are identical and each includes a pair of spaced, opposed side walls 6 extending in the same direction from opposite sides of a substantially flat web 7. The web 7 and the side walls 9 define a channel. The upper (as shown) edges of the side walls 6 each taper to a point 8. Two opposed pairs of lances 9 are struck out from each web 7 and extend into the channel. The lances 9 of each pair are arranged side-by-side in a direction parallel with the side walls 6. Each lance 9 of a pair extends towards the same side wall 6 at an angle of approximately 60° to the web 7 so that its free edge 10 is proximate to and parallel with the side wall. A through aperture 11 is provided in the web 7 in general alignment with the free edge 10 of each pair of lances 9 which aperture 11 is oversized relative to the lances 9. Between the opposed pairs of lances 9, stiffening ribs 12 are formed in the web 7.

The electrical connector is stamped and formed from sheet metal and can be of any convenient length, that is, the shank 5 can be any convenient length.

On making a crimp connection, the cable 3 is first positioned above a connector 1 with the conductor 2 extending along the length of the channel, that is, with the side walls 6 arranged on opposite sides of the conductor 2 (see Figure 3). A first tool 20 is then moved against the cable 3 to cause the points 8 of the side walls 6 to pierce the insulation on each side of the conductor 2 so that the side walls 6 extend through the cable 3 on opposite sides of the flat conductor 2.

A second tool 22 in the form of a tube having a tapered end surface 23 is then positioned above the upper edges of the side walls 6 and moved downwardly until the sidewalls 6 are bent partially inwardly so that they extend towards each other and over the upper surfaces (as shown in Figure 4) of the cable 3. At the same time, the lances 9 pierce the insulation of the cable and are bent slightly towards the web 7.

Finally, a third tool 24 having a flat surface 25 engages the side walls 6 and bends them so that end portions lie flat against the upper surface of the cable 3 (see Figure 5) so that the end portions lie in the same plane which plane is parallel to the plane occupied by the web 7. Simultaneously, the lances 9 are bent downwardly and the edges 10 are moved relative to the lower surface of the cable 3 so that they scrape the insulation from the underside of the conductor 2. The scrapings will tend to accumulate at the edges of the lances but the relatively oversized apertures 11 provide space for the flow of

the scrapings so that they do not interfere adversely with the resulting electrical connection.

In the finished crimped connection, the conductor 2 is partially exposed and is contacted by the edges 10 of the lances 9. Since the lances 9 are bent downwardly, they have a tendency to spring back to their original positions (see Fig 3) and are therefore resiliently biased against the underside of the conductor 2. The tendency of the lances 9 to spring back is counterbalanced by the end portions of the side walls 6 which are bent against the upper surface of the cable and overlies the edges 10 of their respective lances 9.

The configuration of the finished connection is substantially flat and the overall height of the connection is not significantly greater than the thickness of the cable 3.

The ribs 12 stiffen the web 7 and inhibit relaxation of the lances 9.

The connector is suitable for making a butt splice between two flat conductors 2 of two cables 3 as shown in Figure 2. The length of the shank 5 of the middle connector 1 is different from that of the two outer connectors 1 so that the crimp connections are staggered.

Figure 6 illustrates an electrical connector 31 similar in most respects to an electrical connector 1 in that its ferrule portions 4, 4' each have two pairs of opposed lances, the lances of each pair being arranged side-by-side and extending towards the same side wall but in which one ferrule portion 4' has been orientated through 90°. The connector 31 is suitable for making a tap connection between the flat conductors of two cables arranged at right angles.

Figure 7 illustrates an electrical connector 41 similar to the electrical connector 31 but having only one ferrule portion 4' at one end of a flat shank 5 and a tab 42 extending normally from the opposite end of the shank 5.

The electrical connectors 1, 31 and 41 described above can be used effectively for building wiring installations where the cable used is flat conductor cable. The electrical connector 1 is used to make butt connections between conductors, the electrical connector 31 is used to make tap connections and the electrical connector 41 is used to make connections between the conductor of a flat conductor cable and a socket outlet 90 (see Fig 9).

Referring in particular to Figures 8 and 9, when a socket outlet 90 is being installed, a floor plate 78 of thin sheet metal (Figure 8) is positioned beneath an insulating sheet 76 at each connection location on a cable 3 after crimping. The floor plate 78 has upstanding flanges 80 and

screw holes 82 by means of which it is later secured to the floor. The cable 3 passes centrally over the plate 78 and sheet 76 as indicated in Figure 8.

- 5 A metallic base plate 84, Figure 9, is then placed on the upper surface of the cable 3. The base plate 84 is substantially rectangular and has openings 88 which surround the bent over side walls 6 so that
- 10 they will not contact the metallic plate 84. Advantageously, a piece of insulating tape is applied to the exposed surfaces of the side walls 6 as a further precaution against their contacting the base plate 84. The
- 15 base plate 84 has feet 86 on its underside so that it will be supported above the cable 3 and it has slots 89 extending there-through for reception of the tabs 42, two slots being provided along one edge and
- 20 one slot adjacent to the other edge. The base plate 84 is then fastened down by screws which extend through holes 91 in the base plate and through the aligned holes 82', 82, in the sheet 76 and floor
- 25 plate 78. A threaded screw hole 112 is provided in the centre of the base plate 84.

After all of the electrical connectors 41 shown in Figure 8 have been applied to the cable 3, and base plates 78, 84 have

- 30 been fastened down to the floor, a carpet can be laid over the floor to cover all of the cable and the plates 78, 84. A technician then determines the location of the base plate 84 and cuts the carpet
- 35 along the three sides of the base plate to produce a flap which is lifted up to expose the base plate 84 so that the socket outlet 90 can be assembled to the cable 3.

The socket outlet 90 includes a metallic housing. A duplex electrical receptacle 100 is mounted in the housing adjacent the front wall 98 and wires 102 are secured to the receptacle 100 which have push-on type terminals on their ends. In the embodiment shown, these push on terminals

- 45 are contained in insulating housings 104 and are of a size adapted to be mated with the tabs 42 of the electrical connectors 41.

The technician proceeds to install the

- 50 outlet socket 90 by simply pushing the terminals onto the appropriate tabs 42. He then folds the flap and stuffs it into a cavity 107 in the housing which lies between a back wall 96 and internal wall 106. Finally,
- 55 he threads a screw 110 into the hole 112 and tightens the housing against the base plate 84. If it should ever become necessary to remove socket 90 it is merely required that the steps described above be
- 60 repeated in reverse order until the base plate 84 has been removed.

The flat conductor cable 3 described has three spaced, parallel flat conductors 2. The cable 3 has a width of 6.3 cm and the

- 65 conductors are 1.5 cm wide. The cable 3 is

suitable for use in building wiring installations in which it can be placed on a floor or a wall and readily covered by a carpet on a thin panel to provide unobtrusive wiring in a building.

WHAT WE CLAIM IS:—

1. An electrical connector for crimp connection to a flat conductor of a flat conductor cable, comprising a ferrule portion including a pair of spaced, opposed side walls extending in the same direction from opposite sides of a web, the web and the side walls together defining a substantially U-shaped channel in transverse cross-section, the free edges of the side walls being adapted to pierce the insulation of the cable, and at least one lance struck out from the web and extending into the channel towards one side wall with the free edge of the or each lance proximate to and parallel with the one side wall so that in the crimped condition, the one side wall overlies said free edge of the lance or lances.
2. An electrical connector as claimed in Claim 1, in which two opposed pairs of lances are struck out from the web, the lances of each pair being arranged side-by-side along the channel extending at an angle of approximately 60 degrees to the web towards their respective side wall.
3. An electrical connector as claimed in Claim 2, in which apertures are formed in the web where the material of the lances is struck out from the web, the apertures being oversized relative to the lances.
4. An electrical connector as claimed in Claim 2 or 3, in which ribs are formed in the web between the pairs of lances.
5. An electrical connector as claimed in any one of Claims 1 to 4 in which the ferrule portion is arranged at one end of a flat shank, a second substantially identical ferrule portion being arranged at the opposite end of the shank.
6. An electrical connector as claimed in Claim 5, in which the second ferrule portion is orientated through 90 degrees relative to the first ferrule portion.
7. An electrical connector as claimed in any one of Claims 1 to 4, in which the ferrule portion is arranged at one end of a flat shank, a tab extending normally of the shank from the opposite end of the shank.
8. An electrical connection between an electrical connector and a flat conductor of a flat conductor cable in which the connector has a ferrule portion including a pair of spaced, opposed side walls extending in the same direction from opposite sides of a substantially flat web, the side walls extending through the cable on opposite sides of the flat conductor and being bent

screw holes 82 by means of which it is later secured to the floor. The cable 3 passes centrally over the plate 78 and sheet 76 as indicated in Figure 8.

5 A metallic base plate 84, Figure 9, is then placed on the upper surface of the cable 3. The base plate 84 is substantially rectangular and has openings 88 which surround the bent over side walls 6 so that they will not contact the metallic plate 84. Advantageously, a piece of insulating tape is applied to the exposed surfaces of the side walls 6 as a further precaution against their contacting the base plate 84. The base plate 84 has feet 86 on its underside so that it will be supported above the cable 3 and it has slots 89 extending there-through for reception of the tabs 42, two slots being provided along one edge and one slot adjacent to the other edge. The base plate 84 is then fastened down by screws which extend through holes 91 in the base plate and through the aligned holes 82, 82, in the sheet 76 and floor plate 78. A threaded screw hole 112 is provided in the centre of the base plate 84.

After all of the electrical connectors 41 shown in Figure 8 have been applied to the cable 3, and base plates 78, 84 have been fastened down to the floor, a carpet can be laid over the floor to cover all of the cable and the plates 78, 84. A technician then determines the location of the base plate 84 and cuts the carpet along the three sides of the base plate to produce a flap which is lifted up to expose the base plate 84 so that the socket outlet 90 can be assembled to the cable 3.

The socket outlet 90 includes a metallic housing. A duplex electrical receptacle 100 is mounted in the housing adjacent the front wall 98 and wires 102 are secured to the receptacle 100 which have push-on type terminals on their ends. In the embodiment shown, these push on terminals are contained in insulating housings 104 and are of a size adapted to be mated with the tabs 42 of the electrical connectors 41.

The technician proceeds to install the outlet socket 90 by simply pushing the terminals onto the appropriate tabs 42. He then folds the flap and stuffs it into a cavity 107 in the housing which lies between a back wall 96 and internal wall 106. Finally, he threads a screw 110 into the hole 112 and tightens the housing against the base plate 84. If it should ever become necessary to remove socket 90 it is merely required that the steps described above be repeated in reverse order until the base plate 84 has been removed.

The flat conductor cable 3 described has three spaced, parallel flat conductors 2. The cable 3 has a width of 6.3 cm and the conductors are 1.5 cm wide. The cable 3 is

suitable for use in building wiring installations in which it can be placed on a floor or a wall and readily covered by a carpet on a thin panel to provide unobtrusive wiring in a building.

WHAT WE CLAIM IS:—

1. An electrical connector for crimp connection to a flat conductor of a flat conductor cable, comprising a ferrule portion including a pair of spaced, opposed side walls extending in the same direction from opposite sides of a web, the web and the side walls together defining a substantially U-shaped channel in transverse cross-section, the free edges of the side walls being adapted to pierce the insulation of the cable, and at least one lance struck out from the web and extending into the channel towards one side wall with the free edge of the or each lance proximate to and parallel with the one side wall so that in the crimped condition, the one side wall overlies said free edge of the lance or lances.

2. An electrical connector as claimed in Claim 1, in which two opposed pairs of lances are struck out from the web, the lances of each pair being arranged side-by-side along the channel extending at an angle of approximately 60 degrees to the web towards their respective side wall.

3. An electrical connector as claimed in Claim 2, in which apertures are formed in the web where the material of the lances is struck out from the web, the apertures being oversized relative to the lances.

4. An electrical connector as claimed in Claim 2 or 3, in which ribs are formed in the web between the pairs of lances.

5. An electrical connector as claimed in any one of Claims 1 to 4 in which the ferrule portion is arranged at one end of a flat shank, a second substantially identical ferrule portion being arranged at the opposite end of the shank.

6. An electrical connector as claimed in Claim 5, in which the second ferrule portion is orientated through 90 degrees relative to the first ferrule portion.

7. An electrical connector as claimed in any one of Claims 1 to 4, in which the ferrule portion is arranged at one end of a flat shank, a tab extending normally of the shank from the opposite end of the shank.

8. An electrical connection between an electrical connector and a flat conductor of a flat conductor cable in which the connector has a ferrule portion including a pair of spaced, opposed side walls extending in the same direction from opposite sides of a substantially flat web, the side walls extending through the cable on opposite sides of the flat conductor and being bent



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inwardly towards each other and into a common plane, which plane is parallel to the plane occupied by the web, the side walls engaging the cable and overlying a portion of a first surface of the flat conductor, and at least one lance struck out from the web and extending towards one side wall so that the free edge of the or each lance is proximate to and parallel with the one side wall, the free edge of the or each lance extending through the insulation of the cable to engage an opposite second surface of the flat conductor, the said one side wall overlying the free edge of the or each lance.

9. An electrical connection as claimed in Claim 8, in which two opposed pairs of lances are struck out from the web, the lances of each pair being arranged side-by-side in a direction parallel with the side walls, each pair extending towards a dif-

ferent side wall so that their free edges are proximate to and parallel with the side wall.

10. An electrical connector for crimp connection to a flat conductor of a flat conductor cable, constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figs 1 to 5 or Fig 6 or Figs 7 to 9 of the accompanying drawings.

11. An electrical connection between an electrical connector and a flat conductor of a flat conductor cable, constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figs 2 to 5 or Fig 8 of the accompanying drawings.

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